

2006

**Joint Annual Meeting
of the
Florida State
Horticulture Society
and the
Soil and Crop Science
Society of Florida**

June 4 to 6

ABSTRACTS

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Citrus Section

Identification of an *Idaeovirus* in Citrus with Implications as to the Cause of Citrus Blight. K. S. Derrick, M. J. Beretta, and G. A. Barthe, CREC, Lake Alfred, UF /IFAS.

In experiments to determine the cause of citrus blight (CB), subtraction hybridization was done using leaves and roots of an affected tree. Clones were identified that had similarities to *Raspberry bushy dwarf virus* (RBDV), the only known member of the genus *Idaeovirus*. The clones covered a 1555-bp region similar to RNA-2 of RBDV including 595 nts of the 3' end of an ORF that was 60% identical in amino acids to the movement protein of RBDV and a 834-nt ORF that was 65% identical in amino acids to the coat protein of RBDV. RBDV is seed and pollen transmitted, is symptomless in most *Rubus* species, and only causes bushy dwarf disease with mixed infections of the aphid-borne *Black raspberry necrosis virus*. Based on RT-PCR assays, the citrus *Idaeovirus* (CIV) appears to be unevenly distributed in citrus and is present in low concentrations. In a manner similar to raspberry bushy dwarf disease, CB may be a disease caused by a mixed infection of CIV and another virus, such as a strain of CTV. It had been considered that CTV could not be involved with CB, since Carrizo citrange and trifoliate orange, which are very susceptible to CB, are reported to be resistant to CTV. We have shown that mild, decline and stem pitting strains of CTV can infect the roots of these two rootstocks. The virus appears to move into the roots from CTV susceptible scions, but does not move from roots into shoots of Carrizo citrange and trifoliate orange.

Identification of Effective Compounds From Antagonisms for Controlling Foliar Fungal Pathogens of Citrus. Bang-Jau You, Hui-Qin Chen, Lihua Cao, and Kuang-Ren Chung, CREC, Lake Alfred, UF/IFAS.

Saprophytic fungi producing unknown toxic compounds were identified from citrus groves near the CREC campus and were evaluated for controlling the major citrus foliar fungal pathogens causing *Alternaria* brown spot, melanose, citrus scab, postbloom fruit drop (PFD), or greasy spot in Florida. The toxic compounds present in cultural extracts exhibited a strong growth reduction to citrus fungal pathogens by altering hyphal morphology and/or by inhibiting conidial germination. The inhibitory efficacy was unaffected after heating at 95°C for 15 min. However, production of the toxic compounds by antagonisms was markedly influenced with the compositions of media used in the laboratory. Preliminary test in greenhouse revealed that the saprophytic fungi reduced disease incidences of *Alternaria* brown spot on tangerine and melanose on

grapefruit. We are currently working on the chemical determination of the compounds using Nuclear Magnetic Resonance (NMR). The toxic compounds may be useful in developing effective bio-fungicides and providing an alternative for disease management for citrus growers in Florida. Since the compounds are originally identified from microorganisms that already reside in the citrus community, it may reduce a risk for application and may facilitate registration for citrus in the future.

Effect of Hormone Inhibitors on Yield Production of Citrus Associated With Postbloom Fruit Drop (PFD) Caused by *Colletotrichum Acutatum*. Hui-Ling Liao, Hui-Qin Chen, Lihua Cao, and Kuang-Ren Chung, CREC, Lake Alfred, UF/IFAS.

Postbloom fruit drop (PFD) of citrus is caused by *Colletotrichum acutatum*. The fungus infects flower petals causing brownish lesions that result in fruit drop, leaf distortion, and production of persistent calyces, commonly called 'buttons'. Studies combined with molecular and biochemical analyses suggested that imbalance of growth regulators such as auxin, ethylene, and jasmonic acid (JA) in *C. acutatum*-infected flowers may contribute to young fruit drop. Application of auxin transport and action inhibitors such as 2,3,5-triiodobenzolic acid (TIBA), clofibrate, or quercetin, JA biosynthesis inhibitors such as salicylic acid (SA) and aspirin (methyl-SA), or gibberellic acid (GA₃) 7 or 12 d after fungal infection increased young fruit retention.

The commercial products ReZist and Actigard, used as systemic acquired resistance (SAR) inducers, also increased fruit retention. The commercial products with wider application windows may provide another alternative for managing PFD in the field since they are targeted on fruit retention rather than on pathogen control per se and can be applied after symptoms develop.

Prospects for Control of Citrus Canker With Novel Chemical Compounds. J. H. Graham, J. K. Burns, CREC, Lake Alfred, UF/IFAS; T. R. Gottwald, USDA-ARS-USHRL, Ft. Pierce and R. P. Leite, Jr., Instituto Agronômico do Paraná, Londrina, Paraná, Brazil

The spread of citrus canker, caused by *Xanthomonas axonopodis* pv. *citri*, increased greatly in Florida after the hurricanes in 2004 and 2005. Exposure of 80,000 acres as a result of the 2004 storms and the potential for additional exposure after the 2005 season, led to the suspension of the removal of exposed trees under the 1900 ft. law in January 2006. If this policy is maintained and the law changed, canker will soon become endemic in Florida and a principle management practice will be bactericidal sprays to limit fruit blemish and canker-induced fruit drop (depending on variety). Field trials conducted in Brazil demonstrate that copper sprays even at reduced rates are consistently effective for control of canker on moderately susceptible orange varieties. New commercial compounds (Actigard and Messenger) that induce systemic resistance (ISR) in the greenhouse are ineffective for control of disease in the field. Basal resistance (BR) is induced by peptides associated with proteins on the surface of the pathogenic bacterium, such as flagellin. Two active peptides induced bacterial disease control activity in the greenhouse, and therefore, merit further testing. Contact materials, including the fungicide Famoxate and the antibiotic Gentamicin are under field evaluation.

Alternatives to copper minimize potential risks of bacterial resistance, soil accumulation and environmental contamination.

Comparison of Visual Assessment and Polymerase Chain Reaction Assay Testing to Estimate the Incidence of the Huanglongbing Pathogen in Commercial Florida Citrus. Michael S. Irey, USDA-ARS-USHRL, Ft. Pierce; Tim Gast, Southern Gardens Citrus, Clewiston, FL and Timothy Gottwald, USDA-ARS-USHRL, Ft. Pierce.

Huanglongbing (HLB = citrus greening) is one of the most serious diseases of citrus worldwide. The disease is caused by species of bacteria in the genus *Candidatus Liberibacter* and was discovered for the first time in the United States in Florida in August, 2005. To date, the Asian form of HLB, caused by *Candidatus Liberibacter asiaticus*, is the only form of HLB that has been found in Florida. Among the recommended control measures for HLB is the removal of trees (roguing) that express visible symptoms of HLB in order to reduce the potential inoculum reservoir. In areas where HLB is endemic, roguing has been based predominantly on the presence of visible symptoms. Molecular detection protocols are available for the detection of HLB but due to the uneven distribution of the bacterium in the tree, the serological variability of the pathogen, and perceived limitations of the testing methodology, molecular testing generally has been limited to the confirmation of visible infections and not for detecting infections in non-symptomatic plants. Roguing based on visible symptoms does not remove all infected trees but there are little data available to document the actual incidence of infection. In this study, visual surveys were compared to the testing of trees with a polymerase chain reaction-based assay (PCR). Initial results indicate that the incidence of infection based on PCR testing may be up to two times the incidence of infection estimated by visible symptoms alone.

Spatial Analysis of Freeze Events in Florida Using Three Different Interpolation Techniques. Clyde W. Fraisse and Tapan B. Pathak, Agricultural and Biological Engineering Dept., Gainesville, UF/IFAS.

Severe freezes have seriously impacted the agriculture industry in Florida during the last two decades. High impact freezes during 1980's affected the citrus industry significantly and reduced citrus production in northern citrus production zones. Freezes in 1981, 1983, 1985, 1987, and 1989 severely damaged the citrus growing industry and recovery was almost impossible for many citrus growers. Of the dozen or so devastating freezes that have impacted the citrus industry and other agriculture concerns over the last century in the Southeast, nearly all of them occurred during times of neutral El Niño conditions in the Pacific Ocean. In this study, two of the most severe freeze dates, December 25, 1983 and January 21, 1985, were selected for comparing three different interpolation techniques to map freeze events. Interpolation techniques included inverse distance weighting, kriging, and spline. Weather data for 105 meteorological stations from the National Climatic Data Center were used for the study. All three methods worked well in estimating the minimum surface temperature but the most efficient one was kriging. Minimum surface temperature layers generated by kriging for the two freeze events in Florida were overlaid with citrus production zones layers and areas affected by different

temperatures ranges, including 10-14, 14-20, 20-25, 25-28, and 28-32°F were estimated.

Visual Presentation of the Spatiotemporal Aspects of Diaprepes Root Weevil *Diaprepes abbreviatus* (Coleoptera:Curculionidae) Abundance in a Small East Coast Citrus Grove from 2000-2003. G. K. Ross and R. C. Adair, Jr., The Florida Research Center for Agricultural Sustainability, Inc., Vero Beach.

Little is known about the spatial distribution patterns or the rate and direction of the spread of *Diaprepes abbreviatus* infestations in citrus. Weekly adult weevil abundance data obtained from geo-referenced Tedder Traps placed in a diamond-shaped grid were projected geographically by means of a geographic Information System (GIS). The GIS (ESRI ArcGIS) was used to provide spatial interpolation of *Diaprepes* abundance weekly for a period of one to four years (2000-2003). Animation software (Macromedia Flash) was then utilized to combine the weekly interpolations into an interactive animation that enabled visualization of the spatiotemporal aspects of *Diaprepes* abundance. In addition, these *Diaprepes* abundance interpolations were synchronously aligned with weekly rainfall data. The resultant interactive animation successfully portrayed different geographic and seasonal aspects of *Diaprepes* activity while simultaneously observing rainfall in a smoother transition through space and time than was previously thought possible. The visualization of the spatiotemporal aspects of *Diaprepes* abundance captured by the Tedder Traps was much more evident when viewed as an interactive animation than could be derived by more conventional analysis of tabular or graph data. The ability to visualize additional factors such as rainfall or soil temperature in conjunction with spatiotemporal abundance could not only elucidate the ecology of *Diaprepes* but also result in a fully Integrated Pest Management (IPM) program by providing essential timing and location information necessary for precision application of crop protectants.

Web-Based Survey and Modeling Systems for Agricultural Insects and Diseases: Applications in Florida Citrus. J.S. Rogers, Ecostat Inc., Highland City; H.N. Nigg, CREC, Lake Alfred, UF/IFAS; I. Clark, Geostokos Limited, Alloa, Central Scotland; D.S. Hart, Serveon Inc., Wilmington, DE; R. Ehsani, CREC, Lake Alfred, UF/IFAS; D.L. Brock and E.W. Schuster, Massachusetts Institute of Technology, Cambridge, MA.

This paper introduces a web- and PDA-based spatiotemporal survey and forecasting service ("FlyNet") intended for the Caribbean Fruit Fly Free Protocol certification program. One challenge is how this information can be automatically related to data archived in other global information systems. Our solution is a universal process for acquiring, aligning and analyzing information from any agricultural crop-pest domain. Its foundation is a centralized data representation allowing relationships from different input sources to be explored in real-time through mapping, mathematical modeling and OLAP cube reporting. These features are valuable to growers because retrospective analyses against financial data become easier and insects and diseases can be tracked in real-time to facilitate better management decisions. Such capabilities are also useful to regulators who certify crops for sale to foreign or domestic markets. They can also help researchers

who wish to produce and share statistical analyses in real-time rather than wait until the end of an experiment to generate their results. We present our system architecture and show how observational information is acquired by our servers. Results of our first-year mathematical and geostatistical modeling suggest that Caribbean Fruit Fly populations are described by a logistic function and occur with an approximate 30-mile range of influence and 410-day cycle. This study utilizes a new computer language in development at MIT ("M") that provides an interoperable data organization and modeling environment. The application of M will support automatic alignment and modeling of information from different agricultural, ecological, environmental and financial sources.

Rootstock Effects on 'Flame' Grapefruit Trees Grown in the Indian River Region.

William S. Castle and James C. Baldwin, CREC, Lake Alfred, UF/IFAS.

'Flame' grapefruit (*Citrus paradisi* Macf.) trees were planted at 17 x 27 feet as two replicated trials in adjacent beds of Winder loamy sand soil in 1989 or 1990. The eight rootstocks in the 1989 trial had been selected for tolerance to *Phytophthora* and salinity from hybrids produced in the U.S. D. A. breeding program at Indio, CA. The parents were mostly selections of trifoliolate orange (*Poncirus trifoliata* [L.] Raf.), mandarin (*C. reticulata* Blanco), and Rangpur (*C. limonia* Osb.) Tree height among all rootstocks only ranged from 9.7 to 11.7 feet and annual yields were not different when measured in 3 years or when estimated in 2 years. Trees on African shaddock (*C. maxima* [Burm.] Merrill x 'English Large' trifoliolate orange) were the tallest after 10 years, produced the highest cumulative yield over five seasons (31 boxes/tree) and had the highest survival, 87%. Trees on a Rangpur x *C. depressa* Hayata hybrid had the lowest cumulative yield of 17 boxes/tree. The 1990 trial was a comparison of blight tolerance among trees on rough lemon (*C. jambhiri* Lush.), a selection of rough lemon from South Africa, RL-8166, and Swingle citrumelo (*C. paradisi* Macf. x *P. trifoliata*). Virtually all trees survived with only an occasional tree loss to blight through the trial period of 12 years. Trees grew to ca. 10 feet in height and there were no differences in annual measured yields. Trees on Swingle citrumelo had the lowest mean yield among the rootstocks in both trials.

Performance of 'Hamlin' Orange on 14 Rootstocks in Central Florida. K. D. Bowman, USDA-ARS-USHRL, Ft. Pierce.

Fourteen rootstock selections consisting of 12 new numbered hybrids, and two named cultivars were tested as rootstocks for 'Hamlin' orange, *Citrus sinensis* L. Osbeck at the Whitmore Foundation Farm in Lake County. Trees were planted at 3.0 m x 7.6 m spacing and the test included four single-tree replications in randomized complete blocks on Astatula fine sand soil with a pH of 6.2 and. Irrigation in the block was by overhead rotary sprinkler until conversion of the block to under-tree microjets in 2005. Cumulative fruit production over five years, fruit quality, tree growth, and tree health were measured and compared among the rootstocks. The standard rootstocks Carrizo citrange and Swingle citrumelo were intermediate to good in their effect on fruit productivity, while the new numbered hybrid selections ranged from high productivity to very low

productivity. Cumulative production (2001-2005) ranged from 787 kg of fruit per tree for US-1209 rootstock to 400 kg of fruit per tree for US-1206 rootstock. The rootstocks also differed significantly in their effect on fruit brix and other fruit quality traits. The rootstocks Swingle citrumelo and US-1201 typically produced fruit with low brix values, while the rootstocks US-1209 and US-1206 produced fruit with higher soluble solids concentrations. Some of the new hybrid rootstocks appeared promising for more widespread commercial trials.

***Diaprepes*, *Phytophthora* and Hurricanes: Rootstock Selection and Pesticide Use Affect Growth and Survival of 'Hamlin' Orange Trees in a Central Florida Citrus Grove.**

Grove. Robin J. Stuart, Clayton W. McCoy, William S. Castle, James H. Graham, and Michael E. Rogers, CREC, Lake Alfred, UF/IFAS.

We compared the growth and survival of young 'Hamlin' orange trees budded to five rootstocks (C-22, C-32, and C-35 citranges, Cleopatra mandarin and Swingle citrumelo) planted within a declining mature citrus grove infested with the root weevil, *Diaprepes abbreviatus*. The study used a split plot experimental design and all young trees received chemical applications for pest control from planting in September 2001 through 20 months of growth. Subsequently, half the trees received chemical treatments based on a pest-monitoring program whereas the others remained untreated. Over the next two years, treated trees had higher growth rates (except Cleopatra mandarin), larger tree canopies, and less tree decline than untreated trees; and trees on C-32, C-35, and Swingle citrumelo generally outperformed those on C-22 and Cleopatra mandarin. Roots damaged by weevil larvae were often infected by the plant pathogen *Phytophthora nicotianae*, which appeared to be a major factor in tree decline. In the fall of 2004, the grove sustained three hurricanes that killed 18.6% of the young trees and caused major damage to an additional 27.2%. Differential storm damage occurred among rootstock and pesticide treatments at least partly because larger healthier trees suffered more broken branches and fatal trunk injury whereas smaller weaker trees had less damage overall but were more frequently uprooted. Despite hurricane damage, differences in canopy volume showed similar patterns in May 2004 and 2005. This study demonstrates the importance of rootstock selection and effective pesticide use for maintaining citrus groves under stress from *Diaprepes* and *Phytophthora*.

Rootstock Effects on Murcott Tangor Trees Grown in a Calcareous Alfisol or a Spodosol.

William S. Castle and James C. Baldwin, CREC, Lake Alfred, UF/IFAS.

Two replicated rootstock trials were planted with 'Murcott' tangor (putative *Citrus reticulata* Blanco x *C. sinensis* [L.] Osb.) as the scion. The first trial was planted in 1990 near Sebring in Smyrna sand, a Spodosol. Trees on 9 rootstocks including the dwarfing 'Flying Dragon' trifoliolate orange (*Poncirus trifoliata* [L.] Raf.), mandarins, and 'Milam' lemon (putative *C. jambhiri* [Lush.] hybrid) were planted within an established commercial grove. Tree survival was 100% except for trees on sour orange (*C. aurantium* [L.]

that declined from citrus tristeza virus. Tree height after 11 years ranged from 9 feet ('Flying Dragon') to 11 feet (all other rootstocks). There were no large yield differences based on estimates at age 5 and 11 years. The second trial was planted in 1994 near West Palm Beach in Riviera sand, an Alfisol. Trees on 31 rootstocks that were mostly citranges (*C. sinensis* x *P. trifoliata* [L.] Raf.), citrumelos (*C. paradisi* Macf. x *P. trifoliata*), mandarins and somatic and sexual hybrids were planted but data were collected from only trees on 10 of those rootstocks. Tree survival varied from 100 to < 30% (somatic hybrids). The trees on Swingle citrumelo were 9.2 feet tall at age 10 years and those on most other rootstocks were up to 2 feet taller. Yield, as measured in three seasons and estimated in two seasons, was consistently highest in the trees on Volkamer lemon (*C. volkameriana* Ten. & Pasq.). Trees on Volkamer lemon and Smooth Flat Seville performed best in the calcareous areas of the site.

Machine Vision-Based Citrus Yield Mapping System. Radnaabazar Chinchuluun, Won Suk Lee, Thomas F. Burks, Agricultural and Biological Engineering, Gainesville, UF/IFAS.

Knowing the variability of fruits in citrus groves is important for growers to make right management decisions. Current citrus yield mapping systems require hand harvesting, which is labor intensive. Detecting occluded and non-occluded fruits from acquired images in outdoor scenes are one of the major problems in computer vision-based agricultural applications. Moreover, detecting occluded fruits from acquired images has received much attention in computer vision-based agricultural applications since there are no completely robust and efficient methods. This paper presents an automatic machine vision system with two charge coupled device (CCD) cameras, ultrasonic sensors, an encoder and a Differential GPS receiver to estimate citrus yield in natural outdoor scenes. An alternative computer vision algorithm is proposed to recognize visible and partially occluded citrus fruits from images. The average fruit size is determined from images using ultrasonic sensors measuring a distance between the cameras and the fruit laden trees. Finally, a citrus yield map will be created based on position information and the distance measured by the encoder.

Relating Citrus Canopy Size and Yield to Precision Fertilization. A.W. Schumann, H.K. Hostler, S. Buchanon, and Q.U. Zaman, CREC, Lake Alfred, UF/IFAS.

Modern granular fertilizer spreaders with variable rate application (VRA) capability can reduce fertilizer requirements and environmental impacts in Florida citrus groves by improving fertilizer application efficiency by up to 40%. A key component to their success is the real-time canopy sensing system which measures the size of the trees before the appropriate dose of fertilizer is dispensed. In this study, the performance of two types of sensors (ultrasonic and photoelectric) used in two different configurations (distance sensing versus discrete on/off) were compared in citrus groves. The correlations between fruit yield and various sensor output combinations in a 40-acre grove were then compared in order to find the best real-time sensor-based estimator of fruit yield and therefore fertilizer requirement. Young tree fertilization requires particularly fast canopy sensing and a 'look-ahead' feature that is automatically synchronized with ground speed. We tested two different 'look-ahead' control systems using either wheel rotation encoders or the Differential Geographic Positioning System (DGPS) to determine ground speed. Both field measurements and simulations

demonstrated that a well-tuned fertilizer spreader with high-speed sensors, control electronics and hydraulics can precisely fertilize any tree size from resets to mature hedgerows. The fertilizer doses applied automatically to a range of young non-bearing reset tree sizes approximated the IFAS-recommended rates.

Precision Agriculture Technologies for Control and Monitoring Aldicarb

Application. Masoud Salyani, William M. Miller, Sherrie Buchanon, and Roy D. Sweeb, CREC, Lake Alfred, UF/IFAS.

In Florida citrus, aldicarb (a soil-applied pesticide) has been found very effective in controlling certain insects, mites, and nematodes. However, due to its high toxicity and concerns about leaching into ground water, its applications require a 300/1,000 ft (91.4/304.8 m) buffer zone around all drinking water wells. A prototype machine was fabricated that featured both ground- and motor-driven mechanisms, commonly used in citrus applications. The machine was equipped with various controllers and electronic circuits. Three Digital GPS-based approaches were investigated. The first consisted of a DGPS antenna and a low-cost data logger. It could record latitude, longitude, and On/Off status of the discharge mechanisms for monitoring purposes. The second system used a pocket computer with variable rate (VRA) software. With this system, it was possible to achieve On/Off control of both discharge drives based on prescription map. The third system utilized a more sophisticated VRA controller, which allowed detailed operator-machine interface. It could generate variable rate maps and information on application rate, acreage, and total material usage. This paper reports on performance evaluation of the three systems under simulated field conditions. Each system showed certain merits and limitations but all were capable of providing spatial information on actual product application.

The Impact of Harvest Timing on Fruit Quality, Yield and Next Year's Crop. L. Gene Albrigo, CREC, Lake Alfred, UF/IFAS.

Following the freezes of 1980, numbers of processing and packinghouses were decreased as a result of reduced availability of fruit. At the same time, the shift from FCOJ to NFC required increased cold storage capacity as more juice was being held as single strength. Processors preferred for growers to delay harvest and hold fruit on the tree rather than increase processing storage capacity. Several adverse conditions for the grower resulted from these circumstances and decisions. Late season harvests result in more pre-harvest drop along with reduced juice content and higher ratios of the remaining fruit. These ratios are usually above the preferred range for best consumer acceptance. Finally, later harvests reduce the next years crop because the current crop competes for carbohydrates needed for subsequent flower bud formation and fruit set. 'Valencia' orange trees are the most severely affected, but data show that 'Hamlin' oranges and grapefruit are also adversely affected. Problems and costs from these practices to growers and potential solutions to minimize such problems will be discussed.

A Grower's Perspective of Constraints on Harvest Management. Peter McClure, Evans

Properties, Inc., St. Lucie County.

The move to NFC orange juice can be seen as beneficial for Florida growers by providing us a competitive advantage over more distant competitors. This has caused a desire by processors to extend the harvest season so fruit can be stored on the tree. This increases management and logistical problems along with costs to growers. Harvesting costs often double because of increased competition for seasonal labor, warm weather related poor working conditions, and because fruit store better on older, larger trees than on small trees. High temperatures and humidity coupled with increasing fruit senescence reduces fruit in-trailer storage time, which increases logistical problems with picking and hauling. Early or late harvest can reduce total pounds solids per acre and thus reduce grower returns. Late harvest can adversely affect the yield and return of the following crop. Harvesting during the rainy season can exacerbate disease control. Possible solutions to the on-tree storage/extended season problems include premiums paid to growers for early and late fruit, better communications and logistics in picking and hauling, better tree size control and crop management, improved disease management, improved scion varieties and rootstocks, abscission chemical registration, and improved mechanical harvesting techniques.

Harvesting methodology economics and constraints to consider. F. Roka, SWFREC, Immokalee, UF/IFAS.

Mechanical harvesting technology offers the potential to significantly reduce harvesting costs. Hopes of lower harvesting costs with mechanical systems rest on the concept of economies of scale, the spreading of the fixed amount of ownership and other non-operational costs over an increasing number of units of harvested boxes. The concept of economies of scale is straightforward and intuitively simply but achieving that reality within the current state of the Florida citrus industry is exceedingly difficult. Maximum economy of scale will at the very least, capturing the full economic potential of mechanical harvesting and will force the Florida citrus industry to rethink some of the fundamental relationships that traditionally held growers, harvesters and processors together. Meeting the efficiency requirements of mechanical harvesting systems will impose constraints on growers and processors that were never imagined when using conventional hand harvesters. Examples of these constraints will be discussed.

Logistic Issues Associated with Mechanical Harvesting. Thomas H. Spreen, Food and Resource Economics, Gainesville, UF/IFAS.

A shift from hand harvesting to mechanical harvesting of processed citrus offers several challenges for coordination of harvest scheduling with processing plant scheduling. In the present system, the rate at which fruit is harvested can be easily adjusted to meet the needs of the processing sector. Since the marginal cost of hand harvest is mostly labor, harvesters can adjust to fruit demand by processors simply by adding or subtracting the number of pickers. The key to costs of a mechanical harvesting system, however, is to maximize the number of hours that the harvester machine operates. In addition, the rate of fruit removal

associated with mechanical harvest is far greater compared to hand harvest. These two factors will likely lead to a coordination problem between harvesters and processing plants. In this paper, the coordination problem is discussed and possible resolution of the problem is presented.

Managing Harvesting Constraints as a Fruit Buyer: a Collective Viewpoint. Robin Bryant, Magnolia Consulting Inc., Palmetto.

Many constraints are introduced into the harvesting process that must be managed by a fruit buyer. Each juice processing plant has daily load allocations that must be met, but not exceeded. These load allocations may also change during a day based on processing capacity or plant breakdowns. Beyond load allocations, a fruit buyer must manage against changes in underlying fruit quality as defined in contracts. In addition, most growers have some expectation of the timing for harvesting their crop. Finally, management of resources including labor and equipment must be considered. Sufficient amounts of work and monetary compensation must be maintained to prevent hand labor from moving to another harvesting crew. Many times, the acquisition of labor requires the use of complex government programs with their own combinations of limitations. Each of these can have an impact on the fruit quality during the season and grove production in the next season.

Harvesting Requirements of Citrus Juice Processors for NFC and FCOJ Quality. Fran Becker, Peace River Citrus Products. Abstract not Available.

Potential Harvesting Solutions for the Florida Citrus Industry to Maintain Juice Quality and Grove Productivity. Robin Bryant, Magnolia Consulting Inc., Palmetto.

With the continual reduction in the number of processors in the Florida citrus industry, the available processing and storage capacity continues to decrease. Growers and harvesters are being asked to extend the harvesting season later each year in order to compensate for these decreases. As an industry, growers, processors, and harvesters need to determine ways to efficiently utilize the available capacities while maintaining juice quality and grove productivity. By implementing new technologies for mechanical harvesting and quality prediction, a more consistent and higher quality product can be delivered to the consumer.

Converting Soil Phosphorus Readings Based on Mechlich-3 Extraction Method into Mechlich-1 in Two Florida Flatwoods Citrus Groves. Esa Ontermmaa, Lykes Bros. Inc., Lake Placid.

The Mechlich-3 soil phosphorus extraction method (M3-P) is more versatile than Mechlich-1 (M1-P) and is

reported to accommodate a wide range of soil conditions. Yet, adoption of the M3-P by Southern States has been slow. To benefit from the versatility of the M3-P in Florida, a farmer either has to accept the recommendations devised by commercial soil testing laboratories or must convert the M3-P readings into M1-P values and then apply appropriate soil nutrient recommendations. The relationship of M1-P to M3-P varies markedly between nutrients and appears to be distinct to each region of the US where studies have been made. This suggestion of local dependency was confirmed by this study where 105 soil samples taken from two citrus groves less than 20 miles apart showed the conversion equation from M3-P to M1-P to be distinctly different for each location. In a grove with sandy soils, the linear regression between methods resulted in an R-square of 0.29 and the slope of 0.28. Regression using a natural logarithm transformation increased the R-square to 0.41. In a second grove with loamy soils, the regression resulted in an R-square of 0.53 and a slope of 0.79. We found M3-P > M1-P when soil pH \leq 6.3 and when pH > 6.3, M1-P > M3-P. The average pH for soils with pH > 6.3 was 6.95. These observations suggest that soil pH is a more significant factor influencing an increase of Mechlich-1 P over Mechlich-3 P than soil P concentration.

Fertilization of Young 'Minneola' Tangelo Trees on Bedded Groves with Banded Poultry Litter Overlaid with Wood Chips. J. Ferguson, Horticultural Sciences Dept., Gainesville, UF/IFAS; M. Ziegler, Agricultural Resource Management, Vero Beach; J. Hebb, St. Lucie County Extension Service, Ft. Pierce, UF/IFAS and W. Graves, Tetley Groves, Vero Beach.

Poultry litter is usually disked into the soil to conserve nutrients but such soil incorporation can damage surface roots of citrus trees grown on bedded groves. Using an alternative application method, young 'Minneola' tangelo trees on Cleopatra mandarin rootstock on bedded groves in southeast Florida were fertilized for 18 months after planting. Surface-banded poultry litter (PL) was overlaid with wood chips (WC). PL was applied at 12.5, 25, or 37.5 tons per treated acre in a 2-ft wide band within the dripline and overlaid with 25, 50, or 75 tons of WC twice a year. Other treatments included poultry litter applied at 25 tons per treated acre to a 10-ft wide strip in the middle of the bed twice a year and 1 lb of controlled release fertilizer (10-3-7) applied three times per year within the dripline. After 18 months, trunk diameter and plant height were generally similar except for trees to which poultry was applied in the bed middle, suggesting that the lowest PL/WC rate was adequate for tree growth during this time. Percent soil organic matter measured beneath the PL/WC treatments did not increase but leaf P, K, Ca, Mg, and Fe levels were excessive. Total per unit N input costs per year were higher for banded PL/WC and broadcast PL treatments than for the controlled release N treatments. Total cost per treated acre was greatest for the highest PL/WC rate and lowest for the controlled release fertilizer.

The Basis for Citrus Nitrogen Fertilization Recommendations. K.T. Morgan, Southwest FL REC, Immokalee, UF/IFAS; T.A. Obreza, Soil and Water Science, Gainesville, UF/IFAS and T.A. Wheaton, CREC, Lake Alfred, UF/IFAS.

A survey of drinking water wells conducted in Florida between 1988 and 1991 found that nitrate nitrogen (NO_3^-)

N) concentrations in surficial well water near citrus groves on Entisols in central Florida exceeded maximum contamination levels (MCL) of 10 mg L⁻¹. Of 3949 drinking water wells surveyed, 2483 (63%) contained detectible concentrations of NO₃-N. Of these contaminated wells, 584 (15%) contained NO₃-N in excess of MCL. The proportion of wells in Florida contaminated with NO₃-N was similar to that of a nation-wide survey, however, the proportion of wells contaminated above MCL was an order of magnitude higher. Eighty-nine percent of wells contaminated above MCL were located in the central Florida counties of Lake, Polk, and Highlands. Citrus in these counties are grown on Entisols which are uncoated sands with low water holding capacities of 0.04 to 0.09 cm³ cm⁻³, and are thus particularly vulnerable to nutrient leaching. To reduce potential ground water contamination due to citrus production, best management practices were established and UF/IFAS publication SP169 was written with a recommended N fertilizer application upper limit of 200 lbs N ac⁻¹ yr⁻¹ for mature bearing citrus trees. Prior to publication of SP169, the UF/IFAS recommendation was 0.4 lbs N per box of fruit per acre per year based on Bulletin 536D. Publication SP 169 is currently being revised and updated. Based on controlled experiments conducted since 1990, arguments are given for a recommendation based on production levels of soluble solids per acre per year.

Gramoxone Inteon – A New Formulation for Weed Management in Citrus. Shiv D. Sharma and M. Singh, CREC, Lake Alfred, UF/IFAS.

A series of experiments were conducted at different locations to examine the bioefficacy of Gramoxone Inteon. Several common weeds were present but there were different weeds in the mixed flora at different locations. Bioefficacy of Gramoxone Inteon formulation was compared with Gramoxone Max and Touchdown (glyphosate). Gramoxone Inteon at 1.5 and 2 qt/A, Gramoxone Max at 1.0 and 1.3 qt/A, Touchdown at 1.0 qt/A were applied alone and as a tank mix with and Solicam (3.0 lb/A). Non-ionic surfactant X-77 (0.25%) was tank mixed with all the treatments for better spread. Application of Gramoxone Inteon or Max showed almost complete control of grasses and broadleaves weeds even at the lower rates. Highest control was recorded one week after treatment (WAT) and thereafter, percent control values of all weeds were similar until 4 WAT. Addition of Solicam with Gramoxone showed improvement in percent control, however, there was no significant difference with and without Solicam on grasses. In general, the percent control of both types of weeds was significantly higher with any of the Gramoxone formulation than with Touchdown. Both the formulations of Gramoxone proved to be equally good in controlling mixed weed flora in citrus groves. However Inteon formulation has more user-friendly features than Max formulation. This fast, effective herbicide provides broad-spectrum control that is ideal for diversifying a grower's weed control program. Application of Gramoxone Inteon may also help in minimizing the risk of herbicide resistance management.

Tree Thinning Studies to Improve Production and Harvesting of Florida Oranges. S. H. Futch, T. A. Wheaton, J. D. Whitney, CREC, Lake Alfred, UF/IFAS.

Since the 1960s, higher density plantings have produced more fruit early in the grove's life with quicker

returns on investment. These groves may decline, however, after trees reach containment size. In a closely spaced Manatee County grove of 9- to 10-yr-old trees (at the beginning of the study) of 'Hamlin' or 'Valencia' oranges on Carrizo and Swingle rootstock, respectively, selected trees were sheared above the ground to reduce trees per acre and to determine the effects of tree thinning on yield per acre, fruit quality and tree growth. Trees were in hedge rows on two-row beds at 24 feet between rows and 8 feet in-row, providing 227 trees per acre. Tree density was reduced by removing every other or every third tree providing 113 and 151 trees per acre, respectively, and then compared to original hedge rows. For both varieties, yields were significantly reduced with decreased density. Cumulative box yields for 'Hamlin' over a 6-year period were 4,813, 4,247, and 3,956 for densities of 227, 151 or 113 trees per acre, respectively. Likewise, cumulative box yields for 'Valencia' over a 5-year period were 2,863, 2,319, and 1,998 boxes for the same densities. Harvesting efficiency increased with tree removal compared to hedgerow. Tree growth, as measured by trunk circumference, was greater for both varieties with decreasing tree density. During the 6 year study period, high density hedgerows provided highest cumulative yields with differences between treatments decreasing with time.

1-Methylcyclopropene Improves Selectivity of Ethepon Foliar Abscission Sprays

in Citrus. Luis Pozo and Jacqueline K. Burns, CREC, Lake Alfred, UF/IFAS.

1-Methylcyclopropene (1-MCP) is a gaseous ethylene binding inhibitor used to control or delay ethylene-related postharvest problems in a range of horticultural commodities. To evaluate the potential of 1-MCP to prevent unwanted defoliation when using ethephon to loosen mature citrus fruit, branch and canopy sector tests were conducted in 'Hamlin' and 'Valencia' orange [*Citrus sinensis* (L.) Osb.] using 400 mg·L⁻¹ ethephon (chloroethyl-phosphonic acid) in combination with 1, 2.5 and 5 mM 1-MCP. Although no difference in mature fruit loosening was measured between ethephon alone and ethephon + 1-MCP treatments, 1-MCP reduced defoliation and gummosis caused by ethephon. Combining 1-MCP with ethephon in the spray tank followed by application to the canopy was more effective in controlling unwanted defoliation when compared with 1-MCP applications 24 h before or 24 h after ethephon application. Subsequent studies on the effect of 1-MCP + ethephon application on flower and fruitlet abscission demonstrated unwanted abscission in these organs could also be reduced. The results suggest that ethephon-induced phytotoxicity can be reduced with 1-MCP, but the gaseous nature of 1-MCP is an impediment to uniform application. A sprayable 1-MCP formulation is being developed for preharvest use in many horticultural crops.

Defoliation after Harvest with a Trunk Shaker Does Not Affect Canopy Light

Interception in Citrus Trees. Kuo-Tan Li, Jim Syvertsen, and Jill Dunlop, CREC, Lake Alfred, UF/IFAS.

Tree productivity can be directly related to light interception by the canopy. To determine the effects of defoliation and twig loss during mechanical harvesting on canopy light interception, we measured mid-day

interception of direct and total light by mature 'Hamlin' and 'Valencia' sweet orange trees (*Citrus sinensis*) with a 16.3 m² point-grader and a photosynthetically active radiation ceptometer. Light interception measurements were made before and after harvest either by hand or with a linear-type trunk shaker. Leaves and twigs removed during harvest were collected to estimate defoliation and twig loss. Canopy volume and leaf area the following year were estimated. Before harvest at solar noon, well-developed citrus tree canopies intercepted 80% of the direct light and 88% total light per projected area of canopy. Although excessive trunk shaking can remove up to 15% leaf area compared to about 2% by hand harvesting (Li et al., 2005), little change in mid-day canopy light interception before and after harvest were recorded regardless of the harvest method. Canopy volume and total leaf area the following year were not correlated to previous harvest methods. The partial removal of leaves and old twigs by trunk shaking might have improved ventilation and light availability to the inner canopy and thus compensated for the loss of leaf area.

Improving Efficacy of Abscission Sprays for Mechanically Harvested Oranges.

Jacqueline K. Burns, Luis Pozo, CREC, Lake Alfred, UF/IFAS; Kelly Morgan and Fritz Roka, SWFRC, Immokalee, UF/IFAS.

The selective abscission compound 5-chloro-3-methyl-4-nitro-1-*H*-pyrazole (CMNP) improves mature fruit removal of mechanically harvested orange trees in Florida. Uniform fruit removal depends on peel contact by CMNP sprays. With conventional air-blast (AB) sprayers, the increase in nozzle-to-tree distance as tree height increases often results in variable upper canopy coverage and reduced spray penetration. As a result, fruit removal is variable, especially in denser canopies. We compared efficacy and fruit removal when CMNP was applied with an AB or a novel 'GreenTech' (GT) sprayer. The GT sprayer uses a 5.5 m (18') vertical boom with 6 independently-powered fan/nozzle assemblies that can be adjusted to the canopy contour, improving coverage and spray penetration. CMNP (250 mg·L⁻¹) was applied at 1873 and 2810 L·ha⁻¹ (200 and 300 gal·acre⁻¹) with the AB or GT sprayers to 'Hamlin' orange [*Citrus sinensis* (L.) Osb.] in Immokalee, FL. Four days after application, fruit detachment force (FDF) at 1, 2 and 4 m (approx. 3', 6' and 12') height at inside and outside canopy positions were determined. Fruit from GT-sprayed trees had low and uniform FDF at all canopy locations and heights. In contrast, fruit from AB-sprayed trees had greater variability in FDF, especially at the top and inside the canopy. Fruit were mechanically harvested using a trunk-shake-and-catch system. Mature fruit removal was greater and less variable in GT-sprayed than AB-sprayed trees. The results demonstrate that uniform CMNP coverage can minimize variation in efficacy and improve mature fruit removal of trees harvested with a trunk shaker.

Microbiological Evaluation of Mechanically-Harvested Citrus Fruit. R.M. Goodrich and

R. Ehsani, CREC, Lake Alfred, UF/IFAS.

For Florida to effectively compete in the world citrus industry, significant reductions in harvesting costs will be necessary. Mechanical harvesting can be thought of a two-step process: removal of fruit from the tree and

retrieval from the ground and/or collection area. A citrus fruit pick-up machine developed by OXBO International Corp. is being evaluated for its picking rate, picking efficiency, field capacity, and its efficiency for removing undesirable fruit and leaf trash. The performance test is being conducted under different ranges of forward speed, orange varieties and grove conditions. A UF-IFAS machine is also being evaluated for the same criteria. This study evaluates the microbiological aspects of mechanically-handled fruit with respect to fruit surface microflora. Three treatments were evaluated: hand-harvested fruit (control), mechanically-harvested fruit (picked up directly from ground) (MH fruit), and mechanically-harvested fruit in combination with the OXBO or UF-IFAS pick-up machine (MH/PU fruit). Microbial analysis included total plate count (TPC), acidophilic organisms (OSA), generic *E. coli* (as an indicator of potential contamination) and *Salmonella*. In general, hand-harvest control fruit had fewer microbes on the surface of the fruit than either MH or MH/PU fruit. Neither *E. coli* nor *Salmonella* were detected in any of the samples. There were substantial and significant differences between the two fruit surface microflora runs conducted to date which may be due to a variety of factors including the differing mechanical action of the machines, weather, equipment sanitation, grove location and tree/fruit treatments during production.

Processing and Handling Section

Disaster Response for Retail and Distribution Center Perishable Product

Companies. M. T. Talbot, J. P. Emond, Agricultural and Biological Engineering Depart., UF/IFAS.

The mission of the Center for Food Distribution and Retailing (CFDR) is to provide the food industry and the scientific community with a unique environment for developing knowledge that will assure food quality and safety through the whole distribution chain. In light of recent large scale disasters and the potential for future natural and man-made disasters, a need was identified to develop a new initiative related to disaster response for retail and distribution center perishable product companies. This project will expand the CFDR mission and there is excellent potential for coordination with the Extension Disaster Education Network (EDEN). This new research project area is presented, including potential partners (FDEM, DHS/FEMA, DoD, USDA, NASA). Initial project activities include assessment current impact of disasters on the whole retail food chain, inventorying existing plans for post disaster activities, fact-finding industry working groups to develop dialog, with the overall objective of establishing industry norms and areas of research needed. Potential projects could investigate movement of perishable products prior to the disaster, providing mobile electric energy capability, use of short-term cryogenic cooling, certification of food quality for redistribution, decontamination of food materials if required, alternatives to a land-fill disposal of destroyed food materials, methods to improved food resupply and distribution to the disaster area from distance sources. Industry input will assist with establishing project priorities and determining the state of the industry in dealing with the food distribution system disrupted by disasters, methods to maintain refrigeration cooling energy during disasters, efficient and economical waste disposal, etc.

Living with Citrus Canker and Citrus Greening – How will Florida’s Citrus Industry and its Regulators Respond? Mark Estes, FDOACS, DPI: Bureau of Pest Eradication and Control, Winter Haven, FL.

Since 1915, Florida’s citrus industry has battled citrus canker by eradication. The first two canker campaigns were successful, but the most recent effort, entitled the “Citrus Canker Eradication Program” (CCEP), was suspended on January 10, 2006. The decision that the eradication program was no longer feasible resulted largely from scientific predictions of the effects of Hurricane Wilma presented by USDA ARS Scientists, Dr. Tim Gottwald and Mike Irey. These predictions showed that up to 220,000 acres, in addition to the 80,000 acres associated with previous hurricanes, would be lost under current protocols. With USDA’s withdrawal of funding, irrepressible disease spread during legal battles, and the hurricanes of 2004 and 2005, enforcement of the 1900 foot rule and mandatory destruction of trees was officially suspended. However, with guidance from USDA, FDACS, UF- IFAS and industry stakeholders, a new plan, named the “Citrus Health Response Plan” (CHRP), is evolving which combines both citrus canker and greening disease management. The first official draft of the CHRP was released on March 6th, and work has continued to rapidly sort out details of the new program and to stimulate state and federal legislation in support of the industry. The process and outcome of these negotiations are discussed, along with developing protocols designed to sustain the viability of the citrus industry in Florida.

Potential of a New Reduced-Risk Fungicide Fludioxonil for Postharvest Decay Control of Florida Citrus Fruit. Jiuxu Zhang, Florida Dept. of Citrus, Lake Alfred, FL.

Fludioxonil is a reduced-risk, and newly registered compound for the postharvest disease control of fresh fruits including citrus. The efficacies of fludioxonil for the control of stem-end rot and green mold caused by *Lasiodiplodia theobromae* and *Penicillium digitatum* on Florida citrus fruit were evaluated. Fludioxonil actively suppressed the mycelial growth of both pathogens. The ED₅₀ of fludioxonil against *L. theobromae* and *P. digitatum* was 0.033 and 0.034 ppm, respectively. Application of fludioxonil at rates of 500 to 1,200 ppm using a simulated commercial drench system before fruit degreening with ethylene reduced stem-end rot incidence by 85.5 to 93.7%, which were similar to the results obtained from standard postharvest fungicide thiabendazole or imazalil at 1,000 ppm. Aqueous application of fludioxonil at 1,000 ppm using a simulated commercial packingline reduced the incidence of green mold and stem-end rot by 73.4% and 74.3%, respectively. The efficacy of fludioxonil for decay control was reduced when it was mixed with a packing wax. Fludioxonil appears to provide good potential for postharvest disease control on Florida citrus. Fludioxonil could also play an important role in fungicide resistance management since it has a different mode of action compared to thiabendazole and imazalil.

FreshSeal® CHC Reduces Shivel and Decay of Pepper (*Capsicum annum*). Mark A.

Ritenour, IRREC, UF/IFAS, Fort Pierce; Mark P. Kohout, Paul Johnson, and Huating Dou, BASF Corporation, Dinuba, CA

BASF FreshSeal® CHC is a naturally occurring, polymer-based postharvest coating, and has been commercially applied to many horticultural crops including tomatoes and peppers. Experiments were conducted to evaluate the effects of FreshSeal® CHC application on postharvest quality retention of fresh peppers (*Capsicum annuum*) in Florida. Packed cartons each containing approximately 80 'medium' green bell peppers grown in the West Palm Beach / Wellington area were obtained on 1 March 2006 from a commercial packinghouse and treated within 24 hours of harvest. The cartons were randomized and the peppers treated with FreshSeal® CHC (0.5% a.i.) or water (control) by hand sprayer, or by running over a small packingline brush bed. Hand applications completely wet the pepper surface, whereas brush applications covered approximately 70% of the pepper surface. The peppers were then stored for 6 days at 45°F before transferring to room temperature (~76°F). Fruit were weighed, inspected for visible mechanical injury, and evaluated for shrivel and decay 7 days after treatment, and then following an additional 2 days at room temperature. The experiment was a factorial design with two factors (treatment and application method) and five replicates (cartons). Peppers treated with FreshSeal had about 38% less shrivel than the control on day 7, and about 21% less shrivel and 52% less cumulative decay than the control at the end of the experiment. Pepper water loss was not significantly different between treatments or application methods. While brush application in general significantly increased cumulative decay, there were no significant differences in shrivel between hand and brush applications.

BASF FreshSeal® Postharvest Coating Extends Tomato Shelf-Life and Increases Saleable Fruits. Huating Dou, Mark Ritenour, Paul Johnson, and Mark Kohout, BASF Corp., Dinuba, CA; Steven Sargent, Horticultural Sci. Depart., UF/IFAS.

During the past two seasons, the effect of BASF Freshseal postharvest coating in round tomato shelf-life was investigated in eight trials in commercial packinghouses. Fruit were examined under the observation of packinghouse staff. Two trials were conducted at University of Florida (UF) in the year of 2005. The fruit color development, shriveling, and decay incidence were investigated in these trials since they are the major packer's concern in postharvest from the commercial standpoint of view. The trials conducted at UF showed only four of the control fruits and one of mineral oil treated fruit succumbed to decay while no FreshSeal fruits developed decay. The trials are repeating this season to demonstrate concrete evidence that FreshSeal imparts resistance to decay. The five trials in Virginia indicated a general reduction of postharvest loss (decay and shriveling) from 10% in mineral oil waxed fruits to 2-3% of Freshseal coated fruits 12-14 days after storage at 45 F and 85% relative humidity. The trials conducted in January in South Florida reduced total postharvest loss from 39% in waxed fruits to 26 % in FreshSel treated 14 days after storage at 45 F and % RH. The results indicate an increase of total 3 -9 saleable fruits per 60 fruits carton. Assuming that per 60 fruits box cost \$20 at the retail level, Freshseal application increases the economic-return of \$ 1.00 to 3.00

per carton. In addition to the previously discussed results, Freshseal application accelerates fruit color development at least 1 stage earlier than waxed fruits. This benefits the primary packer/handler as well as the re-packer by a flexible transiting of fruits during the postharvest marketing period.

Edible Coatings for Lychee Fruit to Maintain Color in Storage. Anne Plotto, Jan A. Narciso, and Elizabeth Baldwin, USDA/ARS, Citrus & Subtropical Products Laboratory, Winter Haven, FL; Nithiya Rattanapanone, Dept. of Food Science and Technology, Chiang Mai University, Thailand.

The bright red pericarp of lychee (*Litchi chinensis* Sonn.) fruit quickly turns brown after harvest due to peel dehydration, anthocyanin degradation, and fungal growth on the fruit surface. Lychee fruit, cv. Mauricious and Brewster from Florida, and Hong Hauy and Juckapat from Thailand, were dipped in acidic treatments (2-3% citric acid, 2% ascorbic acid, 2% acetic acid, 1% isoascorbic acid), antioxidants (0.5% acetylcysteine, 0.02% hexyl-resorcinol), antimicrobial treatments (peroxyacetic acid (Storox), 5 or 20% ethanol) and various coatings (chitosan, carrageenan, hydroxypropylcellulose [HPC], sucrose fatty acid esters, pectin oligomers, carnauba wax), alone or in combination. Ascorbic and citric acid gave the best results in the Thai experiments. HPC performed well on the Thai fruit, but not on the Floridian fruit. In the Florida experiments, the mixture of isoascorbic acid with acetylcysteine and hexylresorcinol, and 5% ethanol consistently gave higher chroma readings with the L*a*b* color measuring system, indicating higher color intensity. Ascorbic acid, isoascorbic acid, and acetylcysteine alone gave higher chroma in one experiment. Visual evaluation was higher for these treatments after 15 and 21 days storage at 5 °C, as well as for the sucrose fatty acid ester. There was a high anthracnose (*Collectotrichum spp.*) pressure for the Florida harvested fruit in the first year, and in the second year, *Collectotrichum* and *Alternaria* were isolated from the fruit surface. Future efforts will also aim at reducing pathogen pressure in the field, as well as after harvest.

Atmospheric Change and Broccoli Floret Quality in Plastic Containers Maintained under Simulated Household Refrigerator Temperatures. Guiwen W. Cheng, Donald J. Huber, and Steven A. Sargent, Horticultural Sciences Dept., UF/IFAS.

The dynamic changes in atmospheric composition and the quality of broccoli florets in plastic containers under household conditions have not been studied. The objectives of this study were to monitor CO₂ and ethylene accumulation in unvented and vented (a port in the lid) plastic containers with broccoli florets under simulated household conditions. Within unvented containers, carbon dioxide concentration rose quickly to >20% at 10°C and to >8% at 4°C after 3 days and 39.6% at 10°C and 30.8% at 4°C after 6 days. With vented containers the headspace CO₂ was maintained at or below 3%. Ethylene levels were much lower in vented than unvented containers but did not exceed 0.3 ppm in any of the treatments. Higher weight loss was observed with vented containers as storage time extended. The florets degreened quickly in vented containers. Strong sulfurous odors developed in unvented containers but not in vented containers. The accumulation of CO₂ and

ethylene was positively associated with the amount of florets in the sealed containers but not in the vented containers. The presence of an ethylene scrubber prevented the accumulation of ethylene in both unvented and vented containers. However, reduction of container ethylene levels had no evident effect on of CO₂ accumulation. The results indicate that the quality of broccoli florets kept in household plastic containers can be best preserved through a proper built-in ventilation.

Resistance to Postharvest Fungicides in Florida Citrus Packinghouses. David J. Hall, Agri-Chem Consulting, Clermont, FL.

Developed resistance to postharvest fungicides are a serious problem in many citrus packing areas. Florida has apparently avoided this problem for many years. During the past 25 years resistant mold assays have been conducted in Florida citrus packinghouses. While rarely encountered, those cases where resistance was encountered can help understand how the problem may be avoided.

Enzyme-peeled Oranges for Fresh-Cut Slices. Simona Pinnavaia, IVTPA, Via Venezian 26, Milano, Italy; Anne Plotto, Elizabeth Baldwin, and Jan Narciso, USDA/ARS, Citrus & Subtropical Products Laboratory, Winter Haven, FL 33881

Oranges can be satisfactorily processed for fresh slices using a process of enzyme infiltration under vacuum. Scored 'Valencia' and 'Hamlin' oranges were placed under 90 kPa vacuum in a 0 ppm (water-infused) or 1000 ppm enzyme solution (Ultrazyme) at 30 °C for 2 min, followed by 30 min incubation in air. Peel was then removed, peeled fruit were washed, blotted dry, cut, and slices were then dipped in water or 1% citric acid (CA) for 2 min. Drained slices were then placed in 16 oz deli containers and stored at 5 °C for up to 21 d. One additional treatment involved vacuum infiltrating scored oranges in 1% CA, without further dipping the cut slices. All 'Valencia' slices had $<1.0 \log_{10}(\text{cfu/g})$ after 7 d storage, and fruit infused without enzyme but with CA had $<1.0 \log_{10}(\text{cfu/g})$ after 21 d storage. For 'Hamlin', CA controlled bacterial growth on slices from water-infused oranges, except at 14 days. Enzyme-infused oranges resulted in slices with lower counts in both experiments. CA –treated sliced (post enzyme treatment or by infusion) had higher titratable acidity initially ('Hamlin') and after 14 days ('Valencia'). When presented to a taste panel, 'Valencia' slices from enzyme-peeled fruit were preferred for texture after 2 and 8 d in storage. In contrast, slices from fruit infused with water or citric acid were least preferred, were firmer, and had thicker membrane. Appearance of enzyme-treated fruit was preferred for 'Hamlin' oranges. Enzyme or CA treatments did not affect overall flavor of 'Valencia' or 'Hamlin'.

Fumigation of Tomato Fruit with Chlorine Dioxide: Dose Affects Fruit Quality. M. J. Mahovic *, J. A. Bartz, Dept. of Plant Pathology, UF; A. D. Berry and S. A. Sargent, Horticultural Sciences

Dept., UF/IFAS, Gainesville, FL.

Chlorine dioxide (ClO₂) gas has been proposed as a fumigant for fresh market tomatoes. Treatment with 1 to 2 mg of ClO₂/kg of tomato produced a major reduction in recoverable bacterial populations and in the incidence of soft rot in inoculated wounds. However, treatment with up to 99 mg/kg led to a bleaching and damaging desiccation of wounds and stem scars. In this study, standard round tomatoes (cv. "Florida 47" for field pack, all others cv. "Soraya") from three commercial harvest/handling steps were treated with two concentrations (standard and 10× standard) of ClO₂ and then ripened. Tomatoes samples were: 1) harvested at light-red stage, 2) harvested green from field bins (prior to transfer to dump tank, and 3) at green and breaker stages after 3 d in ethylene. Following fumigation treatment, all fruits were stored at 20°C and 95% relative humidity until fully red. Fruits treated for 2 h with ClO₂ at either the standard or 10× dose (2 or 20 mg/kg fruit, respectively) ripened similarly to the control fruit that had not been exposed to ClO₂. However, stem scars on fruit from the 10× treatment became sunken. By day 6 of storage, 69, 41 and 28% of the stem scars on the field packed, ethylene treated or non-ethylene treated green fruit, respectively, developed visible fungal growth. By contrast, no other detrimental changes in fruit quality could be attributed to either dose of ClO₂. While ClO₂ has promise as a fumigant for sanitation, fruit quality issues could arise due to application of excess amounts of ClO₂ gas or by not assuring uniform distribution of the gas in fruit storage facilities.

Determination of Optimum Storage Conditions for 'Baby' Summer Squash Fruit

Cucubita pepo. B. S. Brew *, A. D. Berry, S. A. Sargent, *N. L. Shaw*, and *D. J. Cantliffe*, Horticultural Sci. Dept., UF/IFAS, Gainesville, FL.

There are many types of summer squash (*Cucurbita pepo*), with a wide range of colors, shapes, sizes and flavor. Summer squashes are harvested at immature stages as opposed to winter types that are harvested fully mature. While the lowest safe storage temperature for larger summer squash is 5°C, sensitivity of baby squash has not been reported. Tests were conducted using 'baby' yellow crooked-neck summer squash (cv. Sunray). Fruits were harvested prior to and just after bloom opening, with lengths ranging from 6 to 10 cm. Blooms were removed and fruits were placed in non-vented, polystyrene clamshell containers and stored at 5, 7, 10 and 12 °C for 14 d. To accelerate development of chilling injury fruits were transferred to 20 °C for 24 hr after 7 and 14 d of storage. Chilling injury symptoms included surface pitting, external and internal discoloration, and decay. Based on subjective quality rating scales, fruits stored at 10 °C had the best quality after 7 d of storage plus 24 hr at 20 °C compared with those stored at 5, 7 and 12 °C; storage at 7 °C showed the poorest quality. Respiration rates were 81, 97, 109, and 181 mg CO₂kg⁻¹h⁻¹ for fruits stored at 5, 7, 10, and 20 °C.

Electrolyte Leakage of Beit Alpha-type Cucumbers Pretreated with Liquid 1-MCP during Continuous Ethylene Exposure. A. C. C. Alleoni, A. E. Godoy *, S. A. Sargent, D. J. Huber, Horticultural Sci. Dept., UF/IFAS, Gainesville, FL.

Hydroponically grown cucumbers (cv. Manar) were immersed for 1 min in 1-methylcyclopropene (1-MCP, 100 ppb, 1 ppm or 5 ppm in water) or water only, air dried and stored at 15°C, 99% relative humidity using a flow-through system with either continuous exposure of 13 $\mu\text{L-L}^{-1}$ exogenous ethylene or air. The efflux of solutes from plant tissues is widely used as a measure of membrane permeability in response to various stress conditions. Electrolyte leakage was determined at days 0, 4 and 8 via electrical conductivity of isotonic mannitol solution in which the tissues were incubated for 3 hr. After 8 d storage in ethylene, cucumbers dipped in water only had significantly higher electrolyte leakage compared to those pretreated with 1-MCP in 100 ppb, 1 ppm or 5 ppm (100, 29, 28 and 30% respectively). Fruits stored in air (with or without 1-MCP pretreatment) showed no variation in electrolyte leakage (25%) after the same period. Fruits without 1-MCP pretreatment had worse appearance when exposed to ethylene than those exposed to air. The deleterious effects of exogenous ethylene exposure on the postharvest quality of stored cucumbers were reduced by immersion in aqueous 1-MCP preparations.

Effect of Lipid and Solid Content of Hydroxypropyl Methylcellulose-Beeswax Edible Composit Coatings on Quality of Mandarins cv. *Clemenules*. M. Ll. Navarro-Tarazaga * and M. B. Pérez-Gago, Postharvest Dept., Instituto Valenciano de Investigaciones Agrarias, Moncada, Spain.

Polysaccharide-lipid edible composite coatings are effective extending citrus shelf-life. Their effectiveness depends on the nature and proportion of its components. Increasing lipid content improves the moisture barrier, but it might affect other quality parameters. Internal gas modification of coated fruit has been directly related to coating thickness through the solid content (SC) and viscosity of the coating solution. The objective of this work was to study the effect of beeswax (BW) and SC of hydroxypropyl methylcellulose (HPMC)-BW composite coatings on the quality of *Clemenules* mandarins.

Coatings consisted on HPMC, BW, stearic acid and glycerol. HPMC of two different molecular weights were used to prepare emulsion coatings at three HPMC:BW ratios (1:1, 1:3, 1:30), with 4% and 8% SC and similar viscosity. After coating, mandarins were stored up to four weeks at 5 °C followed by one week at 20 °C.

Quality analysis of the mandarins were done periodically during storage.

Coatings reduced weigh loss and deterioration index, and improved texture of mandarins compared to uncoated samples. These parameters were not affected by SC. As SC increased, internal CO₂, ethanol levels and off flavor increased and fruit appearance got worse. Increasing the BW content reduced weight loss, CO₂, ethanol levels and off flavor. However, coatings with 1:30 HPMC:BW ratio presented a whitish appearance.

The results indicate the need to control SC of edible coatings to avoid the overproduction of volatiles

associated with anaerobic conditions and the need to control the HPMC:BW ratio to get coatings with good appearance.

Characteristics of Laser Etching Depressions on Florida Fruits and Vegetables.

Ed Etxeberria, Greg Drouillard, William M. Miller and Diann Achor, CREC, Lake Alfred, FL and Durand-Wayland, LaGrange, GA.

Natural Light Labeling technology facilitates labeling of produce with precise control of emitted light from a CO₂ laser that removes the pigment layer from the surface of the produce to reveal a contrasting sub-layer. This removal process has been designed so as not to penetrate the surface or “skin” of the produce to reduce possibility of decay. For produce varieties with a low contrast, a natural food color is applied to the etched surface which greatly enhances the contrast. The system uses no consumables like glue, plastic, paper or ink, and has no waste or mess to clean up afterwards. The system can print a variety of information, and can change from one message to the next “on the fly”! For example the NLL system can print PLU’s, country of origin, lot and batch numbers, graphics—virtually anything you might want—all without buying, peeling, storing, or cleaning adhesive labels ever again.

To facilitate quick and easy operation, the machine is equipped with an “easy to use” GUI (graphic user interface) with a WYSIWYG (what you see is what you get) design. The system is specifically designed to easily integrate into and interface with all current packinghouse equipment; and it will not only meet the needs of the grower and packinghouse industry but the consumer and public policy requirements of traceability. It has been tested in several commercial applications, and also tested for product sustainability and consumer acceptance.

Used as an alternative means to label produce, laser beam generated dot-matrix characters can etch in the required price look-up (PLU) information. The pin-hole depressions disrupt the cuticular barrier potentially weakening the natural protection against pathogens. The present study describes detailed characteristics the pin-hole depressions in the cuticles of several fruits and vegetables produced in Florida including tomato, pepper, potato, cucumber, avocado and citrus. Average diameter and depth of the pin-hole depressions are of 200 μm and 25 μm , respectively, regardless of the energy impact durations (30-45 μs) or peel thickness. Immediately after etching, the 2-5 cell-deep depressions contained cuticle/wax deposits. Fluorescent, light and confocal microscopy revealed the deposition of additional layers of cuticle/wax (around the depressions) and protective phenolic compounds (in underlying cell layers) during storage. These developments likely create a potential barrier against pathogenic organisms.

Food Gums Made from Citrus Peel. Winsor G. Eveland, Natural Health Care Products, Inc.; Fibers of Florida Int'l, Inc.; Savory Sun, Inc., Englewood FL.

Process for the production of citrus peel fiber for usage as a hydrocolloid in various food products and the combination of citrus peel fiber with other hydrocolloids to form an irreversible gum/and/or series of gums for specific food applications.

Grapefruit Juice Furanocoumarins and P450 Cytochromes. P. F. Cancalon and C. Haun.

In 1991, Bailey et al discovered that the blood level of the drug felodipine was significantly higher in patients who had consumed grapefruit juice. Further studies showed that the increase in drug bioavailability was due to the elimination from the intestine of an enzyme, of the P450 cytochrome family, CYP3A4. It is mainly located in the liver and in the intestine Enterocytes, but the amount of CYP3A4 can vary greatly between individuals. Furanocoumarins (FC) and some of their dimers (spiroesters) have been identified as the active compounds involved in the interaction process. They have been ranked by order of inhibitory potency: Spiroester 3 (paradisins A) >6,7 DHB>bergamottin>bergapten>bergaptol with comparative strength of 13, 2.2, 1, 1, 0.05 .

The mechanism responsible for the increase in drug blood level by grapefruit juice has investigated by various groups. Under normal conditions, CYP3A4 in the intestine and the liver catabolizes many xenobiotics including drugs and in extreme cases, only 10% of some drugs may reach their target. Study on the effects of processing on grapefruit juice furanocoumarins (FC) showed that the concentration of several FC decreases during storage. The mechanism responsible for FC degradation appears to be a pH, temperature dependent, non-enzymatic hydrolysis involving the removal of the side chain.

Although progress has been made in understanding the grapefruit juice drug interaction process, some aspects are still unclear.

HPLC-ESI-MS Analysis of Furanocoumarins in Grapefruit Juice. John A. Manthey, USDA/ARS, Citrus & Subtropical Products Laboratory, Winter Haven, FL.

The furanocoumarins in grapefruit juice inhibit intestinal and liver cytochrome P450 3A4 (CYP3A4) and are responsible for the effects in humans caused by grapefruit juice consumption on the metabolism of certain prescription drugs. A number of the (furan)coumarins that occur in the highest concentrations in grapefruit juice have already been identified, and these compounds include bergamottin, 6',7'-epoxybergamottin, 6',7'-dihydroxybergamottin, bergaptol, and auraptene (7-geranyloxycoumarin). In addition to these major compounds, there is a variety of other coumarin and furanocoumarin monomers, as well as dimers, mainly of bergamottin derivatives. Many of these minor-occurring compounds, particularly the dimers, are highly active as CYP3A4 inhibitors. Initial purification of these compounds has been achieved by column chromatography, preparative thin layer chromatography, and reversed phase HPLC. Analysis by HPLC-ESI-MS, has provided the partial structural characterizations of a number of these compounds. A common feature of many of these compounds is variously substituted geranyl substituents. The isolation, and the UV and MS spectral properties of these compounds are reported.

Glycemic Index and Glycemic Load as Related to Citrus. Santiago Barros and M. Filomena Valim, Scientific Research, Florida Dept. of Citrus, Lake Alfred, FL.

In some parts of the world glycemic index (GI) is now widely recognized as a reliable, physiological based classification of foods according to their postprandial (after meal) glycemic effect (a measure of the change in

blood glucose following ingestion of carbohydrate containing foods). Carbohydrates have been classified as simple or complex (sugar, starch and fiber) based on their degree of polymerization. However, their effects on health may be better described on the basis of their physiological effects which depends both on the type of constituent sugars and the physical form of the carbohydrate. The level of postprandial glycemia, however, is dictated both by the quality and the quantity of carbohydrate. To consider both factors simultaneously, the concept of glycemic load (GL) was introduced. GL is defined as the product of the carbohydrate content per serving of food and its GI.

The purpose of this presentation is to introduce the concepts of glycemic index, glycemic load and the citrus data currently available related to these two concepts. New GI/GL data developed from authentic commercially processed Florida orange juices will be presented.

HPLC-MS Analysis of Phenols in Longan (*Dimocarpus longan* Lour.) Peel. Somkit Jaitrong, Postharvest Technology Institute, Chiang Mai University, Chiang Mai, Thailand; Nithiya Rattanapanone, Dept. of Food Science and Technology, Faculty of Agro Industry, Chiang Mai University, Chiang Mai, Thailand; John A. Manthey and Elizabeth A. Baldwin, USDA/ARS Citrus & Subtropical Products Laboratory, Winter Haven, FL.

Longan fruit are susceptible to chilling injury, where the peel exhibits discoloration (water-soaking and/or browning area on the peel). Two varieties of longan (Daw and Biew Kiew) were subjected to abusive cold storage to evaluate the changes in the phenolic compounds that occurred in peel exhibiting chilling injury. The peel of the stored fruit was freeze-dried and subsequently extracted with 80% aqueous methanol. HPLC-PDA analysis of the peel extracts showed a very large number of phenolic compounds. Fractionation of the phenols by size-exclusion P2 (Biogel) chromatography effectively separated several main classes of phenols, including ellagic acid conjugates, flavone glycosides, and a collection of putatively similar phenols based on their common UV and MS properties. Analysis of phenolic extracts following hydrolysis showed that the majority of flavones constituted glycosides of quercetin and kaempferol. A number of other unusual flavone conjugates were also detected by HPLC-ESI-MS analysis. Similar analyses also showed evidence of 2 ellagic acid-pentose conjugates. The spectral properties of these compounds are reported.

Carotenoid Profile of Peel and Juice of Valencia Oranges Treated with Abscission Chemical 5-chloro-3-methyl-4-nitro-1H-pyrazole (CMNP). Fernando Alferez, Luis Pozo, and Jacqueline K. Burns, CREC, Lake Alfred, FL.

The compound 5-chloro-3-methyl-4-nitro-1H-pyrazole (CMNP) selectively induces mature citrus fruit abscission. Previous work demonstrated that CMNP promoted senescence of mature fruit and advanced some maturation traits, such as chlorophyll degradation and increase in total carotenoid content in flavedo. This indicated that carotenoid accumulation was enhanced and suggested a differential carotenoid profile as a consequence of CMNP treatment. Citrus is one of the most complex sources of carotenoids among fruit.

Carotenoid accumulation occurs during fruit maturation, and carotenoids serve as vitamin A precursors and antioxidants, reducing the risk of certain forms of cancer. Alteration in the carotenoid profile of fruit treated with CMNP may positively impact the final quality and attributes of the juice. We studied the effect of CMNP on the carotenoids profile of juice and peel both quantitative and qualitatively during maturation of Valencia fruit in early, mid and late seasons. We compared this treatment with non-treated and with ethephon treated fruit. In this communication we report on the differential accumulation of carotenoids after CMNP treatment.

Packing Florida's Fresh Citrus Fruit Organically. David J. Hall, Agri-Chem Consulting, Clermont, FL.

Florida packers of organic fresh citrus fruit face some obstacles unique to this growing area. Practical methods of dealing with these are discussed. Some promising new methods are being developed. Some of these are highlighted along with their possible future application.

The Use of stir-bar sorptive extraction for analytical food analysis. Kevin L. Goodner, USDA/ARS, Citrus & Subtropical Products Laboratory, Winter Haven, FL; Jinhe Bai, MCAREC, Oregon State University, Hood River, OR.

Stir Bar Sorptive Extraction (SBSE) is a technique that is similar to solid phase microextraction (SPME), except a small magnetic stir bar with a non-polar coating is used for detection of organic compounds in various sample matrices instead of a small fiber. Due to the relatively large amount of coating, there is a smaller relative variation between stir bars than there is among different SPME fibers. In addition to the advantage of the larger capacity of the SBSE, their use enables researchers to employ multiple stir bars during an experiment instead of relying on a single fiber. This report will discuss some fundamental issues regarding calibration curves using SBSE and SPME for quantitative volatile research, as well as present a small storage study used to simulate shipping of the stir bars for remote analysis, and initial results of some remote analysis where the stir bars were used for in-situ fresh pear analysis.

A Model for the Role of 5-chloro-3-methyl-4-nitro-1H-pyrazole (CMNP) in Mature Fruit Abscission. Fernando Alferez, Luis Pozo, Anish Malladi, and Jackie Burns, CREC UF/IFAS, Lake Alfred FL.

Control of mature citrus fruit abscission can be achieved in commercial cultivars such as 'Valencia' or 'Hamlin' by the use of CMNP. The different rate of fruit development between these two cultivars provides an excellent dual system in *Citrus sinensis* to explore the involvement of growth regulators and signaling pathways governing abscission. During 'Valencia' late season harvest, mature fruit coexist with young developing fruit on the same tree. Young fruitlets are a source of auxins: inhibitors of abscission. At the same time, auxin

signaling in response to several stresses is mediated by phospholipase A₂ (PLA₂). PLA₂ has been shown to induce abscission and other separation processes in plants. In our studies, CMNP promoted PLA₂ activity in mature fruit. Auxins are believed to be responsible for a transient lack of efficacy of CMNP promoting mature fruit abscission, known as the less responsive period (LRP). Later, efficacy is recovered and an increase in PLA₂ activity can be measured in flavedo of naturally senescent fruit. There is a paradox in the mode of action of auxins inhibiting abscission in one hand but also inducing PLA₂ activity. We present here a model that integrates maturation, PLA₂ activity and auxin synthesis and transport in the tree with the competence to abscise of mature citrus fruit.

Determination of Molecular Weight Citrus Pectin Using Ion Chromatography. Gary A. Luzio, USDA/ARS, Citrus & Subtropical Products Laboratory, Winter Haven, FL

Objective was to investigate the use of ELS as a mass detector coupled with MALLS for determining the molecular weights of pectins and other polysaccharides under changing buffer concentrations using HPLC. This would permit the direct determination of the charge to size ratio of pectin which is important for many applications involving pectin. For calibration of the ELS, the chromatography was performed under isocratic conditions using concentration values obtained from an interferometric refractive index detector (RI). The observed response fit a power trendline ($y = ax^b$) at for the concentration response of the RI versus the voltage response of the ELS. Band broadening, which could occur between the detectors, was not observed and did not affect the calibration values. Without adjustment the ELS was used as a mass detector for MALLS to accurately determine molecular weights of pectin which had been deesterified with pectin methylesterase with methanol present in the reaction mixture under gradient conditions.

Using a Mass Spectrometer Library Matching System to Identify Citrus and Other Food/Non-Food Products. Kevin L. Goodner, USDA/ARS, Citrus & Subtropical Products Laboratory, Winter Haven, FL; Vanessa R. Kinton, Alcohol & Tobacco Tax and Trade Bureau, Ammendale, MD.

A method that identifies products based on a composite mass spectra using standard chemical library searching functions is presented. Composite mass spectra were collected sampling the headspace of a product directly without separation into a mass spectrometer. A library of spectra for 51 products (5 soaps, 2 hand lotions, 4 potato chips, 4 ketchups, 2 peanut butters, 4 breath mints/gums, 13 citrus juices, 1 bourbon, 3 onions, 5 colas, 3 coffees, 5 peppers) was generated, and 7 unknowns samples (17 runs total with replicates) were tested against the library. Eleven of the 17 unknown sample runs were correctly identified with the top rated library match, four were identified as the second best match, and 2 were not identified in the top two matches. This level of correct matching (15 of 17 as best or second best match) is encouraging, suggesting that this technique could be used on a larger scale for product identification. This technique requires fewer analyses, doesn't require advanced statistical knowledge, and uses widely known mass spectral library tools.

Krome Section

New Tropical Fruit Crops for South Florida. Chris Rolling, Fruit and Spice Park, Homestead, FL.

South Florida has from its early settlement been viewed as the only tropical growing area in the continental United States. From the 1830's when Henry Perrine introduced mangos, avocado, sisal and other crops for his ill-fated plantation on Cape Sable, visionaries have continually planted new crops from around the world in South Florida. During the early 1900's grapefruit, king orange, key lime, avocado, mango were South Florida fruit crops. After the flood and hurricanes of the 1940's king orange and grapefruit decline as commercial crops in S. Florida. Persian lime, avocado, mango and papaya became the dominate crops until the early 1980's. At that time public acceptance of new foods expanded to embrace many exotic fruits. Lychee, longan, carambola, passion fruit, mamey sapote and sapodilla emerged as new crops. From the 1980's until the present acreage of mango, lime and avocado have decreased due to urbanization, hurricanes, foreign imports and citrus canker. Markets of tropical fruits still present an opportunity for growers in South Florida. Several fruits are candidates for development. Promising candidates are dragon fruit (*Hylocerus* spp.), green sapote (*Pouteria viridis*) and Abiu (*Pouteria caimito*).

The story of <http://www.lycheesonline.com/> and what you can learn from our experience. William Mee, President of Lycheesonline.com, West Palm Beach, FL.

Lycheesonline.com began as a hobby and as a "crash test dummy" for Internet marketing and application development. It has since evolved into a full time enterprise. In this story we review specific issues and challenges to marketing and fulfillment of specialty and perishable agricultural and value added products via the Internet. Further, we provide a nuts and bolts "how to" guide on the "do's and don'ts" of developing and operating an Internet based business. Issues covered range from content development and search engine optimization to automation of the CRM "customer relationship management" process.

Prospective analysis of impact of area increment of pineapple crop in the Atlantic Region of Costa Rica. Ricardo O. Russo¹, Gabriela Zúñiga², and Pánfilo Tabora^{1, 1} EARTH University, Guácimo, Costa Rica² Ministry of Agriculture and Husbandry, Guápiles, Costa Rica.

Pineapple (*Ananas comosus* (L.) Merr), a non-traditional crop that has followed the banana marketing model has increased in area and production very significantly in the last 8 years. Its production is characterized by a diversity of systems and cultivation techniques, going from small scale production of rustic varieties (improved by small farmers), to intensively improved varieties production (Montelirio, Smooth Cayenne, Champaka and MD2). In 1973, the area cropped to pineapple was about 738 hectares. A decade

later roughly 2,500 ha (35% North Huetar Region, 35% Brunca Region and 22% Central Region). Recently, the pineapple area augmented from 13,500 ha in 2002 to 15,500 ha in 2003, and this year –2006- the total surface planted will reach 26,000 ha in all of Costa Rica with more than 9,000 ha in the Atlantic Region. The objective of this work was to do a prospective structural analysis of trends and the construction of scenarios of the impact that such expansion will cause in the region. Structural analysis has two complementary objectives. Firstly, it looks to achieve a representation as exhaustive as possible of the pineapple production system that allows, in a second phase, to reduce the complexity of the system to its essential variables. The main actors, and the endogenous and exogenous factors of pineapple expansion were identified. An incidence matrix between actors and factors were built, and from this incidence matrix, a cross-impact matrix of the key factors of pineapple production was mounted in order to identify foresight scenarios on the increase of pineapple area in the region.

Role of Risk Analysis in Reducing Risks Associated with the Importation of Fruits and Vegetables. F. Mehdizadegan, K.R. Lakin. USDA, Center for Plant Health Science and Technology, Plant Epidemiology and Risk Analysis Laboratory, Raleigh, NC.

Increase in international travel and trade has raised the risk of introduction of harmful exotic plant pests to the United States' plant resources and ecosystems. Florida's agriculture is particularly vulnerable as the requests for importation of fruits and vegetables into the United States increase, the volume of agricultural products arriving at its ports would correspondingly increase. To safeguard against the risk of introduction of exotic plant pests associated with the importation of plant and plant products, the Center for Plant Health Science and Technology's Plant Epidemiology and Risk Analysis Laboratory provides comprehensive risk analyses for plant commodities proposed for importation into the United States.

Through science-based risk analyses, the risk of introduction and establishment of exotic plant pests can be reduced by accurately analyzing offshore pests dynamics, identifying agro environmental pests of quarantine significance and determining the potential pathways through which they could enter into U S agricultural production systems. The risk analysis process estimates the risk level for quarantine pests and providing the opportunity to identify appropriate risk mitigation options.

Highly successful wedge grafting technique for rambutans, lychees, longans, mangosteens and other fruit trees. Panfilo Tabora, EARTH University, Costa Rica and Luis Atienza, Horticulture Technician, U. P. at Los Baños, Philippines.

The wedge grafting technique is described in detail for students, nursery growers and technologists. Formerly recognized as very difficult to do and with poor results (Morton, 1987 and Brunner, 2002), it has been yielding recently very high graft success beyond 95% in rambutans, lychees and longans, 100% in mangosteens and also very high in other fruit trees in Costa Rica.

Used at EARTH University as a technique for student practice, it has proven to have very high success even

with beginners. This technique which has been pioneered in the Philippines has proved to be a major boost for the rise of the rambutan production and exports in Central America and is on its way for applications in lychees, longans, avocados, mangos, mangosteens and others. It is now used in Honduras, Guatemala and Brazil for these crops.

The State of the Florida Tropical Fruit Industry and the challenges growers face.

Dewey Steel, President of Tropical Fruit Growers of South Florida (TFGSF).

The Tropical Fruit Growers of South Florida is a group of commercial growers who organized nearly 20 years ago to represent our industry. Chris Rollins, who is the current director of Miami Dade's Fruit & Spice Park, spearheaded the idea to form this organization. Chris saw that there were many growers who could benefit from a coalition that would become unified to support the tropical fruit industry. This group's mission would evolve into teaching member's how to be better growers through education, promoting the tropical fruit industry and working with Extension, TREC, and other governmental and private organizations to help our industry. We would also receive grants through the help of Tropical Fruit Advisory Council and further promote the industry with marketing initiatives.

Since then, we have accomplished much, but face many challenges. Our growers have suffered from offshore competition, hurricanes and loss of farmland due to increasing development pressure. We now are exploring options and looking for innovative ways to stay competitive and further enhance our ability to keep Florida tropical fruit farming viable.

Herbicide Efficacy to Control Parthenium (*Parthenium hysterophorus*) Under Grove Conditions in Homestead, Florida. Jonathan H. Crane and Robert Stubblefield, TREC UF/IAS, Homestead, FL.

Parthenium hysterophorus L. is in the Asteraceae and common names include parthenium, carrot weed, ragweed parthenium, and star weed. Indigenous to Mexico and Central and South America, parthenium is considered very invasive and is a major weed pest in India, Australia, Taiwan, Ethiopia, and parts of the U.S. In the U.S. parthenium is found in 23 states and in Florida parthenium is found in 22 of 67 counties. Parthenium invades agricultural areas, disturbed areas, range and grasslands, and urban areas and has become resistant to control with glyphosate. Four herbicides alone and in specific combinations [Finale (glyphosate-ammonium), Roundup-Ultramax [glyphosate N-(phosphonomethyl) glycine], Finale+Roundup-Ultramax, AIM (carfentrazone-ethyl), and MM01 (proprietary)] were tested in two field trials for their efficacy in controlling parthenium under south Florida grove conditions. Treatments were laid out in a completely randomized design with 3 to 5 plots per treatment. Parthenium plants were counted within a 20-inch square grid prior and post herbicide application in each trial. Data were analyzed as repeated measures analysis. In the first trial, parthenium control was significantly greater for Finale alone and Finale+Roundup-Ultramax

compared to water sprayed control, AIM+crop oil, MM01+Silwet, and Roundup-Ultramax alone. In the second trial, control of parthenium with Finale alone at the rate of 3 or 4 quarts/acre and Finale+Roundup-Ultramax at 2 rates was significantly better than water sprayed control. Finale alone effectively controlled parthenium under grove conditions in south Florida.

Horticultural Lessons within the William F. Whitman Tropical Fruit Pavilion. Richard J. Campbell, J. Valls and N. Ledesma, Fairchild Tropical Botanic Garden, Coral Gables, FL.

Nearly a century has past since Dr. David Fairchild first wrote about the immense potential in the Americas of exotic tropical fruit. He and fellow tropical fruit pioneer Wilson Popenoe were enchanted by the allure of exotic tropical fruit; they foretold of their emergence in the mainstream United States marketplace. Many of David Fairchild's early articles in the proceedings of the Florida State Horticultural Society told this story. Yet, the durian (*Durio zibethinus*), mangosteen (*Garcinia mangostana*), duku (*Lansium domesticum*) and tarap (*Artocarpus odoratissimus*) remain novelties to the United States consumer- a considerable distance from their predicted importance. The Whitman Tropical Fruit Pavilion at FTBG has the potential to help realize the century-old aspirations of David Fairchild, and to forge a new horticultural reality for exotic tropical fruit in the Americas. Three years into the Whitman Pavilion project we can report of early success with the mangosteens and their relatives. Five durian species and several selections of langat show considerable promise. Rambutan (*Nephelium lappaceum*) pulasan (*Nephelium ramboutan-ake*), and tarap have been disappointing. The use of clonal material has been important for early success with precocity and public show quality. The challenge remains pollination within the enclosed structure and successful horticultural management of difficult species.

Laboratory and field infestation studies on immature green 'Tommy Atkins' and 'Keitt' mangoes to determine host status to the Caribbean fruit fly (Diptera: Tephritidae). J. E. Peña¹, W. P. Gould², M. K. Hennessey³, G. J. Hallman⁴, and J. Crane¹; ¹TREC, UF/IFAS ²USDA-ARS-PPQ, Riverdale, MD; ³USDA-APHIS-PPQ-CPHST-PERAL, Raleigh, NC; ⁴USDA-ARS Kika de la Garza Subtropical Agricultural Research Center, Weslaco, TX.

This research was conducted to determine if the Caribbean fruit fly would infest green mangoes under laboratory conditions and naturally in the field. Field collected fruit covering the green mango harvest season were held for Caribbean fruit fly infestation. Fruit infestations were also done in the laboratory using laboratory flies. Fruit fly populations were presumed present in the fields in 1995 and 1996 and we recorded their presence in 2002 in mango and a nearby guava orchard. No larvae emerged from any of 2,598 green 'Tommy Atkins' mangoes collected in the field in 1995 and 1996, or 1,184 green 'Keitt' mangoes collected in 2002 in the field. No larvae emerged from 470 mangoes collected at packinghouses in Homestead, Florida, in 2002. Laboratory cage infestation data showed a very low (1.22 larvae per fruit in 1995, 0.01 larvae per fruit in 1996, 0.02 larvae per fruit in 2002) rate of larval emergence under very high fly population pressure and

compared to positive controls, indicating that the fruit is a very poor host. Because no larvae were found in any of the field collected samples in 1995, 1996, or 2002, and the laboratory cage infestation tests produced very low infestations, it was concluded that green 'Tommy Atkins' and 'Keitt' mangoes have a low likelihood of being a pathway of introduction for Caribbean fruit fly.

Chemical Control of Flowering Thrips on Tropical Fruit. J. E. Peña, R. E. Duncan and C. W. Meister. TREC UF/IFAS, Homestead, FL.

Flowering thrips, *Frankliniella bispinosa* and *F. kellyae* (Thysanoptera: Thripidae) are the most common thrips observed on bloom of mango, avocado, litchi, other tropical fruit trees, ornamentals and weeds during winter and spring in Florida. Infestations on tropical fruit blossom are usually the result of adult thrips dispersing, abruptly in very large numbers, from a range of weeds, grasses and other flowering plants. On tropical fruit, damage by these insects is caused by feeding on petals, pistils and by deposition of eggs in the fruitlets. Two experiments were conducted on mango and avocado during 2005 to determine efficacy of different pesticides (Acetamiprid, Fenpropatrin, Milbemectin and Zeta-cypermethrin) against these species. The relationship between thrips density and damage to avocado fruit was determined.

Low-chill peaches adapted to subtropical Florida and tropical Puerto Rico

R.E. Rouse, SWFREC, UF/IFAS, Immokalee, FL; Maria Del Carmen Libran, Evelio Hernandez, and Lilliam Cardona University of Puerto Rico at Mayaguez, Dept. of Horticulture Mayaguez, P.R.

Low-chill peach (*Prunus persica* L. Batsch) cultivars adapted for subtropical climates and tropical highlands have been developed by the University of Florida deciduous fruit breeding program. Cultivars requiring approximately 100 to 150 chill units have been evaluated in south Florida and Puerto Rico. Chilling has been accomplished in Florida by changing latitude and in Puerto Rico by changing altitude. Four cultivars (Flordaprince, TropicBeauty, Flordaglo, UFGold) have been evaluated in two localities of the central mountainous region of Puerto Rico. Parameters of tree growth, flowering time and formation, fruit development, and fruit quality have been evaluated. Preliminary results show trees fruit with commercial crops maturing in April and May with fruit 5 to 8 cm diameter weighing 80 to 130 gram during an optimum market window when there are no other peaches available. Three of the four low-chill peach cultivars are adapted to climatic conditions prevailing in the central mountainous region of Puerto Rico. The recommended cultivars are high quality and suitable for commercial, u-pick, and home planting.

Options for Subtropical Peach Production in Florida

J. J. Ferguson, J. X. Chaparro, D. M. O'Malley, Horticultural Sci. Dept., UF/IFAS and L. Harrison, FDOACS, Tallahassee.

During the 1990s new patterns for fresh fruit marketing emerged, with international industry groups, like those

of apple growers, shifting emphasis from commodity production to high value premium fruit marketing. Large supermarket chains have also consolidated purchasing power, thereby increasing control of fruit quality standards. Although new cultivars have posted profitable returns, oversupply has eventually depressed prices. In response “Club Marketing” has sought to control planting and marketing of new patented cultivars to maintain long term premium prices. Following this model, subtropical peach production could rapidly expand in Florida, providing a lucrative specialty crop following the example of low-chill Florida highbush blueberries bred for the early spring market window. Fresh packed, tree ripe fruit could be marketed as high value produce rather than as a broad seasonal commodity. Marketing options developed by the Vidalia onion industry and other profitable cooperatives could include exclusive licensing of patented cultivars to grower investors operating within a new generation cooperative model. This grower organization would own exclusive rights to UF patented subtropical peaches, operating as a production and marketing entity to control nursery production and orchard development, provide yield-based royalties to support research and extension programs, and ultimately to manage market supply for profitable grower investor returns.

Preliminary studies for controlling bacterial spot in low-chill peaches

T. Wert, E.P. Miller and J.G. Williamson Horticultural Sci. Dept., UF/IFAS;
R.E. Rouse SWREC UF/IFAS, Immokalee, FL.

Florida’s subtropical climate allows peach trees to retain their leaves for most of the year. Vegetative growth begins in late January or early February and trees can retain their leaves until December. Symptoms of bacterial spot (*Xanthomonas arboricola* pv. *pruni* (= *X. campestris* pv. *pruni*)) often occur on foliage and fruit in May. The disease persists and multiplies rapidly under warm weather, and complete defoliation can occur by October on susceptible cultivars. Copper based fungicides can be used during dormancy and early in the growing season. However, the risk of phytotoxicity from copper sprays increases as the season progresses. A spray program was developed during the summer of 2004 and repeated in the summer of 2005 in an attempt to control bacterial spot. Basic copper sulfate (Cuperofix Disperss®) at a rate of 23g/200gal H₂O applied at 400 gpa, was used in the experiment along with a non-ionic surfactant and a pH reducing agent. The spray program began in early June just prior to summer pruning and just after final fruit harvest as complete. Trees were sprayed on a three week schedule until early October. Preliminary observations indicate that the copper sprays delayed defoliation until mid-December compared to mid-November for the control trees during both years. This spray program may help alleviate the condition of “fall bloom” which can occur in some trees when they defoliate too early in the fall. Overall health and tree vigor may also be increased from additional photosynthesis occurring during late fall and early winter.

Changes in Tropical Fruit Production in Florida and Elsewhere through Time. Robert J. Knight, Jr. IFAS, TREC UF/IFAS, Homestead, FL.

The marketing picture for tropical fruit crops has changed through time thanks to economic and climatic

factors and to crop diseases and pests. As an example, 40 years ago mangos marketed in the U.S. were produced for the most part in Florida. This picture changed with increased entry of fruit from Haiti and Mexico, and later from producers in Central and South America. One consequence has been transformation of the mango from a fruit available in summer to one available for much of the year in metropolitan supermarkets. Production of limes, long important in south Florida, has recently been largely eliminated here by appearance of the bacterial citrus canker disease, and Mexico has become an important supplier. Hurricane Andrew severely affected avocado production in south Florida and subsequent real estate development removed much land from production, which moved to the Dominican Republic and elsewhere. Production of other tropical fruit crops also has changed, in some cases dramatically, in Florida and other parts of the world.

The Development of Microsatellite Markers for *Persea americana* (Avocado). James W. Borrone¹, Helen A. Violi², Randy Ploetz², Raymond J. Schnell¹ ¹ USDA-ARS, National Germplasm Repository, Subtropical Horticultural Research Station, Miami, FL. ² Dept. of Plant Pathology, TREC UF/IFAS Homestead, FL.

Because of their relative abundance, distribution across the genome, hypervariability and co-dominance, microsatellites, or simple sequence repeats are considered to be cost effective and efficient molecular genetic markers for parentage analysis, linkage mapping, association studies, and genetic fingerprinting of cultivars. Currently, there is a small set of microsatellite markers available for *Persea americana*. We are expanding the number of available microsatellite molecular markers by screening pre-existing avocado expressed sequence tag (EST) libraries. To date over 6183 sequences have been screened and 100 have been selected for marker development based upon the size, location, and type of microsatellite identified. The development of an additional 100 SSR markers, along with the currently available SSR markers, should provide suitable coverage of the avocado genome for association studies and linkage mapping. These are the first steps in devising a marker assisted selection program for avocado.

Development of Phytophthora Root Rot-Resistant Avocado Rootstocks for the Caribbean. Helen A. Violi², James W. Borrone¹, Randy Ploetz², Raymond J. Schnell¹, Cecile T. Olano¹ ¹ USDA-ARS, National Germplasm Repository, Subtropical Horticultural Research Station, Miami, FL. ² Dept. of Plant Pathology, TREC UF/IFAS, Homestead, FL.

Phytophthora root rot (PRR), caused by *Phytophthora cinnamomi*, poses the greatest limitation to avocado production worldwide. Through a collaborative effort between researchers at the USDA-ARS facility in Miami and the University of Florida, Phytophthora root rot (PRR)-resistant avocado rootstocks are being developed for the Caribbean. Avocado breeding presents several challenges. These include a long regeneration time and the low efficiency of controlled pollinations. This prevents the creation of recombinant inbred lines on which traditional breeding are based. To overcome these challenges we are: i) increasing the number of accessions from the Caribbean in breeding blocks; ii) screening large numbers of half-sib and full-sib seedling progeny in controlled

greenhouse and field trials; iii) genetically characterizing parents of PRR tolerant and susceptible progeny with molecular markers and iv) with the identified markers, developing marker assisted selection protocols for resistance.

Preparation for and Recovery from Hurricanes for Tropical Fruit Trees in the Home Landscape. Jonathan H. Crane, TREC UF/IFAS, Homestead, FL and Carlos F. Balerdi, Miami-Dade County Cooperative Extension Service, Homestead, FL.

There are hundreds of thousands of tropical and subtropical fruit trees planted in the home landscapes of south Florida. Many of these trees were quite old (>20 years old) and large prior to the recent multiple hurricanes experienced in south Florida during 2004 and 2005. However, many trees are less than 12 years old having been planted post hurricane Andrew (1992) and the citrus eradication program (1995). If possible, fruit trees planted in the home landscape should be placed away from other trees, buildings, structures, and power lines. Trees already established in the landscape should be pruned annually to open up the canopy to air movement and to control tree size and to minimize potential damage to the tree and nearby structures. The tropical/subtropical fruit tree recovery rate from the devastating effects of hurricanes and tropical storms is influenced by the severity of tree damage, wind intensity and direction of the storm, rainfall amounts and flooding duration (if that occurred), time of year of the storm and subsequent weather conditions following the storm. Depending upon the extent of storm damage (e.g., limb breakage, toppling) fruit trees should be pruned to remove dead or heavily damaged wood, facilitate resetting of toppled trees, or removed completely. After a storm, fertilizer and watering regimes may need to be modified to facilitate regrowth and recovery of damaged trees. Recommendations for specific fruit crops vary and will be discussed.

Anthracnose of Pitaya: A new disease on a new crop in South Florida

A.J. Palmateer and R.C. Ploetz. Dept. Plant Pathology, TREC, UF/IFAS.

Columnar, climbing cacti in the genera *Hylocereus* and *Selenicereus* produce fruit known variously as pitaya, pitahaya, dragonfruit or strawberry pear. *Hylocereus undatus*, a native of Mexico that produces red fruit, has recently become a commercial crop in South Florida. In December, 2004, a new disease was observed in a commercial planting in Miami-Dade County. Reddish-brown lesions with conspicuous chlorotic haloes developed on the ribs of vines, in particular where spines emerged from the rib edge. Eventually, lesions had white centers and coalesced to rot much of the vine column; in severe cases only the vascular column in the vine center remained unaffected. Salmon-colored spores and acervuli were observed in lesion centers. Disease samples were collected and tissue from lesion margins were surface disinfested and plated on one-half strength acidified potato dextrose agar. The fungus *Colletotrichum gloeosporioides* (Penz.) Penz. & Sacc was isolated from all symptomatic plant tissues. Fungal colonies produced abundant conidia in culture that were hyaline, straight, cylindrical, and averaged 14.7 µm (range 12.5 to 17.5 µm) by 5.0 µm (range 3.8 to 7.5 µm). Two isolates of *C. gloeosporioides* were shown in repeated experiments to cause the described disease. Koch's postulates were completed with the reisolation of the isolates that were used to inoculate plants. To our knowledge this disease had not been reported previously on this crop.

Phylogenetics Analysis of North American Native Cynthiana/Norton Grape Variety using DNA Microsatellite Markers. [Lelan Parker](#), Patricia Bordallo and Violeta Colova (Tsolova). Center for Viticulture Science & Small Fruit Research, CESTA, Florida A&M University, Tallahassee, FL.

Cynthiana/Norton is considered the best American native grape variety for fine wine with suspected to have tolerance to PD (Pierce's disease) and proven low susceptibility to foliar and fruit disease. The variety is being very successfully grown for commercial wine production for more than a century in the Eastern States and since a decade in Louisiana within PD zone as well. Most of the grapevine varieties in existence today are centuries old and are considered to have arisen by various means: domestication of wild vines, spontaneous crosses between wild vines and varieties and crosses between two or more varieties. Using the methods of molecular analysis the pedigree describing the genetic history of grape variety can be reconstructed. DNA-microsatellites have proved to be the markers of choice for this purpose since they are transmitted in a codominant Mendelian manner. It is assumed that Cynthiana/Norton is originated from *Vitis aestivalis*, Michaux. We are investigating the phylogenetics of Cynthiana/Norton grape via data mining in the North American grape germplasm collections, ampelographic analysis and specifically expressed in the variety microsatellite markers. We are using an already published set of 13 pairs of SSR primers designed for other *Vitis* sp. For purpose to develop more specific markers, Norton publicly available expressed sequence tags (ESTs) were used to screen for SSR. Two hundred two SSRs out of 2,101 ESTs were located and the promising SSR primers were synthesized for specific amplification in the targeted grape accessions. This study is designed to identify the pedigree and genetic make up of Cynthiana/Norton grape and to verify that this particular grape variety carry tolerance to Pierce's disease and is appropriate for high quality red wine production under Florida environmental conditions.

[\[1\]](#)

The banana sector in the Atlantic Huetar Region of Costa Rica. Ricardo O. Russo ,

[\[2\]](#)

EARTH University, Guácimo, Costa Rica and Eliécer Ureña , School of Agricultural Economics, University of Costa Rica.

The Atlantic Huetar Region (AHR) of Costa Rica, has been a source of wealth, and its population shows a wide cultural diversity. However, the indicators of poverty (underutilization of the labor force, income, and the relative increase of the informal economy), have shown a worrisome trend which could lead to stagnation of the social and economic development of the whole region. An analysis of some aspects of the banana sector of the AHR, carried out in 2004, which is part of a study on employment, income and welfare of the AHR population in the framework of the Multiphase Program for Sustainable Development of the AHR supported by the Inter-American Development Bank is presented in this paper.

From 53,000 ha in 1994, banana cultivated area has declined to current 42,000 ha, due to a concentration of the plantations in areas of greater performance, abandoning those of negligible potential by its soil

characteristics. However, an increase in productivity due to an increase in the performance average, and favourable climatic and market conditions has been observed (2,157 boxes ha⁻¹ in 2002, to 2.459 in 2003). Increases in crop area or employment are not expected unless a clearer situation in the international market conditions is defined, especially in the European Union. However, a fall in exports may cause serious regional economic problems.

Tropical Fruit Urban Forestry at Fairchild Tropical Botanic Garden. Richard J. Campbell, N. Ledesma and J. Valls, Fairchild Tropical Botanic Garden, Coral Gables, FL.

South Florida horticulture continues to evolve with changes in land usage due to urbanization, governmental regulation and the needs of the community. An urban forestry project was initiated in 2004 at FTBG in conjunction with the Whitman Tropical Fruit Pavilion. This project provides the home owner and estate gardener with examples of tropical fruit in the urban landscape. The formal landscape design has been important to the success of the project and is built around a central plaza with plantings of economically important (including fruit) crops radiating out of a central point. Carambola and guava have been a successful display element as a mirrored espalier planting to frame the plaza and demonstrate a novel method for estate gardening. The use of superior clonal material has been vital to the success of the project, allowing for precocious flowering and fruiting of a range of species. Furthermore, the use of dwarf clones and horticultural management to control size of sapodilla, jackfruit, mamey sapote and mangos have added considerable impact to the project. The project continues to evolve in both species selection and horticultural management; however, early response to the project shows considerable potential for public impact both in urban forestry and estate gardening.

Cut Your Costs and Sell More: How Tropical Horticulture Firms Can Penetrate New Export Markets. Stephen Colyer, Miami-Dade College, Miami, FL.

Florida tropical ornamental horticulture firms have a unique opportunity: to get state and federal funds to support international marketing efforts. This paper proposes that these firms create a marketing co-operative that would enable participants to benefit from (1) active, strategic, industry marketing support from the Florida Dept. of Agriculture and Consumer Services (DACs) and (2) marketing support from the US Dept. of Agriculture (USDA).

As the Florida tomato, citrus, and corn industries have found, Florida DACs can be a marvelous ally in supporting marketing efforts, increasing consumer awareness of Florida products, consumer interest in those products, helping build the platform for increased sales of Florida grown products. The support ranges from advertising, promotional support at the retail level, to specific promotions. For example, a US commodity, corn, was turned into a high-margin specialty item at retail in Britain. Florida DACs support ranges from marketing strategy development, marketing mix element definition, to developing and deploying the marketing campaign.

But Florida DOACS is not the only relevant player: the USDA's Foreign Agriculture Service has two programs, the "Generic Program," and the MAP-Branded, which can be used to support marketing efforts. The Generic Program allows participants to be part of trade shows and trade missions at reduced or nominal cost. The MAP-Branded program allows participants to defray 50% of qualified marketing expenses. Were Florida ornamental horticulture providers to band together in a marketing cooperative, it would enable participants to access these resources that are impossible to access individually or hard to work on a firm-by-firm basis.

The Link between Xylem Sap Composition and Pierce's Disease among Grape Cultivars. Brown, Bravo G.^{1*} and Sheikh M. Basha², Center for Viticulture and Small Fruits, Florida Agricultural & Mechanical University, Tallahassee, FL.

Bunch grapes (*Vinifera* spp.) cannot be grown successfully in the southeastern United States due to their high susceptibility to Pierce's Disease which is endemic to the region. However the native muscadines are more tolerant to the disease. This could be due to the presence of substances present in xylem sap that may cause the disease. The nutrition of the xylem sap is critical for the survival of the bacteria (*Xylella fastidiosa*) that caused the disease. It is therefore very important that we evaluate the biochemical composition which includes amino acid, soluble sugars and protein present in the sap. In addition the conductivity and pH of the xylem sap was also analyzed. The objective of this study was to determine differences in xylem sap composition among the Muscadines, Florida bunch hybrids and California bunch grape cultivars. For this purpose xylem sap was collected from each cultivar during different seasons and developmental periods and subjected to biochemical analysis. The pH of the California bunch and Florida hybrids was found to be higher (pH 6.14, 5.95) than that of the muscadine genotypes (pH 5.78). The xylem sap conductivity varied between (4000 to 12000 microhm/ cm³) among the grape genotypes tested. The free amino acids content of the bunch grape genotypes was relatively higher (.035mg/ml) than the muscadine (.016mg/ml) genotypes. However, soluble sugars levels appear to be similar (.021 to .019mg/ml) among the genotypes. Differences in polypeptide composition among the genotypes are being determined using SDS gel electrophoresis and will be discussed.

JABOTICABA (*MYRCIARIA CAULIFLORA* BERG.) - A DELICIOUS FRUIT WITH AN EXCELLENT MARKET POTENTIAL. ¹A.R. Rafie and Carlos Balerdi, Miami Dade County Extension, Homestead, FL and Jonathan Crane, TREC UF/IFAS, Homestead, FL.

The Jaboticaba is a delicious fruit from Brazil, Bolivia, Paraguay and Argentina. It is highly esteemed and is commercially cultivated in large quantities in Brazil. Several factors favor its potential in South Florida. Jaboticabas are well adapted to the humid subtropical climate of South Florida. In recent years a large Brazilian population has settled in South Florida. Brazilians are very familiar with the fruit and have a high esteem for it, thus providing the initial clientele needed for its commercial production. The main drawback for

its commercial production is that trees grow at a very slow rate and it may take 5 to 7 years to begin production. Other drawbacks are the difficulty in propagation and lack of named cultivars. At present, most jaboticabas are grown from seeds, so trees offered by nurseries are mostly seedlings which will exhibit a large amount of variability in horticultural and organoleptic qualities. Picking is tedious as fruits are small and must be picked individually and shelf life is limited. Fruits do not appear to be susceptible to diseases or to the Caribbean fruit fly. This paper covers the potential market for this under exploited fruit.

Ornamental, Garden and Landscape Section

Charlotte County "A Tree-Mendous Giveaway" Program. R. E. Mitchell, Charlotte County Cooperative Extension Service, UF/IFAS.

In September 2005 the Charlotte County Extension Service was awarded a grant of \$120,348.00 from the Florida Dept. of Agriculture and Consumer Services (FDACS) through their Urban Forestry Grant. The two-year grant, entitled A Tree-Mendous Giveaway, will help to replenish our Urban Forest, which experienced significant losses during the 2004 and 2005 hurricane seasons. Trees are essential to energy conservation, stormwater runoff reduction, beautification, safety and comfort. Up to 6,500 Charlotte County residences are eligible to receive two free trees. Participants receive the trees of their choice in exchange for less than an hour of their time, during which they will learn about proper planting and aftercare of their two trees.

How Does Irrigation Frequency and Volume Affect Establishment and Growth of Three Common Ornamental Shrubs in Landscapes? E. F. Gilman, M. P. Paz, Environ. Hort. Dept., UF/IFAS, K.A. Moore, Ft. Lauderdale REC, UF/IFAS, S.M. Scheiber, MFREC, UF/IFAS and S. Vyapari, GCREC, UF/IFAS.

Landscape water consumption has become a prime target for water conservation and regulation. Imposing water restrictions during landscape establishment is detrimental to plants that have not developed sufficient root systems to compensate for transpirational water losses. Generally, municipalities regulate irrigation frequency but not application rate. Application frequency affects establishment rates of shade trees, but effects on shrub establishment are not well documented. Three irrigation volumes (3, 6, or 9 L), two irrigation frequencies (every 2 or 4 days) and two planting dates (May 2004 and November 2004) were tested on *Viburnum odoratissimum*, *Ilex cornuta* 'Burfordii Nana', and *Pittosporum tobira*, 'Variegata' to study their impact on shrub establishment and growth. Data collected included plant quality ratings, growth indices and root to shoot ratio. Irrigation for each plot was discontinued 11 weeks after planting (WAP) and harvested 64 WAP. Irrigation volume, irrigation frequency, and planting date had no effect on shrub plant quality, growth index or root to shoot ratio.

Flowering Days: A Guide to Species Selection and Promotion of Ornamental Flowering Trees. Stephen H. Brown, Lee Cooperative Extension Service, UF/IFAS.

Currently, the time of year and bloom duration of ornamental flowering trees is vague. An accurate forecasting of the start and completion of bloom periods of ornamental flowering trees will allow, nurseries, landscape designers, and gardeners to make better growing, purchasing, placement and promotional decisions. This can be done by a new concept known as 'Flowering Days'. Flowering Days is defined as the average numbers of days a species is in bloom that are equal to or greater than 50 percent of its maximum blooming potential. The flowering days of a species is determined by the average flowering days of at least three individuals in that species over three consecutive years. In a single season, the flowering days of three trees each of *Tabebuia aurea*, *T. impetiginosa*, *T. ochracea*, and *Ceiba speciosa* were determined. Their flowering days were 16, 21, 11 and 30 days, respectively. Of the *Tabebuias*, the flowering days of *T. ochracea* were most synchronized, beginning on the same day and ending one day apart. *T. impetiginosa* flowering days were the least synchronized beginning and ending 36 and 24 days apart, respectively. The start of *C. speciosa* flowering days were separated by 22 days and ended 25 days apart. Over three seasons, the flowering days for a single tree of *C. speciosa* lasted 32 days.

Amazing New Shrubs for the Florida Landscape. Robert E. Bowden, Harry P. Leu Gardens, Orlando

Harry P. Leu Gardens is operated by the City of Orlando, and one of its primary goals is to test plants from both temperate and tropical locations from throughout the world for heat and cold tolerance. With a collection of more than 8500 different plants to maintain and evaluate, the staff tests tropical plants for cold hardiness in Orlando's sometime frigid winters (sometimes reaching temperatures as low as 17° F). Likewise, staff considers plants from temperate areas to determine their hardiness in hot and humid conditions common to Central and South Florida. Many shrubs previously thought to have either cold or heat sensitivity have been assessed at Leu Gardens over the last decade and many of the successful candidates will be discussed in this presentation.

Efficacy of Fungicides for Control of a Difficult Fungus *Erysiphe cichoracearum* Powdery Mildew on Gerbera Daisy, *Gerbera jamesonii*.

Robert T. McMillan, Jr., James Steele, Kerry's Bromeliad Nursery, Inc., Homestead; and Wagner A. Vendrame, TREC, UF/IFAS.

Powdery mildew, caused by the fungus *Erysiphe cichoracearum* is a serious disease of Gerbera Daisy, *Gerbera jamesonii*. In 2005-06, five products including conventional, reduced risk biological fungicide, were trialed for efficacy against *Erysiphe cichoracearum* in a polyhouse at Kerry's Bromeliad Nursery, Inc. The Gerbera plants were started from tissue cultured liners potted in four-inch, six-inch, and eight-inch

plastic pots. Trial plants of six susceptible cultivars were potted and placed in ebb and flood trays with 384 four-inch, 160 six-inch, and 80 eight-inch pots per tray. Natural infection was allowed to take place prior to the first application of the chemicals. Fungicides were applied on a 7 to 21 day schedule or on a closer interval depending on disease severity and replicated 4 times per treatment. Compass (trifloxystrobin) at 1 oz per 100 gallon of water and Systhane (myclobutanil) at 2 oz per 100 gallon of water were significantly more effective in the control of powdery mildew than copper at 1.5 lb per 100 gallon of water and milk 16 fl oz per 100 gallon of water.

Survey for Cymbidium mosaic and Odontoglossum ring spot viruses in domestic and international orchids. R. T. McMillan, Jr. Kerry's Bromeliad Nursery, Inc., Homestead; A. Palmateer and W. A. Vendrame, TREC, UF/IFAS.

Virus diseases of orchids came into prominence in the early 1960s. The three most prominent viruses found in orchids are Cymbidium mosaic potexvirus (CMV), Odontoglossum ringspot tobamovirus (ORV), and Tobacco mosaic tobamovirus (TMV). The percentage of orchids infected by these viruses is significant and will continue to increase until commercial clone laboratories, commercial growers, and hobbyist collectors take the necessary means to control and stop the spread of them. Plants from the commercial clone laboratories are showing a high percentage of clone plants infected with these three viruses. This is an indication that the stock plants from these laboratories were not checked for viruses or were brought into the laboratories as contaminants. Commercial nurseries and clone laboratories country of origin that have been surveyed to date are Brazil, Colombia, Thailand, Taiwan, United States, and Venezuela. Leaf samples were taken from liners, single and multiple flowering plants, and sent to Agdia Laboratory (Elkhart, IN). A complete virus scan was run on all leaf samples. Results indicate that CMV, ORV, and TMV are a serious problem in orchids since a high percentage of the samples was found to be infected with all three viruses.

Dynamics of Powdery Mildew in a Homogenous Urban Sand Live Oak Forest. Robert J. Northrop, Hillsborough County Cooperative Extension Service, UF/IFAS.

Powdery mildew fungi are a family of obligate parasites of horticultural plants, agricultural crops, and trees. These fungi may retard the growth of young plants and may kill tree seedlings (Chevalier and Frochot, 1997). While the evidence is inconclusive, recurring attacks of powdery mildew, in combination with other pathogens or herbivory by mammals and insects are thought to even cause older trees to die. A recent outbreak of the disease associated with sand live oak (*Quercus geminata*) is the focus of an ongoing investigation in the Tampa Bay region. A review of the literature suggests that this occurrence is unprecedented in its intensity and geographic extent. It is suspect in the loss of mature trees within the region, and demonstrates how the lack of urban forest diversity can lead to uncommon disease and insect infestation patterns, and mature tree mortality.

Ramorum Blight and Sudden Oak Death Research Review and Florida Nursery Cases. P.F. Harmon, Dept. Plant Pathology, UF/IFAS and C.L. Harmon, Southern Plant Diagnostic Network and Dept. Plant Pathology, UF/IFAS.

Ramorum blight and sudden oak death are diseases caused by *Phytophthora ramorum* on woody ornamentals and some oak tree species. Although the pathogen has been introduced into Florida on nursery stock, *P. ramorum* is not endemic in the state and is regulated, so research options in Florida are limited. The pathogen was recovered by the Florida Division of Plant Industry from camellia plants in 6 nurseries sampled in 2004. The pathogen again was recovered on camellia plants in nurseries in 2006. Published results of research projects conducted in the western United States and Europe concerning survival, spread, pathogenicity, and containment of *P. ramorum* will be summarized and discussed. Potential implications of these results for ornamental nurseries, landscapes, and the Florida environ will help to direct future *P. ramorum* research.

Using Best Management Practices (BMPs) to Stay in Business – A Political Primer. Erica Marie Santella, TruGreen, Orlando.

Although new to the Green Industries, BMPs are an established concept for Florida agricultural industries, including citrus, cow/calf, and silviculture. The overall goal of any BMP is to provide guidelines to conserve and protect Florida's water. The expectation of the industry was less need for local fertilizer ordinances, which are becoming more common. All stakeholders had be part of the process for the BMP document to be accepted and useful. Total Maximum Daily Loads (TMDLs), are being set for each level of impairment, and the first one reviewed for turfgrass was phosphorus. From that, grew the BMPs for Green Industries'. Groups that participated in the writing included: Dept. of Agriculture, Dept. of Environmental Protection, several water management districts, University of Florida IFAS, Dept. of Community Affairs, and industry. The first publication of this living document was both time consuming and expanded the point of views of all participants. Not only was new information shared and accepted but the group eventually came to agreements or compromises on all parts of the manual. There are several important groups that now need to be educated: the industry itself, the clients who use landscaping services (including property managers), city and county governments, and the general public, The most difficult support to gain has been local governments. Too often, personal appearances before local boards is required to get acceptance of the State Green Industries' Best Management Practices.

What is the Role of Nearshore Nutrient Sources on the Florida Red Tide, *Karenia brevis*? M. B. Neely and Cindy Heil, Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission, St. Petersburg.

Southwest Florida experiences annual coastal blooms of the toxic marine dinoflagellate *Karenia brevis*. Although these red tide blooms predate Florida's settlement, there is increasing public concern as to the effects of coastal development and associated coastal nutrient eutrophication on these blooms. *Karenia brevis* is a photoautotroph, with an absolute requirement for nitrogen (N), phosphorus (P), a variety of trace metals and the vitamins B12, thiamin and biotin. Although current research has shown that *K. brevis* is capable of subsisting on both inorganic (NO_{3+2} , NO_2 , NH_4 , PO_4) and organic (dissolved organic nitrogen and phosphorus, urea) nutrient forms, its slow growth rate (0.3 divisions day^{-1}) suggests that it is not an especially good competitor for inorganic nutrient sources in coastal waters and that organic nutrients are essential for bloom maintenance. Based on over 50 years of red tide research, nearshore nutrient sources are only one of many nutrient sources required to support red tides, and by themselves, only supply sufficient nitrogen and phosphorus to support small to medium sized red tides.

Shade Tolerance of St. Augustinegrass (*Stenotaphrum secundatum* [Walt.] Kuntze.) Cultivars. S. F. Anderson and L.E. Trenholm, Environ. Hort. Dept, UF/IFAS.

The objectives of this research were to rank the relative shade tolerance of some new St. Augustinegrass cultivars and to determine what shade levels the cultivars can tolerate. Two consecutive studies were conducted in a glasshouse at the University of Florida Turfgrass Research Envirotron. Cultivars tested were 'Amerishade', 'Delmar', 'Deltashade', 'Floratam', and 'Palmetto'. Grasses were grown in 6 in. pots in full sun or under shade structures that provided 30, 50, or 70% shade. Pots were maintained at the recommended mowing height for each cultivar and fertilized according to IFAS recommendations. Irrigation was provided as needed. Data collected included visual measurements of turfgrass quality, color and density, leaf length and width, and dry matter yield. Spectral reflectance measurements monitored light assimilation. In Trial 1, Amerishade generally obtained highest quality, color, and density ratings in full sun and at all shade levels, followed by Delmar. Floratam ratings were consistently among the lowest. All cultivars maintained good visual scores with 30% shade; Amerishade and Delmar maintained good quality with up to 50% shade. In Trial 2, Amerishade again ranked highest for visual ratings at all shade levels, while Palmetto ranked either as good or just below Amerishade. Floratam again was consistently lowest. Amerishade and Palmetto maintained good visual scores with up to 50% shade. In both trials, Deltashade ranked higher than Floratam but was not in the top rankings.

An IPM Approach to Mole Cricket Control on Athletic Fields. Fred J. Santana, Sarasota County Cooperative Extension Service, UF/IFAS.

The need for an IPM approach to control mole crickets on Sarasota County ballfields became apparent in the 1990s. Control had become entirely scheduled with blanket application of chemical sprays and baits. An IPM program of regular soap flush monitoring was initiated to determine the presence of mole crickets. The tawny mole cricket, *Scapteriscus vicinus*, was the most common mole cricket detected. Liquid formulations of an

insecticide were applied to the soil to control the occurrence of young mole crickets nymphs during April, May, and June. Smaller nymphs are easier to control early in the summer. Effective control of nymphs in early summer was often enough to suppress their occurrence for the rest of the summer and fall. As a supplement to the program, biological control with entomopathogenic nematodes was initiated on several fields.

Steinernema scapterisci, which only infects *Scapteriscus* species of mole crickets was purchased commercially (Nematac S) and applied with a boom sprayer. This attempt to establish the nematodes was unsuccessful due to a lack of necessary irrigation following application of the nematodes. To enhance the biological control effort, a solitary wasp named *Larra bicolor* or the Larra wasp was obtained from the University of Florida and released at a ballfield complex. This wasp only attacks mole crickets, which it stings, paralyzes and lays an egg on. Prior to the release, the preferred nectar host plant, *Spermacose verticillata* was also obtained and planted. The wasp has successfully established and is a regular visitor to the plants.

The Host Plant Range of the Lobate Lac Scale, *Paratachardina lobata* (Hemiptera: Coccoidea: Kerriidae) in Florida. Forrest W. Howard, Bryan Steinberg, Ft. Lauderdale REC, UF/IFAS; Robert Pemberton, USDA-ARS, Invasive Plant Lab., Ft. Lauderdale; Gregory Hodges, FDACS, DPI and David McLean, Nova Southeastern Univ., Ft. Lauderdale.

A list of 315 host plant species of lobate lac scale *Paratachardina lobata* (Chamberlin) (Hemiptera: Sternorrhyncha: Coccoidea: Kerriidae) is presented. Host records were generated by examination of plants during 2002 to 2006 for the presence of this scale insect in nurseries, urban landscapes, and natural areas in southern Florida. Plants were considered hosts if the presence of one or more mature females indicated that the insect developed on the plant. On any given site, infestation levels tended to be related to plant species, but relative susceptibility was not evaluated due to the variation in plant size, age, growing conditions, etc., and also because the history of infestation of individual sites was unknown. Nevertheless, several plant species are recognized as highly susceptible based on consistently high infestations at multiple sites, while certain other plant taxa that were abundantly represented in the infested areas were consistently free of lobate lac scales. Additional observations of host plant relationships of this scale insect are discussed.

Methiocarb and Acetamiprid for Control of Silverleaf Whitefly on Ornamentals. J.F. Price and C.A. Nagle, GCREC UF/IFAS.

Bemisia argentifolii, silverleaf whitefly, has been an important pest of ornamentals production and maintenance in Florida for much of the past two decades. Naturally occurring predators, pathogens and parasitoids maintain populations at acceptable levels on many host plants in the landscape and even in some production environments. However circumstances occur in the landscape and more often in production that necessitate chemical control of the pest. One experiment was performed on hibiscus and one on lantana to evaluate acetamiprid alone and in combination with methiocarb for control of silverleaf whitefly. Responses of egg, nymphs and pupae to chemical treatments and an untreated check were recorded. Acetamiprid alone

performed well and the addition of methiocarb enhanced efficacy nominally.

New Caladium, Gerbera, and Lisianthus Cultivars for Florida. Zhanao Deng and Brent Harbaugh, GCREC UF/IFAS.

The ornamental plant breeding program at the Gulf Coast Research and Education Center has focused on developing new cultivars with improved disease resistance or stress tolerance that can perform well in Florida's climate. This effort resulted in the release of three new caladium, four gerbera, and thirteen lisianthus cultivars in 2005. 'Garden White' and 'Dynamite Red' caladiums are very vigorous and can tolerate full sun conditions. 'Summer Rose' caladium is similar in appearance to 'Rosebud' but produces more tubers. All four of the gerbera cultivars perform well in the landscape with a continuous production of flowers for many months. 'UF Multi-flora Peach' and 'UF Multi-flora Pink Frost' gerberas have small flowers, but plants display multiple flowers and buds resulting in plants with as much color as plants with large flowers. Two gerbera cultivars have excellent powdery mildew resistance. The UF Savanna series of lisianthus cultivars has eight colors, is heat-tolerant, and intermediate in height compared to the Maurine and Florida Series making them ideal for the 6-inch flowering pot plant market. 'UF Savanna Blue Frost' and 'UF Savanna Pink Frost' are the first pot type lisianthus with these vivid bi-colored flowers. The UF Double Joy series has five colors and double flowers (10 or more petals compared to five petals in single flowers). These are the first double-flowering and heat-tolerant varieties suitable for production as flowering potted plants.

Jogger Stoppers – Colorful and Tough Perennials for Florida. Robert E. Bowden, Harry P. Leu Gardens, Orlando.

Harry P. Leu Gardens is a botanical garden operated by the City of Orlando, and one of its primary goals is to test plants from both temperate and tropical locations from throughout the world for heat and cold tolerance. With a collection of more than 8500 different plants to maintain and evaluate, the staff tests tropical plants for cold hardiness in Orlando's sometime frigid winters (sometimes reaching temperatures as low as 17° F). Likewise, staff considers plants from temperate areas to determine their hardiness in hot and humid conditions common to Central and South Florida. Many perennials previously thought to have either cold or heat sensitivity have been assessed at Leu Gardens over the last decade and many of the successful candidates will be discussed in this presentation.

Fort Lauderdale Trial Garden – Year 4 (2005-2006). Kimberly K. Moore and Luci Fisher, Ft. Lauderdale REC, UF/IFAS.

Rooted cuttings of vegetatively propagated annuals from Danziger were planted on September 9, 2005) while rooted geranium cuttings from Fischer were planted on December 1, 2005. All cultivars were planted with 3 groups of 6 plants that were randomly placed in the garden. Plants were watered 3 times a week for 30

minutes using overhead irrigation. Monthly evaluations were conducted to measure and record plant height and width (size), flower number, and quality rating. Quality was rated on a scale of 1 to 5 with 5 = excellent and 1 = poor. One consumer preference survey was conducted in March. Quality and consumer preference results will be presented.

Citrus Greening: Implications for the Ornamental and Landscape Industries. C. L. Harmon, Southern Plant Diagnostic Network and Dept. Plant Path., UF/IFAS, and P.F. Harmon, Dept. Plant Path., UF/IFAS.

Candidatus *Liberibacter asiaticus*, the bacterial causal agent of citrus greening disease, is vectored by the Asian citrus psyllid and movement of infected plants. The disease causes poor fruit set and taste, fruits that won't ripen, dieback, and eventually can kill citrus trees. Symptoms may take up to 3 years to develop, increasing the chance of purchasing and shipping infected plants. Due to the transition from the citrus canker eradication program, planting of citrus species is being allowed in areas that may be positive for citrus greening finds. Education, production of citrus under screen and an insect management program, purchasing certified plants, and eventually, development of resistant cultivars, will protect the Florida citrus industry and decrease the risks to residential and commercial properties statewide.

Update and Management of the Asian Citrus Psyllid, *Diaphorina citri* (Homoptera: Psyllidae) on Orange Jasmine. C. M. Mannion and J. E. Pena, TREC UF/IFAS.

The Asian citrus psyllid, *Diaphorina citri* is a pest of citrus and close relatives of citrus. This psyllid is an efficient vector of the bacterium that causes citrus greening. Orange jasmine, *Murraya paniculata*, is a common landscape and production plant in south and central Florida and is a host of the psyllid. High populations of the psyllid can be found on orange jasmine in the south Florida landscape. There has been increased interest in management of this pest with the recent confirmation of citrus greening in Florida. Currently there is a compliance agreement for growers shipping orange jasmine from infested areas. Studies were conducted to determine the efficacy of pesticides on psyllid populations on orange jasmine. Issues on the status, population levels, and natural enemy complexes on orange jasmine will be discussed.

Biological Control Agents of the Cycad Aulacaspis Scale, *Aulacaspis yasumatsui*. Ronald D. Cave, IRREC UF/IFAS.

Biological control is viewed as the key element in any management program to control the cycad aulacaspis scale (CAS), *Aulacaspis yasumatsui*. However, the list of natural enemies that utilize the scale as a nutritional resource is incomplete, and those that are known need more investigation. Sixteen species of ladybird beetles (Coccinellidae) have been observed on scale-infested cycads in Florida. *Chilocorus cacti* and *Cryptolaemus montrouzieri* are the most frequently encountered, but do not suppress scale

populations. *Rhyzobius lophanthae* is a voracious predator that has been reported to adequately control CAS in Hawaii; in Florida it has only been seen in the Tampa and Tallahassee areas. The tiny predator *Cybocephalus nipponicus* is widespread on cycads throughout south Florida. Only two parasitic wasps are known to attack the cycad aulacaspis scale. *Coccobius fulvus* attacks female scales and occurs widely throughout south Florida. Rates of parasitism vary considerably but overall parasitism is about 40%. *Arrhenophagus chionaspidis* causes over 70% mortality of male scales in Asia, but has not been observed parasitizing CAS in Florida although it is known to occur in the state. Exploration for additional parasitoids of CAS is pending. Laboratory studies have shown that five species of commercially available entomopathogenic nematodes can kill female scales. Entomopathogenic fungi such as *Aschersonia* require research.

Hand Pollination and Seed Propagation of *Philodendron selloum*. L. M. Miller, Hillsborough County Extension Service, UF/IFAS and R. D. Newton, Suncoast Plant Nursery, Plant City.

Philodendron selloum is a large-leaved self-heading philodendron that is an economically important nursery crop in Central Florida. It is a popular landscape plant across USDA hardiness zones 8B through 11. Highly valued for its dramatic tropical appearance, *P. selloum* is also used in interiors and protected areas outside its hardiness range. It tolerates a wide variety of environmental conditions from low to high light and moisture levels and has relatively few pest problems. In its native Brazil, *P. selloum* is pollinated by a single species of large scarabaeid beetle. Because this beetle is not present in the United States, and the female flowers on a inflorescence are receptive 48 hours before the male flowers produce pollen, hand pollination is necessary. Due to the effort required to produce them, seed can be difficult to obtain and expensive, ranging from \$5.00 to \$10.00 per thousand in cost. This presentation documents the pollination process and describes seed collection, cleaning and storage methods for *Philodendron selloum*.

Preliminary Comparison of Effects of White and Black Shade Cloth and Ground Covers on Three Cut Foliage Crops. Robert H. Stamps and Cindy C. Boone, MFREC, Apopka, UF/IFAS.

Florida is the predominant state producing florists' greens in the United States. The majority of that production occurs under shade, especially under artificial shade provided using shade cloth. Black shade cloth is the common color used in the industry but other colors have become available. The purpose of this preliminary shadehouse experiment was to compare the growth and vase life of three cut foliage crops under white and black shade cloth. In addition, the effects of white and black groundcovers were evaluated. For ruscus (*Ruscus hypophyllum*) and umbrella plant (*Cyperus alternifolius*), stems produced under the white shade cloth or on the black groundcover were heavier than stems produced using the other color treatment. Neither shade cloth nor groundcover color affected stem weights of ming "fern" (*Asparagus retrofractus*). There were no interactions between shade cloth and groundcover treatments. Although not readily apparent visually, a* values (a measure of greenness) for ruscus cladophylls were affected by shade cloth treatments.

Stem case lives were not affected by treatments and averaged 141, 44 and 9.3 days, respectively, for ruscus, umbrella plant and ming "fern". Air temperatures, and ruscus leaf temperatures, stem water potentials and stomatal conductances measured in the morning and afternoon were not affected by treatments.

Effect of Benzyladenine on Branch Induction in *Magnolia grandiflora* 'D.D. Blanchard'. J. Popenoe, Lake County Cooperative Extension Service, UF/IFAS.

Magnolia grandiflora 'D.D. Blanchard' trees have several growth flushes during the year. However, the buds that break are not always evenly spaced around the tree as required for top grades and standards. A series of experiments were conducted to test the effectiveness of 6-benzyladenine (MaxCel plant growth regulator solution from Valent BioSciences Corp.) in promoting bud break. In August 2004, just before the late summer growth flush, benzyladenine was applied to three-year-old trees as a spray directed at the main trunk at 0, 100, 1000, and 5000 ppm applied once, twice or three times weekly. Treatments were applied to five trees along the row (not randomized) and branches from the main trunk greater than 5 cm counted before and 6 months after treatment. Trees receiving 5000 ppm three times had more new main branches than other treatments. In March 2005, benzyladenine at 0, 2500, 5000 and 7500 ppm was applied as a spray directed at the main trunk three times weekly to five-year-old trees in a randomized block design with 4 blocks and 5 trees per block. No treatment increased main branch numbers. In August 2005, benzyladenine at 0, 2500, 5000 and 7500 ppm was applied three times weekly as a spray directed at the main trunk of young trees, an average 1.9 cm caliper and 32 cm tall, in a randomized block design with 4 blocks and 5 trees per block. Results of these and other trials and possible implications will be discussed.

Evaluation of Growth and Marketable Quality of Herbaceous Perennials Treated with the Growth Retardant, Ethephon. Sudeep Vyapari and Robert J. Graves, MFREC, Plant City, UF/IFAS.

To evaluate response of herbaceous perennials to ethephon and to assess marketable quality, containerized plants of Irish Moss, Scotch Moss, and Salvia were treated once with FLOREL[®] (ethephon) at 0, 250, 500, or 750 ppm, two weeks after transplanting into 0.7 g containers. Standard nursery practices of fertigation, pest control, and weed management were followed during six weeks of production period. Data were collected on growth indices and marketable quality ratings (scale of 1 -5) every two weeks. The experimental design was a completely randomized and data analyses were made using the analysis of variance with SAS general linear model procedure. At 750 ppm concentration the mean growth indices were low whereas, control (0 ppm) produced the highest mean growth indices. Significant differences in marketable quality ratings were observed among the four treatments. Plants not treated with FLOREL[®] had the best mean marketable rating (4.3) as compared with 500 ppm (3.6) or 750 ppm (3.5) concentrations. Irish moss had significantly higher mean quality rating (4.4) compared with either Salvia (3.7) or Scotch Moss (3.3) when no growth retardants were used.

Student Perceptions on Course Delivery Methods. Kimberly K. Moore and George E. Fitzpatrick, Ft. Lauderdale REC, UF/IFAS.

Instructors at the off-campus teaching programs at the University of Florida deliver course work towards Bachelor of Science degrees using a variety of distance education (DE) technologies in addition to on-site instruction. These DE technologies include interactive video conferencing, videotape, and web-based courses. The question often arises as to how many courses should be delivered using DE versus live on-site instruction. Another question arises as to how best utilize the time of on-site instructors through the use of team-taught courses. Two surveys were conducted to ascertain how students perceive the quality of education they are receiving using a mixture of delivery methods.

Vegetable Section

Soil Moisture in the Potato Root Zone under Seepage Irrigation. Fernando Muñoz-Arboleda and Chad M. Hutchinson, Horticultural Sci. Dept., FAS REC UF/IFAS, Hastings, FL.

Seepage irrigation is a common practice for potato production in Florida. Under this type of irrigation system a perched water table is maintained about 20 inches deep from the top of the row during irrigation events regardless the physiological stage of the potato crop. Over-saturation in the root zone is a factor producing internal problems such as brown center and hollow heart. The potato crop evapotranspiration increases from planting to full flowering and decreases from full flowering to harvest making the water demand a variable factor throughout the potato cycle. A study to describe the soil moisture profile as affected by irrigation events with a fixed water table all over the potato cycle was planned. Observation wells were installed to monitoring the water table depth under potato var. Atlantic. Access tubes for a profile probe to measure soil moisture at six different depths from the top of the potato row were installed by the side of each well. Linear regression between water table depth and soil moisture at the six different depths as independent and dependent variables respectively was performed. From the analysis was possible to conclude that a variable water table depth depending on the potato physiological stage should be necessary to ensure optimal soil moisture in the potato root system in order to minimize internal problems affecting tuber quality.

Influence of Drip Irrigation and Nitrogen Rates on Strawberry Cultivars. Bielinski M. Santos¹, Eric H. Simonne², John R. Duval¹, Elizabeth A. Golden¹, and Alicia J. Whidden³; ¹GCREC IFAS, Wimauma, FL. ²Horticultural Sci. Dept., UF/IFAS, Gainesville, FL. ³Hillsborough County Extension Service, Seffner, FL.

Current recommendations for nitrogen (N) fertilization and drip irrigation greatly differ from those used by most strawberry growers. Three field trials were established during winter 2003, 2004 and 2005 to determine the

effect of different drip irrigation and N rates on three strawberry varieties. In all seasons, drip irrigation rates were 60, 80, 100, and 120 gal/100 ft/week, and strawberry varieties were 'Strawberry Festival', 'Ventana', and 'Winter Dawn'. During 2003 and 2004, N rates were 0.36, 0.48, and 0.60 lb/acre/day, whereas 0.36, 0.60, and 0.84 lb/acre/day were used in 2005. There were significant early and total yield differences among all three cultivars. However, there were no significant drip irrigation or N rate effects within each strawberry variety.

Effects of Nitrogen Rates on Summer Squash (*Cucurbita pepo*) Growth and Yield.

Bielinski M. Santos, Camille E. Esmel, and James P. Gilreath, GREC UF/IFAS, Wimauma, FL.

Nitrogen (N) is one of the most growth-limiting for vegetable production in sandy soils. In Florida, current recommendations for pre-planting N applications (100 lb/acre of N) in 'Crookneck' summer squash (*Cucurbita pepo*) differ from those used by the growers (>200 lb/acre). Therefore, two field studies were conducted in Ruskin and Balm, Florida, to examine the effect of 50, 100, 150, 200, 250, and 300 lb/acre of N on summer squash growth and yield. In Ruskin, plant vigor increased linearly with N rates, whereas there was no significant N effect in Balm. No differences in petiole sap NO₃-N were observed in either location. In

Ruskin, there was a rapid marketable yield increase (≈25%) between 50 and 100 lb/acre of N, followed by no change afterwards. In contrast, there was no yield response in Balm. In the latter location, no crop had been established in the previous three years, enabling the soil to maximize its organic N accumulation (>40 lb/acre organic-N), whereas in Ruskin the experimental location had been continuously planted during the last three seasons (≈25 lb/acre organic-N). The data demonstrated that organic N is an important source of the nutrient to complement pre-plant applications in summer squash.

Monitoring Nitrate Concentrations in Shallow Ground Water Below a

Vegetable Field. Eric Simonne, Michael Dukes, George Hochmuth, Bob Hochmuth, and David Studstill, Horticultural Sciences Dept., UF/IFAS, Gainesville, FL.

The development of best management practices (BMP) and the allocation of pollution among land users in a watershed through the total maximum daily load process (TMDL) require an understanding of the effect of cultural practices on both yields and nutrient leaching below the root zone. Nitrate concentrations in ten wells screened at the 7-m depth in and around a 2-ha vegetable field were monitored every three weeks between January 2001 and December 2005. Crops were a rye cover crop in winter, watermelon (2001-2003) and tomato (2004-2005) in spring, and pumpkin in fall. Treatments were different each year, but ranged from 100% to 300% of nitrogen and irrigation recommended rates. Wells could not be assigned to a specific fertilization treatment, but instead reflected the overall impact of all combined treatments on shallow ground water. The objectives were to (1) describe the seasonal trends, (2) identify peaks in nitrate concentration, and (3) determine if rainfall affects NO₃-N concentration in the wells. Overall, NO₃-N concentrations ranged between 0 and 45 mg/L during the 5 year period and showed a slight downward trend. Nitrate concentration was <5 mg/L in two wells up stream from the field. Peak yearly concentrations were greater in the east and

south wells (down stream from the field) and were 42, 34, 29, 23, and 29 mg/L NO₃-N for 2001-2005, respectively. Nitrate concentration in the inside wells tended to be higher than in the perimeter wells. No clear seasonal trends were visible except in 2003 when concentration in all wells remained <10 mg/L NO₃-N during the spring watermelon crop. The high rainfall events due to hurricanes Frances and Jeanne in 2004 (>12 cm of rain each) did not affect nitrate concentration. Because NO₃-N discharge into the environment may occur after the growing season, monitoring should be implemented on a year-round basis.

Optimization of Drainage Lysimeter Design for Field Determination of Nitrogen Loads. Aparna Gazula, Eric Simonne, Michael Dukes, George Hochmuth, Bob Hochmuth, and David Studstill, Horticultural Sci. Dept., UF IFAS, Gainesville, FL.

Collecting leachate from lysimeters installed below vegetable fields may be used to quantify the amount of nitrogen released into the environment. Because limited information exists on the optimal design type and on the effect of design components on lysimeter performance, the objective of this study were to identify existing designs and their limits, assess cost of design, and test selected designs. Ideally, lysimeters should be wide enough to collect all the water draining, long enough to reflect the plant-to-plant variability, durable enough to resist degradation, deep enough to allow for cultural practices and prevent root intrusion, have a simple design, be made of widely available materials, and be cost-effective. Also, lysimeters should not restrict gravity flow thereby resulting in a perched water table. Previous study done with a group of free-drainage lysimeters (1-m long, 45-cm wide, installed 45-cm deep) under a tomato-pumpkin-rye cropping sequence resulted in variable frequency of collection and volume of leachate collected (CV of load = 170%). Improving existing design may be done by increasing the length of collection, lining the lysimeter with gravel, limiting the depth of installation, and/or breaking water tension with a fiberglass wick. Individual lysimeter cost was estimated between \$56-84 and required 9 to 14 man-hr for construction and installation. Costs on labor may be reduced when large numbers of lysimeters are built. Labor needed for sampling twenty four lysimeters was 8 man-hr/sampling date. Because load may occur after a crop, lysimeter monitoring and sampling should be done year round.

Yields of Hurricane-damaged Tomato Crops in Southern Florida. Kent Cushman, Monica Ozores-Hampton, and Eric Simonne. WFREC UF/IFAS, Immokalee, FL.

In 2005, Florida agriculture experienced a second year of devastating hurricanes with \$2.2 billion in damage to crops and farms. Hurricane Wilma cut a path diagonally across southern Florida on 24 Oct 2005 and damaged many of the tomato farms of the region at a time when growers were in full production. Tomato prices increased from \$1.50 to \$4.00 per half kg. Plants were stripped of leaf tissue and some fields flooded for more than 8 h. The objective of this study was to document season-long yield reductions due to a severe storm event such as hurricane Wilma. Yields from 10-plant plots in a randomized complete block design with four replications and from two seepage-irrigated tomato farms were recorded during the 2004-2005 and 2005-

2006 growing seasons. Fruits were counted, graded by size, and weighed. Hurricane-damaged crops during 2005-2006 consistently yielded about 60% of that of undamaged crops during 2004-2005. Hurricane-damaged crops lost yield in the extra-large size category but gained some in the large and medium size categories. Petiole sap data indicated that plants received adequate nutrition after the hurricane, by grower practice of supplying supplemental N and K, and plant nutrition did not limit yield. Results indicate seepage-irrigated tomato plantings can be rescued after hurricanes though yield may suffer in the extra-large size category.

Review of Nutrient Management Systems for Florida Vegetable

Producers. D. Cantliffe, P. Gilreath, D. Haman, C. Hutchinson, Y. Li, G. McAvoy, K. Migliaccio, Tropical T. Olczyk, S. Olson, D. Parmenter, B. Santos, S. Shukla, E. Simonne, C. Stanley, and A. Whidden, University of Florida, IFAS.

The vegetable fertilizer task force (VFTF) was created by the UF/IFAS Dean for Extension in 2006 to review nutrient management systems for Florida vegetable producers. The charge was to (1) review new data generated since the last fertilizer recommendations were developed, (2) propose science-based updates, (3) develop interim recommendations when research data are missing, and (4) develop a strategy plan to fill gaps in knowledge and secure funding for needed research. The VFTF is comprised of Extension horticulturists and agricultural engineers with state-wide responsibilities in water and nutrient management, as well as Extension county agents from all the major vegetable producing regions of Florida. The VFTF has met periodically to review and address its charge. This paper outlines how recent UF/IFAS fertilizer research results may be incorporated into science-based recommendations for Florida's vegetable farmers.

County Faculty In-Service Training for Water Sampling and Chemical Analysis. Y.C.

Li, T. Olczyk, K.W. Migliaccio, Q. Wang, G. Liu, Y. Qian, N. Campbell, G. Yu and L. Rosado, University of Florida, IFAS.

The objective of the in-service was to introduce field concepts and applications related to environmental evaluation of surface water and groundwater. Training focused on basic concepts of water chemistry and hydrology related to water sampling and monitoring techniques, instrumentation, water quality data analysis, and evaluation and reporting. The training was a combination of lectures, hands-on lab activities, and a field tour. Several water quality monitoring programs were presented. Various water sampling methods were demonstrated. Participants measured water quality using quick testing kits, and sophisticated instruments.

A Review of Cover Crop Research in Florida: Support for Cover Crop Inclusion in Vegetable Production Systems. Danielle D.Treadwell, Horticultural Sci. Dept., Gainesville, UF/IFAS.

Cover crops benefit the farming system by increasing the efficiency of nutrient cycling, improving soil physical and chemical properties, and reducing insect and weed populations. Due to water quality concerns and the need to moderate nutrient loads to surface and ground water, producers are seeking economically viable alternatives to optimize production efficiency without negatively impacting the environment. Research indicates that utilizing cover crops as a partial source of nitrogen can reduce the total N added to the system as well as reduce the risk of nitrate leaching. Some cover crop species have been associated with an increase in plant available phosphorous following incorporation as a green manure. Cover crop integration in vegetable production systems is considered a Best Management Practice according to the Florida Dept. of Agriculture and Consumer Services. In addition, vegetable producers who utilize cover crops in their farming system for nutrient uptake following a vegetable crop may be eligible for conservation payments through NRCS. Despite these advantages for growing cover crops, year-round cropping schedules limit opportunities to include a non-cash crop in the farming system rotation. Furthermore, the number of cover crop species that flourish in the subtropical climate of Florida is limited. The objective of this review is to summarize previous cover crop research in Florida and identify benefits of specific cover crop species, provide general management guidelines to achieve that benefit, and suggest opportunities for inclusion in Florida vegetable production systems.

Characterization of Velvetbean Lines with Respect to Morphological Traits, Phenology, and Biomass Production. Inga Zasada, Aref Abdul-Baki, USDA-ARS, Beltsville, MD and Waldemar Klassen and Maharanie Codallo, TREC, Homestead, UF/IFAS.

Velvetbean is a vigorous annual legume which possesses many positive agronomic attributes. The plant provides ground cover and thereby reducing erosion, fixes nitrogen reducing the need for nitrogen fertilizers, and suppresses several pests and pathogens reducing pesticide applications. The phenology, morphology and biomass production of ten velvetbean lines, including 'Georgia Bush', were evaluated in a field trial at Homestead, FL. The lines varied in geographical origin and seed color. Days from seeding to first floral buds ranged from 43-135 days, to first blooms 60-153 days, and to first pods 68-160 days. Half of the lines had indeterminate flowering habit, while four of the lines and 'Georgia Bush' were determinant. Biomass at maturity ranged from 2.79 to 7.7 Mg/ha. The selection of a line that produces large amounts of biomass and matures rapidly is desirable from a cover crop perspective.

Development of Multiple Pest-Resistant Sweetpotatoes for Organic Production and for New Uses by ARS and IFAS. Janice R. Bohac¹ T. Olczyk², E. H. Simonne², D.M. Jackson¹, and R. T. Nagata², ¹US Vegetable Laboratory USDA -ARS Charleston SC, ² University of Florida IFAS.

The highly nutritious sweetpotato is heat tolerant and can produce well in many areas of the Sunshine State. Types grown include the orange-fleshed, sweet, moist varieties, and the starchy-dry fleshed, 'Boniato'

varieties favored by Hispanic markets. Major pests that limit production of the crop include viruses, sweetpotato weevil, soil insects and root knot nematodes. Over many years, scientists at the USVL, ARS have developed diverse genotypes with high levels of resistance to soil insects, root knot nematodes, *Fusarium*, and moderate resistance to sweetpotato weevil. Some genotypes also have allelopathy to weeds like yellow nutsedge. A bioassay was developed to study the insect resistance to soil insects like *Diabrotica*. It was found to correlate with field insect resistance. Some of the biochemical compounds that confer resistance have been identified. The ARS scientists have joined with IFAS researchers to conduct Florida field trials to evaluate sweetpotato genotypes for resistance to insects and disease and for other horticultural traits. In recent field trials in Homestead, Florida some sweetpotato genotypes were found to be very highly resistant to the sweetpotato weevil under severe weevil pressure. The first sweetpotato cultivar released for Florida is an insect and nematode resistant cultivar named 'Liberty'. It has excellent quality as a dry-fleshed Boniato type for fresh market. This cultivar and other USVL genotypes are superior to current Boniato varieties because the USVL genotypes do not oxidize when sliced and can be stored for up to a year. These traits are also critical for processing and value-added products.

Efficacy of Jack Frost Foam® for Frost Protection on Vegetable

and Strawberry Transplants. R. J. McGovern¹, C. R. Semer IV¹, and Lajos Pecsenka², ¹Plant Pathology Dept. and Plant Medicine Program, UF/IFAS, ²American Ag. Foam LLC, Casper, FL.

This research evaluated Jack Frost Foam® (American Ag Foam LLC, Casper FL.) applied to pepper, tomato, squash, watermelon and strawberry transplants for frost protection. Two experiments were conducted (2005 and 2006) at Univ. of Florida, Plant Sci. Res. and Educ. Unit, at Citra, FL. Transplants were planted in 16 December and 17 January into fumigated beds covered with plastic mulch. The experiment a complete randomized split plot design with six replications consisting of 6 to 20 plants per replication. Watch Dog Model 425 data loggers positioned 14 cm above the soil line were used to record the temperatures in one protected plot and one control plot. The foam was hand applied to a height of 35 cm above the bed. Two frost events occurred in December and one frost event occurred in January. The results of both tests were similar; the foam provided a 6.2 to 10.7 ° C temperature increase at the meristem of the treated transplants versus the unprotected transplants. Transplants not protected with the foam died within 24 to 48 hr after the frost event due to freeze injury. The treated plots showed some plant loss in areas where the foam was blown off the plots.

Performance of Methyl Bromide Alternatives for Strawberry in Florida and Spain.

Bielinski M. Santos¹, José M. López-Aranda², James P. Gilreath¹, Alicia J. Whidden³, Luis Miranda², Carmen Soria², and Juan J. Medina². ¹Gulf Coast Research and Education Center, IFAS-University of Florida, Wimauma, Florida; ²Instituto Andaluz de Investigación y Formación Agraria. IFAPA. CICE-Junta de Andalucía. Spain. ³Hillsborough County Extension Service, IFAS-University of Florida, Seffner, Florida.

Field trials were conducted in two locations in Huelva, Spain, and one in Florida, USA, to determine the effect of selected methyl bromide (MBr) alternatives on strawberry yield and soilborne pest control. Treatments in both locations were: a) non-treated control, b) MBr + chloropicrin (Pic) at a rate of 400 kg/ha, c) 1,3-dichloropropene (1,3-D) + Pic at 300 kg/ha, d) Pic at 300 kg/ha, e) dimethyl disulfide (DMDS) + Pic at 250 + 250 kg/ha, and f) propylene oxide at 550 kg/ha. In both Spanish locations, the results showed that 1,3-D + Pic, DMDS + Pic, and Pic had similar yields as MBr + Pic. Similar results were found in Florida, USA, with the exception of propylene oxide, which had equal marketable fruit weight as MBr + Pic.

Efficacy of Drip-delivered Herbicides for Weed Control in Tomato in Puerto Rico and Dominican Republic. Bielinski M. Santos¹, James P. Gilreath¹, Maria de L. Lugo², and Luis E.

Rivera². ¹Gulf Coast Research and Education Center, IFAS-University of Florida, Wimauma, Florida; email: bmsantos@ufl.edu. ²Crop Protection Dept., University of Puerto Rico at Mayaguez, Puerto Rico.

Two field studies were conducted in Gurabo, Puerto Rico, and Mao, Dominican Republic to examine the potential of drip-applied herbicides for weed control in polyethylene-mulched tomato. The herbicide treatments were: a) metolachlor at a rate of 1.1 kg ai/ha; b) napropamide at 2.2 kg ai/ha; c) pebulate at 4.5 kg ai/ha; and d) trifluralin at 0.8 kg ai/ha. A non-treated control was added. Each herbicide plot was split in two application methods: Pre-emergence application and through the drip lines with 50 m³ water. In both cases, herbicides were delivered three weeks before tomato transplanting. In both locations, there were no significant differences between the two delivery methods. Metolachlor showed the best control of broadleaf weeds (>80%) and highest tomato fruit yield. Applying herbicides through the drip lines is a viable alternative in mulched tomato grown in heavy soils.

The Effect of Time after Harvest on Stem Scar Water Infiltration in Tomato. Sarah M. Smith^{*}, J.W. Scott and J.A. Bartz, University of Florida IFAS.

Tomato (*Lycopersicon esculentum* Mill.) fruit are subject to water infiltration through the stem scar when they come in contact with the water of a dump tank in a packing house. When fruit infiltrate water, they can infiltrate *Erwinia carotovora* along with the water, which causes bacterial soft rot development. To determine the amount of water infiltrated through the stem scar at different times after harvest, fruit were immersed in water in a pressure cooker for two minutes at 0, 6, 12 and 24 hours after harvest. Two cultivars, Florida 47 and Sebring, were grown in a completely randomized block design with three blocks and 10 plants per block. The fruit were harvested at the mature green stage and weighed to determine the amount of water infiltrated at the different times after harvest. Sebring infiltrated significantly less water than Florida 47. The amount of water infiltrated by both cultivars at 0 hours was significantly greater than at 6, 12 and 24 hours after harvest. The amount of water infiltrated by each cultivar was not significantly different at 6, 12 and 24 hours.

Yield and Quality of ‘Atlantic’ and ‘Harley Blackwell’ as a Result of Multiple Planting Dates, Nitrogen Rates and Accumulated Growing Degree Days in Northeast Florida.

Christine M. Worthington* and Chad M. Hutchinson, University of Florida, Dept. of Horticultural Sciences, Gainesville, Florida.

Potato planting in Northeast Florida starts in early January and proceeds through early March. The performance of varieties over this wide range of possible planting dates has not been sufficiently investigated. A factorial experiment with four blocks was planted at the UF/IFAS Hastings Farm in Hastings Florida in 2005. Planting date ((PD), 6 dates spaced two weeks apart starting 11 Jan, 2005), variety (V, ‘Atlantic’ and ‘Harley Blackwell’), and nitrogen rate (NR, 168 and 224 kg·ha⁻¹) were the main effects. Accumulated growing degree days (GDD – 7C base) were calculated for key development stages (emergence and full flower) for each planting date. For the planting date main effect, plants in planting date four had significantly higher total and marketable yields (35.39 and 32.52 t ha⁻¹) compared to all other planting dates. Total and marketable yields in the variety main effect for Harley Blackwell were significantly higher (26.62 and 20.88 t ha⁻¹) than Atlantic (24.36 and 19.54 t ha⁻¹), respectively. PD x V x NR interaction was significant for marketable yields. Harley Blackwell produced significantly higher marketable yields at PD 3 at the 168 kg N·ha⁻¹ rate compared to Atlantic (28.81 and 23.68 t·ha⁻¹), respectively. Atlantic at planting date four at 168 kg N ha⁻¹ had the highest IHN levels (26%) of all other PD x V x NR treatments. Accumulated GDD over all planting dates for Atlantic and Harley Blackwell at emergence and full flower were approximately 200 and 800, respectively.

‘Harley Blackwell’ a New Chip Stock Potato Variety for Florida.

Chad M. Hutchinson and Doug M. Gergela, Horticultural Sciences Dept., UF; David A. Dinkins, UF IFAS St. Johns County Extension Office; and Edsel E. Redden UF IFAS Putnam County Extension Office.

‘Harley Blackwell’ is an internal heat necrosis (IHN) resistant chip stock potato variety recently released by the USDA. It was tested at the University of Florida’s Plant Science Research and Education Unit for eight seasons from 1998 to 2005 originally under the selection number B0564-8. Production practices followed standard IFAS BMP recommendations. ‘Harley Blackwell’ tubers are consistently described as having a tan to buff skin color with a netted texture. Tuber flesh color is white to cream. Tuber shape is rated as ‘mostly round’ to ‘round to oblong’ with an eye depth of intermediate to shallow. Overall external tuber appearance is noted as fair to good. ‘Harley Blackwell’ plant architecture is described as spreading to upright with a good canopy. Early plant vigor (size) is rated similar to ‘Atlantic’, the current chip stock standard variety. ‘Harley Blackwell’ and ‘Atlantic’ have a similar early plant maturity rating. Overall, tuber appearance, growth characteristics, and maturity rating for ‘Harley Blackwell’ are similar to ‘Atlantic’. Total and marketable yields of ‘Harley Blackwell’ averaged approximately 10% less than ‘Atlantic’ over all seasons evaluated. In addition, specific gravity averaged approximately 0.05 lower than ‘Atlantic’ although still in an acceptable range for Florida chip potatoes. ‘Harley Blackwell’ exhibited no IHN compared to ‘Atlantic’ at up to 80%. ‘Atlantic’ should continue to be planted for early contracts when yield is important and IHN is less of a problem. ‘Harley

Blackwell' should be planted to fill late season contracts when quality in 'Atlantic' can be problematic.

Taste Panels Evaluate Quality of Five Strawberry Selections for Florida. Craig K. Chandler, Gulf Coast Research and Education Center – Balm, UF, and Anne Plotto, USDA/ARS Citrus and Subtropical Products Lab, Winter Haven, FL.

Five promising selections from the GCREC strawberry breeding program were compared with the industry standard 'Strawberry Festival' in consumer panels on February 2nd and March 9th 2006. Several of the selections were rated equal to, but not higher than, 'Strawberry Festival' for appearance and/or flavor in February. Appearance and flavor of 'Strawberry Festival' decreased in March. Selection FL 00-51 had the best flavor and selection FL 01-116 had the best appearance ratings in the March panel. Other fruit and plant characteristics of these selections will also be discussed.

Effect of Priming Treatments on Embryo Elongation and Germination of Unaged and Aged Vegetable Seeds. Gokhan Hacisalihoglu and J. White; Florida A&M University, Biology Dept., Tallahassee, FL.

Germination and seedling emergence of vegetable seeds are often slow, particularly under stress conditions. Pre-sowing seed enhancement techniques such as solid matrix priming improve seed germination and seedling growth. This study examined the combined effects of priming and aging on the embryo elongation and germination of a number of vegetable seeds including pepper and eggplant. Unaged and aged (42 C and 95% RH) seeds were primed with Micro Cel E in the presence of water for 5 days at 30 C. Speed and uniformity were quantified using time of 50% germination (T50) and final germination %. Embryo elongation was used as a rapid test by observing the visibly elongating embryos from cut seed coat over the time. Priming on controlled aged seeds had different effects on seed germination and embryo elongation depending on the severity of aging and therefore seed deterioration. Our results showed that priming increased mean germination time and final germination percentage in all tested vegetable species. Furthermore, controlled aging decreased mean germination time and embryo growth. These results and current status of this project will be presented.

Nitrogen BMP Efforts with Tomato Production in Florida: Update for 2005-2006 Season. Monica P. Ozores-Hampton, Eric Simonne, Eugene McAvoy, Phil Stansly, Sanjay Shukla, Pam Roberts, Fritz Roka, Tom Obreza, Kent Cushman, Phyllis Gilreath, and Darrin Parmenter. University of Florida/IFAS, SWFREC, Immokalee, FL,

Florida tomato growers generate approximately \$600 million in revenue. The "*Florida Vegetable and Agronomic Crop Water Quality/ Quantity Best Management Practices Manual*" which has

been adopted by rule in the Florida Administrative Code in February 2006 describes the possible cultural practices that are available to tomato growers for improving water quality (Best Management Practices or BMP). The current UF-IFAS Nitrogen (N) fertilization rate of 200 lbs N/acre (with supplemental fertilizer applications under specified conditions) may need to be adjusted based on the growing season, soil type, and irrigation system. Because growers should be actively involved in the development and implementation of BMPs, the objectives of this project were to establish partnerships with southwest Florida tomato growers with seepage irrigation practices and evaluate the effects of N application rates on yield, plant growth, petiole N sap, and plant disease. Seven on-farm trials were conducted during the 2005-2006 season. Treatments consisted of N fertilizer rates ranging from 200 to 320 lbs N/acre, with each trial including both the UF-IFAS rate and the traditional rate. Results from the seven seepage tomato trials during the fall 2005, winter and spring 2006 will be reported. The first year of this project confirmed the need for recommendations to be tested for several years and provide flexibility to account for the local growing conditions. Working one-on-one with commercial tomato growers allowed us to focus on each farms' educational needs and identify specific improvements in nutrient and irrigation management practices.

Growing Microgreens: Maybe the Ultimate Specialty Crop!

Nancy Roe, Farming Systems Research, Boynton Beach, FL.

Microgreens have been a popular product with chefs in "high end" restaurants for over 10 years. The most commonly used species are those in the crucifer family (*Brassica* and *Eruca* spp.). Some buyers like to include herbs or greens such as basil (*Ocimum basilicum*), celery (*Apium graveolens*), cress (*Lepidium* spp.), and cilantro (*Coriandrum sativum*), as well as pea (*Pisum sativum*) shoots and corn (*Zea mays*) sprouts. We grow in 25X 50 cm flats filled with a commercial peat/ perlite or vermiculite mix. Production problems include "damping off" complex, birds, and (rarely) insects. The crops are grown only to cotyledons or first leaf, cut manually, and sold by weight in plastic boxes. Some chefs prefer to buy the greens uncut in the flat and cut their own as needed. Although microgreens are sold for high prices, production costs, such as the medium, seed, and hand labor, are also high. They also must be refrigerated and cannot be stored for long periods of time so most are sold locally or shipped with cold paks via overnight mail. Although growers in some areas say that the markets for microgreens are "saturated", there are still openings for small growers in other areas, since many restaurants prefer to buy this product locally.

Growing and Marketing Garden Cress and Mache at Local Green Markets in

Southeast Florida. Kenneth D. Shuler, Stephen J. Nie, Deanna Shuler and Pei-Ann N. Shuler, Stephen's Produce N, Jupiter, FL.

Stephen's Produce began growing and marketing garden cress (*Lepidium sativum*) in 2001 and mache (*Valerianella locusta*) in 2002 from a 0.15 acre backyard market garden to help supply the West Palm Beach Green Market with a Saturday supply of "garden fresh" produce. The garden has been expanded each year. In 2005-2006, 0.38 acres were under cultivation and clientele were being served at two weekend green

markets. Garden cress and mache were two of the 30 crops grown and have been included in the crop mix each year. Planting schedules, growing and harvesting methods, yields, and sales figures are discussed. For the 2004–2005 season, 13 plantings of garden cress and 9 plantings of mache were made. Cress was sold for 23 weeks and mache for 20 weeks of the 28 week sales season which began 6 Nov and concluded 15 May. These crops were cut, washed, and bagged the day before sales. Prices were \$2.00 per quart bag containing from 84 to 114 g of greens. An average of 9 bags of cress and 19.9 bags of mache were sold each week in 2004-2005.

Growing and Marketing Mizuna and Tokyo Bekana at Local Green Markets in Southeast Florida. Kenneth D. Shuler, Stephen J. Nie, Deanna Shuler and Pei-Ann N. Shuler, Stephen's Produce N, Jupiter, FL.

Stephen's Produce began growing and marketing mizuna, *Brassica rapa* (Japonica group), in 2001 and Tokyo bekana, *Brassica rapa* (Chinensis group), in 2002 from a 0.15 acre backyard market garden to help supply the West Palm Beach Green Market with a Saturday supply of "garden fresh" produce. The garden has been expanded each year. In 2005-2006, 0.38 acres were under cultivation and clientele were being served at two weekend green markets. Mizuna and Tokyo bekana were two of the 30 crops grown and have been included in the crop mix each year. Planting schedules, growing and harvesting methods, yields, and sales figures are discussed. For the 2004–2005 season, 10 plantings of mizuna and 28 plantings of Tokyo bekana were made for the 28 week sales season which began 6 Nov and concluded 15 May. These crops were cut, bunched, and banded the day before sales. Prices ranged from \$1.00 to \$1.75 per bunch and an average of 19.5 bunches of mizuna and 24.6 bunches of Tokyo bekana were sold each week in 2004 -2005.

Resistance to Aphid-transmitted Viruses in Compact Tropical Pumpkin Hybrids. Susan E. Webb, Entomology & Nematology Dept., UF/IFAS.

The results of a survey of cucurbit viruses in Florida showed that compact hybrids of tropical pumpkin (*Cucurbita moschata*) were rarely infected with aphid-transmitted viruses, even when surrounding varieties showed severe symptoms. Two varieties, 'El Dorado' and 'Las Estrella,' were grown in the greenhouse and mechanically inoculated with three viruses that are commonly found in Florida cucurbits: *zucchini yellow mosaic virus* (ZYMV), *papaya ringspot virus type W*, and *watermelon mosaic virus 2* (WMV-2). Plants were tested by ELISA at 2 and 4 weeks post-inoculation. Both varieties appeared to have some resistance or tolerance to ZYMV and were least resistant to WMV-2. Virus titer was low in most cases, however, and symptoms were mild. PRSV-W and WMV-2 were transmitted to both varieties by aphids, but symptoms were either very mild or not detected. Whether or not these plants can serve as sources of virus for aphids is not yet known.

Management of Twospotted Spider Mite (TSM), *Tetranychus urticae* Koch, Using Acramite. Dakshina Seal, Tropical Research and Education Center, UF/IFAS, Homestead, FL.

Twospotted spider mite is an important pest of various vegetable crops. It can cause serious economic yield loss in the instance of high population abundance. Spintor and Agrimek is frequently used to control this pest. Acramite alone at 16 fl. oz. provided significant reduction of twospotted spider mite on sweet corn. Acramite in combination with organosilicone provided improved control of twospotted spider mite. The effectiveness of Acramiate in controlling twospotted spider mite was comparable to Spintor and Agrimek.

Palm Beach County's Changing Landscape: Historical Trends and Future Direction of the Agricultural Reserve. Darrin Parmenter, University of Florida, IFAS, Palm Beach County Extension Service.

In 1980, an area of approximately 21,000 acres in southern Palm Beach County was formally designated as the Agricultural (Ag) Reserve. With an emphasis on the preservation of agriculture in an area that was quickly becoming surrounded by development and urban encroachment from the coastal communities, densities and clustering were established in order to prevent premature development within the Ag Reserve. By the late 1990's, as urban pressure and land-use issues became county-wide concerns, Palm Beach County developed a Master Plan recommending that the county purchase lands within the Ag Reserve suitable for agricultural purposes, and make them available to individuals willing to continue farming through a lease program. In order to move forward with this land acquisition program, a \$150 million bond referendum, with \$50 million to be used for environmentally sensitive lands throughout the county and \$100 million to be used within the Ag Reserve, was developed. In March of 1999, the bond issue was approved by the voters by a two to one margin. In mid-2005 approximately 8,100 acres are in agricultural production (peppers, tomatoes, nursery, etc) within the Ag Reserve; the remainder is divided amongst water retention, buffer zones, conservation, and development. It is with optimism from the concerned parties – agricultural, water and land management, development – that this area stays in agriculture for generations to come.

A Model for Sustainable Production of Habanero Peppers. G. L. Queeley, C. S. Gardner, and T. A. Hylton, Coop. Ext. Service, College of Engineering Sci., Technology, and Agriculture, Florida A & M Univ., Tallahassee, FL.

America's fascination with spices has resulted in a diverse array of hot pepper (*Capsicum spp.*) name brands and differentiated spicy condiments on the shelves of grocery stores and restaurants throughout the United States. A market that was historically dominated by Tabasco products, is now overrun with scores of new brand items ranging from jellies and cheeses to various intensities of the more popular salsa. As the demand for spicy products escalate throughout the U.S., hot peppers will no doubt play a leading role in the success of the spicy condiment industry. The demand for fresh hot peppers and their value-added by-products will no doubt lead to expansive land clearance for production. This will further translate into an

increased demand for inputs such as fertilizers and pesticides in an effort to maximize profits. Extensive land clearance combined with non discretionary use of agricultural chemicals traditionally have been known to have adverse effects on the environment. Published examples include eutrophication of streams, groundwater contamination and ecological imbalance. It is therefore imperative that as we strive to satisfy our cravings for spicy condiments, we develop sustainable models using low cost production inputs that jointly alleviate environmental concerns and at the same time minimize costs and maximize profits.

Response of Scotch Bonnet Hot Pepper to Incremental Phosphorous Levels on a Sandy Loam Soil. C. S. Gardner and G. L. Queeley

College of Engineering Sci., Technology, and Agriculture, Florida A& M Univ., Tallahassee, FL.

Phosphorous is an essential element for plants and is not always readily available for uptake on most soils. In crop production systems, low availability has been addressed by application of P fertilizers or lime. However, even when adequate amounts of P exist in soils, farmers tend to apply incremental amounts of fertilizers to their crops to ensure profitable yields. The efficiency of this process may be affected by factors such as P immobilization in the soil and the cost of fertilizer acquisition and application. Furthermore, intensive P fertilization may lead to runoff and pollution of surface water resources. Therefore, application of phosphorous fertilizer, plant P uptake and use, and soil phosphorous are of considerable interest in agro-ecosystems. A one year study was conducted to determine the threshold application rate of P fertilizer for growth and yield of Scotch Bonnet hot pepper (*Capsicum chinense* Jacq.), a crop being developed to benefit small-scale farmers. The experiment was arranged as a RCB design with six replicates. Six levels of P (TSP 0-46-0) were applied in equally spaced amounts of 0, 56, 112, 168, 224, and 280 kg ha⁻¹. Soil type at the site was an Orangeburg sandy loam with a baseline P level of 21 ppm. Data were collected on parameters such as fruits per plant, fruit size, and marketable fruit yield (kg ha⁻¹). Results showed significant increases in fruit size for applied P over baseline P level. The study suggests that baseline P level is adequate to sustain plant growth and yields.

SCSSF 2006 ABSTRACTS

Enhancing Turf Quality in Bahiagrass by Over-Expression of a Gibberellin Catabolizing Enzyme. M. Agharkar¹, F. Altpeter^{1,2,3}, H. Zhang¹, M. Gallo^{1,2,3},

K. Quesenberry¹, D.S. Wofford¹ and G.L. Miller⁴ ¹Agronomy Dept.,UF/IFAS ²Plant Molecular and Cellular Biology,UF/IFAS ³Genetics Institute, Univ. of Florida, Gainesville, FL ⁴Dept. of Environmental Horticulture,UF/IFAS.

Bahiagrass (*Paspalum notatum* Flüggé) is a low input, drought tolerant, and disease resistant warm season turfgrass used for residential lawns and along highways in the Southeastern US. Turf quality of

bahiagrass is compromised by prolific seedhead production, open growth habit, and light green color. The objective of this study was to improve the turf quality of bahiagrass by over-expression of a gibberellin catabolizing enzyme, gibberellin 2-oxidase (GA2ox). Gibberellin 2-oxidase1 and GA2ox8 ORF's were isolated from *Arabidopsis* and sub-cloned under the control of the constitutive ubiquitin or 35S promoters. Co-transfer of constitutive *nptII* and GA-2 oxidase expression cassettes into seed derived callus cultures from turf-type bahiagrass (cv. Argentine) was carried out. Transgenic plants were confirmed by NPTII ELISA (Agdia), PCR, and RT-PCR. Phenotypic data were generated under controlled environment conditions of soil or hydroponics grown plants and allowed to identify transgenic bahiagrass lines with a superior phenotype. Turf quality and persistence of the transgenic bahiagrass will be determined under field conditions at the University of Florida, Plant Science Res. and Educ. Unit near Citra, FL.

Soil Conditions Affect Sweet Corn and Sunnhemp Initial Growth and Root

Proliferation. B.R. Morton, J.C. Linares, J.M.S. Scholberg, and K.J. Boote

Agronomy Dept., UF/IFAS.

Roots are critical for the interception of nutrients before nutrient loss can adversely impact the environment. A study was conducted to determine the effect of soil conditions (dry, moist, compacted, and nutrient addition) on root growth, root proliferation patterns, and shoot growth of sweet corn (*Zea mays* L.) and sunnhemp (*Crotalaria juncea* L.). Acrylic growth tubes were filled with potting soil and root growth was monitored at 2 to 3 day intervals. The soil compaction treatments greatly reduced root elongation and rooting depth for both species. Soil water deficit increased root elongation for sweet corn at 2 wk after planting but subsequently rate of root growth slowed, possibly due to reduced assimilate supply. Sweet corn, being a C4 species, grew faster and had much higher root length intensity. Sunnhemp, a C3 species, grew slower but was less affected by adverse soil conditions. While sweet corn had an exponential decrease in root length intensity with depth, sunnhemp had a relatively more even root distribution throughout the upper 60 cm of the soil profile. Water use efficiency (WUE) for sweet corn was enhanced by either water stress or supplemental nutrients and values were twice as high as those for sunnhemp. Growth and WUE for sunnhemp were not affected greatly by adverse soil conditions, probably related to the smaller plant size of sunnhemp at this stage of growth.

Growth and Phenology of Native Legumes in Two Light Environments

S. E. Cathey and T. R. Sinclair. Agronomy Dept., UF/IFAS.

In the fire-maintained longleaf pine- (*Pinus palustris*) wiregrass (*Aristida stricta*) ecosystem, legumes are important for replacing nitrogen lost from frequent burning. Restoration of understory nitrogen-fixing legumes is important for prescribed fire practices and wildlife habitat improvement. The objectives of this study were to document the influence of shading on growth habits and biomass accumulation on native legumes and to observe subsequent effects of shading on phenological development and nodule number and morphology. Initial observations of growth responses to shade, phenological development through a season, and nodule morphology for eight species of native legumes were made. The group of species in this study

represented all three major subfamilies of Fabaceae and two distinctly different growth forms: vining/spreading and erect herbs. Biomass accumulation was not significantly reduced by shade for any of the species. Although stem elongation responses to shade were only significant for three species, *Clitoria mariana*, *Crotalaria rotundifolia*, and *Lespedeza hirta*, a general pattern of vining/spreading plant etiolation under shaded conditions and a lesser effect on more upright plants was evident. Weekly measurements of plant height, plant canopy expansion, and notations regarding phenological phase were used to describe changes in each species over a single growing season. Nodules varied from spheroid to elongate to coralloid.

Extended Daylength and Fertilization Effects on Above- and Below-ground

Bahiagrass Mass and Chemical Composition. S.M. Interrante^{*1}, L.E. Sollenberger¹, A.R. Blount¹, T.R. Sinclair¹, J.C.B. Dubeux², and J.M.B. Vendramini³ ¹Agronomy Dep, UF/IFAS; ²UFRPE- Depto. de Zootecnia, Recife, PE, Brazil; and ³Soil and Crop Sci. Dep., Texas A&M Univ.

Bahiagrass is the primary pasture grass in Florida, and pastures are productive from April to November in northern Florida. The reduction in bahiagrass growth during winter months may be attributed to short daylengths. Research has been aimed at increasing bahiagrass productivity during short-daylength months through genetic selection and development of cultivars that are insensitive to photoperiod. There are concerns that increasing above-ground growth may negatively affect the partitioning of organic matter to storage structures, possibly resulting in reduced tolerance to defoliation and potential stand loss. An extended daylength field study was conducted to evaluate a cold tolerant, less daylength sensitive bahiagrass type against existing bahiagrass cultivars. Treatments were the factorial combinations of two daylength treatments, two fertilizer treatments, and three bahiagrass genotypes in four replications of a split-plot arrangement of a completely randomized design. Dry matter yields were determined by regular harvests to an 8-cm stubble height. Destructive samples were collected three times per season, and plants were divided into shoot, rhizome, and root fractions for subsequent analyses. There were no differences in total season DM yields for the extended daylength treatment ($P>0.05$). For the November harvest, DM yields for genotypes under extended daylengths were generally greater than those under normal daylengths ($P<0.05$). However, April normal daylength DM yields and above-: below-ground ratios were greater than those under extended daylengths ($P<0.05$). In April, Pensacola and Tifton 9 root and rhizome DM yields were greater than PICA C4 ($P<0.1$). Fraction N content will also be measured.

Population Dynamics and Within Plant Distribution of Thrips and

***Orius insidiosus* in Cotton.** E.A. Osekre¹, D.L. Wright², and J. Marois² ¹Agronomy Dept., UF/IFAS ²NFREC, UF/IFAS, Quincy, FL.

Thrips (*Frankliniella* spp.) are serious pests of ornamental, vegetable, and fruit crops in the field and

greenhouses, and they are widely distributed. Feeding by thrips results in distortion, discoloration, stunting, and silvering of foliage, flowers and fruits, and cotton is one of such crops. Several studies on thrips over the years had centered on population dynamics and biology of the insect on crops other than cotton. A few studies had, however, looked at the spatial distribution of the insects and some of their natural enemies, especially *Orius insidiosus*, on various crops. However, there have been reported variations in the success of *O. insidiosus* as a natural control agent of thrips in these studies. Field studies were therefore conducted at the North Florida Research and Education Center at Quincy to determine the: 1) plant part preference and population distribution of *Frankliniella* spp. on cotton, and 2) association between the populations of thrips and *O. insidiosus* on various plant parts or fruit development of field cotton plants. Results showed that more adult *Frankliniella* spp. occur in the flowers than on the leaves and that *O. insidiosus* is not an effective predator of *Frankliniella* spp on field cotton.

Predicting Tomato Fruit Growth Dynamics in Terms of Fresh Weight and Size: A Review and Modeling Approach. M.R. Rybak¹, K.J. Boote¹, J.M.S. Scholberg¹, C.H. Porter², and J. W. Jones.² ¹Agronomy Dept., UF/IFAS ²Agric. and Biol. Engineering Dept., UF/IFAS.

A number of tomato (*Lycopersicon esculentum* Mill.) crop models have been developed which simulate fruit yield based in cumulative dry matter. Tomato growers, however, would be more interested in models that could predict the weekly pattern of yield on fresh weight basis including variation in marketable size. Such models could assist growers in planning their management and commercialization strategies especially relative to harvest timing and fruit quality. Tomato production varies week to week and accurate predictions are hard to achieve. The developmental stage and growth rate of individual fruits are influenced by environmental, cultural and genetic traits. Therefore, functional relationships need to be understood in order to build useful simulations. This paper reviews the literature concerning the factors that regulate single fruit growth patterns and increases in size for fresh market tomato. The paper analyzes the use of this information to support improving tomato crop models. A conceptual model is presented for predicting fresh weight and size of fruits over time, starting with crop-model-predicted dry mass per fruit and fruit thermal age.

Enhancing Biosafety of Transgenic Bahiagrass by Engineering Inducible Cell Death
S. Sandhu¹, F. Altpeter^{1,2,3}, A. S. Blount⁴, K. Quesenberry¹,
 M. Gallo^{1,2,3}, and M. Singh⁵ ¹Agronomy Dept.,UF/IFAS ²Plant Molecular and Cellular Biology,UF/IFAS
³Genetics Institute, Univ. of Florida, Gainesville, FL ⁴NFREC,UF/IFAS, Quincy, FL ⁵CREC, UF/IFAS, Lake Alfred, FL.

Bahiagrass (*Paspalum notatum* Flüggé) is the most important forage grass in Florida and, in addition, it is used widely as low-input turf. We recently developed an efficient genetic transformation protocol for bahiagrass. Transgenes with the potential to enhance turf and forage quality as well as stress tolerance were introduced into bahiagrass. Risk assessment and risk management research are integral components of this

grass biotechnology program. 'Argentine' bahiagrass is a tetraploid apomict which reproduces by producing seeds and vegetatively by stolons. We are investigating the targeted, selective elimination of transgenic plants by engineering inducible cell death. Inducible cell death with the ArgE/ N-acetyl phosphinothricin system could be used for selective control of transgenic plants and for monitoring vegetative and sexual reproduction of transgenic plants. N-acetyl phosphinothricin is a non-toxic herbicide precursor which is converted to toxic herbicide phosphinothricin (glufosinate) by the ArgE gene product. Transgenic plants expressing the ArgE gene have been generated by biolistic transformation with the ArgE gene under the control of a constitutive ubiquitin promoter. Gene expression in the transgenic lines was confirmed with RT-PCR analysis and real-time RT-PCR was used to identify lines with high expression of the ArgE gene. Following subcloning of the transgenic plants we will apply N-acetyl phosphinothricin to determine the functionality of the proposed system.

Plant Regeneration of Lotononis through Cotyledon Culture. M.L. Vidoz and K.H. Quesenberry Agronomy Dept., UF/IFAS.

Lotononis (*Lotononis bainesii* Baker) is a subtropical forage legume, which prefers sandy soils and exhibits some frost tolerance. The objective of this research was to evaluate the effect of different plant growth regulators (PGR) on the *in vitro* response of cotyledons of 50 genotypes of lotononis. Seeds were scarified with concentrated sulphuric acid for five minutes, rinsed with running water for 10 minutes, surface disinfected in 70% ethanol for 30 seconds followed by 0.6% NaOCl plus one drop Tween 20[®] for 10 minutes, and rinsed 3x with sterile distilled water. Disinfected seeds were placed onto half strength Murashige and Skoog (1962) basal medium (MS) with 1.5% sucrose and 0.7% agar for germination. Cotyledons from one-week-old seedlings were cut longitudinally into two pieces, so that four pieces were obtained per genotype and placed onto MS without PGRs, MS + 1mg L⁻¹ thidiazuron (TDZ), MS + 1mg L⁻¹ 2,4-dichlorophenoxyacetic acid (2,4-D), and MS + 1mg L⁻¹ picloram (PIC), respectively. Cultures were incubated at 25±2 °C, with 14-h photoperiod. After two weeks, 54% of the genotypes developed adventitious buds from small callus produced on explants on medium containing TDZ. Explants placed on the medium devoid of PGRs remained unresponsive, whereas those cultured on media containing either 2,4-D or PIC produced callus but no organogenesis. After 60 d, buds were transferred to MS + 0.01 mg/L benzyladenine + 0.01mg/L indolebutyric acid, where they elongated and rooted. Plants were placed onto MS without PGRs for further development. Regenerated plants were successfully acclimatized *ex vitro*.

Preliminary Studies on the Effect of Chitosan on the Germination of Cabbage Seeds Inoculated with *Xanthomonas campestris* pv *campestris* (Pammel). Camille Webster¹, Kome U. Onokpise², Michael Abazinge¹ and James Muchovej² ¹Environmental Sci. Inst., Florida A&M University, Tallahassee, FL² Division of Agric. Sci., Florida A&M University, Tallahassee, FL.

Black rot in cabbage (*Brassica oleracea* var *capitata* L.) can cause significant reductions in yield. Black rot is caused by the bacterium, *Xanthomonas campestris* pv *campestris* (Pammel) Dowson, and is a

destructive disease of worldwide importance. *X. campestris* pv *campestris* is dependent on type III protein secretion system, which relies on transport proteins, secreting several hypersensitive reaction proteins and outer proteins, causing an interaction with the plant. Chitosan is a hydrophilic polyelectrolyte and an insoluble biopolymer that is widely distributed in nature. It has been exploited as a seed treatment and pesticide. The objective of the present study was to investigate the effect of chitosan on the germination of cabbage seeds inoculated with *X. campestris* pv *campestris*. Inoculated seeds were treated with 1 g, 3 g and 5 g of different concentrations of chitosan and sown in trays containing washed construction sand in a greenhouse for 14 d. During this period, the average daily temperature was recorded. Moisture content (%) and pH of the soil as well as percent seed germination were determined. Germination decreased in inoculated seeds with an increase in the concentration of chitosan. Soil of inoculated seeds had a higher pH compared to that of the non inoculated seeds. Soil pH was extremely high with increasing concentration chitosan. The results suggest that *X. campestris* pv *campestris* and chitosan *per se* contribute to high soil pH and subsequently to reduced seed germination. Further studies are underway to determine the effect of chitosan on *X. campestris* pv *campestris*.

Assessing the impact of drinking water treatment residual on phosphorus solubility in P-impacted soils: Relative efficiencies of commonly used soil test methods.

Sampson Agyin-Birikorang, George A. O'Connor, and Lee W. Jacobs, Soil and Water Sci. Dep., UF/IFAS. Abstract not available.

Soil Properties in Traffic and No-Traffic Areas in Golf Courses and Relationship with Goosegrass Growth. Claudia Arrieta¹, Philip Busey¹, and Samira Daroub²

¹FLREC, UF/IFAS, Fort Lauderdale, FL ²EREC, UF/IFAS, Belle Glade, FL.

Goosegrass (*Eleusine indica*) is a serious weed in golf and sports bermudagrass turf. Growth of goosegrass on traffic areas has been considered an indicator of compacted soil. The objectives of this study were to investigate the relationship between compaction and goosegrass occurrence and compare soil properties in traffic and no-traffic areas of golf tees on three courses in South Florida. Soil penetrometer resistance (SPR), water and organic matter content, and goosegrass cover and plants numbers were measured for each side of the tee on five tees in each golf course. Four relatively undisturbed soil cores were taken from traffic and no-traffic sides and analyzed for saturated hydraulic conductivity, pore space content, distribution (macro, micro), bulk density, and water holding capacity. Number of goosegrass plants and cover differed between sides of the tees and showed higher values on the traffic sides. The SPR was analyzed by depth at in 2.5-cm increments from 2.5 to 12.5 cm. Soil penetrometer resistance was marginally related to traffic across all three golf courses at 2.5-cm depth. The effect was attributable to one golf course in which traffic affected penetrometer resistance at all depths. There was no effect of traffic on any soil parameter. However, organic matter was associated with both bulk density and volumetric water content; and SPR with water holding capacity by volume and micropore percentage ($P < .05$). We conclude that goosegrass infests trafficked areas more than non-trafficked areas, but it is not related to compacted soil.

Soil Carbon Pools in Slash Pine-Based Silvopastoral Systems of Florida

Solomon G. Haile¹, P.K. Ramachandran Nair¹ and Vimala D. Nair² ¹School of Forest Resources and Cons., UF/IFAS, ²Soil and Water Sci. Dept., UF/IFAS.

Compared to most agricultural systems, tree-based land-use systems such as silvopasture, that integrate trees in pasture production systems, are likely to enhance soil C sequestration in deeper zones of the soil profile. The total soil C at six depths (0-5, 5-15, 15-30, 30-50, 50-75, and 75-125 cm) were determined in a silvopasture of slash pine (*Pinus elliottii*) + bahiagrass (*Paspalum notatum*), and on an adjacent treeless pastures at two sites, representative of Spodosols and Ultisols in Florida. The C contents within three fraction-size classes (<53, 53-250, and 250-2000 μm) of each soil profile were determined. Using stable C isotope signatures, the plant sources (C3 vs C4 plant) of C fractions were determined and traced at both sites. Compared with the treeless pasture, the Spodosol profile between trees in a row in the silvopasture contained more C in the fraction <53 μm at and below the spodic horizon (40-cm deep). In both soil types, the C3 plant (slash pine) contributed more C in the smallest soil fraction (<53 μm) than the C4 plant (bahiagrass) at all soil depths, particularly at the lower depth. The results support the hypothesis that under similar ecological settings, silvopastoral systems retain more stable C fraction in the soil profile than under treeless pasture.

Manure Components Affecting Phosphorus Stability of

Dairy Manure-Amended Soils. Manohardeep S. Josan, Vimala D. Nair, and W.G. Harris. Soil and Water Sci. Dept., UF/IFAS.

Manure applications to soils not only elevate P concentrations, but also result in a build-up of manure-derived components such as Mg, Ca, Si, and dissolved organic carbon (DOC). Despite high pH and abundant Ca in manure, stable forms of Ca and P such as apatite, do not form and high levels of P continue to be released from manure-amended soils. In this study we evaluated the inhibitory effects of Mg, Si, and manure-derived DOC on Ca-P crystallization in the presence and absence of solids (clay-sized fractions). Solutions containing Mg, Si or DOC were prepared in a medium containing the average leachate concentrations of the other major chemical species found in manure-amended soils. These solutions, including a control, were incubated with and without clay fractions obtained from these soils for 20 wk. The median equilibrium concentrations of Ca and P after incubation were significantly less in solutions without solids, with the exception of the DOC-solution. In the presence of solids, the control and Si-solution had lower median P concentrations (28 mg/L) than the Mg-solution (34 mg/L). The presence and absence of solids did not affect the behavior of P in the DOC-solution (50 mg/L); however Ca concentrations declined from 266 to 144 mg/L possibly due to organic complexation. Formation of hydroxyapatite in both the control and Si-solution and the more soluble brushite in the Mg-solution were confirmed by x-ray diffraction. Therefore, Mg in manure-amended soils can inhibit the formation of stable forms of calcium phosphates.

Evaluation of a controlled-release fertilizer program on Florida orange production

Carolina Medina*¹, T. Obreza ¹, J. Sartain ¹, F. M. Roka ², and R.E. Rouse.² ¹Soil and Water Sci Dep., UF/IFAS; and ²SWFREC UF/IFAS, Immokalee, FL.

Applying water-soluble nitrogen (N) fertilizer to Florida citrus on deep sandy soils may lead to poor nutrient use efficiency and possible nitrate contamination of groundwater if rainfall or irrigation is excessive. Since most of Florida uses groundwater for drinking, excess nitrate represents a health hazard to the public. Controlled-release fertilizers can potentially synchronize nutrient release patterns with crop demand while minimizing nutrient losses to the environment. The N release patterns of four coated fertilizers (CitriBlen[®]; Agrocote[®] Type A; Agrocote[®] Type C(D) and Agrocote[®] Poly-S[®]) and a water-soluble formulation were measured in a long-term field evaluation. Similar studies were simultaneously conducted in central and southwest Florida. Mesh bags containing 3.5 g of elemental N from each source were placed on the soil surface within the irrigated zone under the tree canopy to estimate N release rates. Despite differences in total amount of N released between locations, N release rates at both locations followed the same order: Water-soluble formulation > Agrocote[®] Type A > CitriBlen[®] > Agrocote[®] Poly-S[®] > Agrocote[®] Type C (D). N release patterns coincided with the citrus fertilization strategy outlined in ridge Best Management Practices (BMP). Leaf tissue was also sampled at three commercial citrus orchards located in southwest and central Florida to compare the effects of CitriBlen[®] and a conventional water-soluble fertilizer program on mature orange tree nutrition. Results indicated that CitriBlen[®] applied only once per

Reducing Phosphorus Loss from Pastureland through Silvopasture. G.-A. Michel^{1,2},

Vimala D. Nair², P. K. R. Nair¹ ¹School of Forest Resources and Cons., UF/IFAS ²Soil and Water Sci. Dept., UF/IFAS.

Phosphorus loss from sandy soils that predominates the 1.4 million ha of pastureland in Florida is a major cause of nutrient pollution of water bodies. We hypothesize that the loss of P to surface and ground water could be less from silvopastoral systems than from treeless pastures because the trees would remove the nutrient from the soil. An on-farm research was conducted in 2004 on two slash pine (*Pinus elliottii*)–bahiagrass (*Paspalum notanum*) silvopastoral systems located in Manatee (27° 13' N, 82° 8' W) and Suwannee (30° 24' N, 83° 0' W) counties. The soils in Manatee and Suwannee are respectively Spodosols and Ultisols. Soil samples were collected by depth (0–5, 5–15, 15–30, 30–50, 50–75, and 75–100 cm.) The soil P storage capacity (SPSC), the maximum amount of P that can safely be applied to a soil before it becomes an environmental concern, was used as the environmental soil P indicator. Water-soluble P concentrations at 0- to 5-cm depth were 4 and 10 mg kg⁻¹ respectively, in the silvopasture and treeless pasture in Suwannee and 11 to 23 mg kg⁻¹ in Manatee. Total SPSC to one meter depth were 337 and -59 kg ha⁻¹, respectively, in the silvopasture and treeless pasture in Suwannee and 329 and 191 kg ha⁻¹, respectively, in Manatee, suggesting that P buildup within the soil profile was less in the silvopastoral systems

than in the treeless pastures.

Basis for Estimating P Source Coefficients for the Florida P Index. Olawale O. Oladeji, George A. O'Connor and Jerry B. Sartain, Soil and Water Sci. Dept., UF/IFAS.

Realization that different P sources can result in varying P losses prompted inclusion of a P-source coefficient in Florida P index. However, three P-source coefficients (PSC) in the drafted P index (0.05 for fertilizer and manure, 0.015 for biosolids, and 0.10 for waste water) may be insufficient. We investigated impacts of P sources on P losses, and identified basis for PSC determination that could account for the varying P losses. Four P sources [poultry manure, Boca Raton biosolids (high water soluble P), Pompano biosolids (low water soluble P), and triple super phosphate (TSP)] were surface applied to a Florida sand at two rates (56 and 224 kg P ha⁻¹) to represent low and high soil P loads typical of P-based and N-based rates. Simulated rainfall was applied at 71 mm h⁻¹ on amended soils in boxes constructed to national protocol specifications but modified to collect leachates. Masses of bioavailable P (BAP) lost from various P sources followed similar trends with source percentage water extractable P (PWE; values in parentheses): TSP (84%) > manure (18%) > Boca Raton biosolids (12%) > Pompano biosolids (4%). Regression of BAP loss with application rate ($r^2=0.36$) was improved by accounting for P source differences with Florida P index coefficients ($r^2=0.54$) and Pennsylvania PSC values ($r^2=0.70$), but better with PWE ($r^2=0.83$). The result agreed with another leaching study with two Florida soils amended with eight biosolids, chicken manure, and TSP. Use of coefficients based on PWE of source is suggested for the Florida P index.

Controlling Phosphorus Loss from a Manure-Impacted Soil with Aluminum Water Treatment Residuals. T. J. Rew, D. A. Graetz, Vimala D. Nair, and George O'Connor, Soil and Water Sci. Dept., UF/IFAS.

Dairy and beef operations in the Lake Okeechobee watershed in Florida and across the nation are receiving attention as a result of their contribution of P to surficial water bodies. Prior research has shown that water treatment residuals (WTR) are capable of sequestering soluble P thereby reducing P loss through runoff and leaching. The objective of this research was to evaluate an Al-WTR for controlling P loss from a manure-impacted soil obtained from a dairy sprayfield. Soil samples were removed as 0 to 10 cm and 10 to 20 cm layers and packed in boxes (100 cm x 30 cm x 20 cm) designed to collect runoff, subsurface flow, and leachate. Water treatment residual at a rate of 2.5% of soil dry weight was either surface applied or incorporated to 10 or 20 cm depths. The soil was then sprigged with stargrass (*Cynodon nlemfuensis*). Water was applied with a rainfall simulator following a nationally recommended protocol. Subsurface flow and leachate were collected after runoff ceased from a depth of 10 and 20 cm, respectively. Surface application of WTR reduced soluble P (SP) in surface runoff by 75% but did not affect SP in subsurface drainage and leachate. Incorporation of WTR reduced runoff SP by approximately 45%. However, SP in subsurface flow and leachate was reduced by approximately 90 and 95%, respectively, when the WTR was incorporated into

the 20 cm of soil. These results show that AI-WTR can be effective in reducing P losses from manure-contaminated soils.

Nutrient Composition of Tifton-9 Bahiagrass in the First Season of a Silvopastoral System with Boer X Spanish Goat Crosses. Nadine G. Bradley and Oghenekome U. Onokpise Agronomy, Forestry and Natural Res. Conservation Program, Florida A&M Univ., Tallahassee, FL.

'Tifton-9' bahiagrass (*Paspalum notatum* Flüggé) has become one of the most widely used forage varieties in the southeastern United States for grazing and hay production. Its use in silvopastoral systems is only now being evaluated. In April 2005, Tifton-9 bahiagrass seed were broadcast at a rate of 11 to 17 kg ha⁻¹ between widely spaced tree rows of loblolly pine (*Pinus taeda* L). In September 2005, 16- to 18-mo old Boer x Spanish crossbreed goats (*Capra hircus*) were introduced into fenced paddocks of established bahiagrass for grazing. The experimental design was a split-plot design in two replicates with stocking rate treatments randomly assigned to blocks. The stocking rates were 10 and 15 animals per hectare. Nutrient composition of Tifton-9 was determined prior to grazing (PG) and at 4, 6 and 8 wk during grazing (DG) by the goats. Forage samples for nutrient analysis were collected randomly from each paddock using 1 m² quadrants and analyzed for dry matter (DM), moisture (MC), crude protein (CP), nutrient digestible fiber (NDF), acid digestible fiber (ADF) and total digestible nutrient (TDN). There was no significant difference in the nutrient composition of the bahiagrass forage due to treatment PG or any time DG. This is particularly important for producers who want to manage silvopastoral systems for sustainable agriculture. It may be that for Tifton-9 bahiagrass, limited amounts of shading will not significantly affect its nutrient composition PG and DG.

Spatial and Seasonal Variations of Shallow Groundwater Nutrients in the Lower St. Johns River Basin, Florida. Ying Ouyang, St. John's River Water Management District, Palatka, FL.

This study characterized the shallow groundwater quality in the north area of the Lower St. Johns River Basin (LSJRB), Florida, using field measurements, EPA's water quality criteria, and two-dimensional kriging analysis. Comparison of groundwater nutrient concentrations with EPA's water quality criteria shows that the maximum nitrate/nitrite (NO_x) concentrations exceeded the EPA's drinking water standard limits, whereas the maximum total nitrogen (TN) and total phosphorus (TP) concentrations exceeded the EPA's ambient water quality criteria recommendations for rivers and streams in nutrient ecoregion XII (southeastern area). Discharge of this groundwater with high TP and TN concentrations into the LSJR would degrade the ambient water quality. Kriging analysis shows that concentrations of groundwater nutrients varied from location to location as well as from season to season. High kriging estimated groundwater NO_x concentrations were observed in the residential areas with a high-density of septic tank distribution. Study also reveals that more areas were found with high NO_x concentrations in summer. Further study is warranted to estimate the

discharges of shallow groundwater nutrients (with concentrations exceeding the EPA's water quality criteria) into the LSJR and their potential adverse environmental impacts upon the river water quality.

Soil-test Phosphorus Trends in Everglades Agricultural Area Histosol Profiles. *Y.

Luo¹, G. Kingston², R.W. Rice³, and J.M. Shine, Jr.⁴

¹ EREC, Belle Glade, FL, ²BSES Limited, Bundaberg DC, QLD 4670, Australia

³ Palm Beach County Extension Service, UF/IFAS, Belle Glade, FL.

⁴ Sugar Cane Growers Cooperative of Florida, Belle Glade, FL.

Over time, soil profiles in the Everglades Agricultural Area have changed as a consequence of soil subsidence. Our objective was to characterize soil test P (STP) with depth in six different Histosol soil series (euic, hyperthermic Haplosaprists). Soil profiles were sampled at 25-cm increments, air-dried, and extracted using four STP methods including water (Pw), acetic acid (Pa), Mehlich-1 (M1), and Mehlich-3 (M3). For a deep (90-152 cm) Torrey soil series with relatively low (43%) organic matter (OM), Pw declined from 2.2 to 0.7 mg kg⁻¹ (32%), Pa from 49.9 to 34.4 mg kg⁻¹ (69%), M1 from 43.6 to 30.7 mg kg⁻¹ (70%), and M3 from 24.1 to 5.2 mg kg⁻¹ (22%) for the 0- to 25-cm and the 75- to 100-cm increments, respectively. For the Terra Ceia, another deep (186-226 cm) soil series with greater (69%) OM, Pw decreased from 109 to 4.5 mg kg⁻¹ (5%), Pa from 2455 to 100 mg kg⁻¹ (4%), M1 from 1474 to 69.4 mg kg⁻¹ (5%), and M3 from 1982 to 36.1 mg kg⁻¹ (2%), respectively. A similar trend occurred for two medium depth soil series, Pahokee and Lauderdale, with all P measurements declining (6-7% Pw; 10-16% Pa; 15-60% M1-P; and 4-5% M3-P) from the 0- to 25-cm to the 75- to 100-cm increments. For the two shallow soils, Dania (11-56 cm) and unclassified "Villa Lago" (16-26 cm), Pw, Pa, M1-P, and M3-P ranged between 8.4 to 26.2, 138 to 420, 65.4 to 211, and 74.3 to 374 mg kg⁻¹ for the 0- to 25-cm increment, respectively. In general, STP concentrations across methods were greatest at the soil surface and declined rapidly with depth.

Application Rate of Water Treatment Residuals Based on Agro-Environmental

Thresholds. Olawale O. Oladeji, Jerry B. Sartain, and George A. O'Connor, Soil and Water Sci. Dept., UF/IFAS.

Studies have shown water treatment residuals (WTR) are useful soil amendments to control excessive soluble P in soils. Applying WTR without considering its chemical composition (Al, P, and Fe contents) however, could result in inadequate or excessive immobilization of soil soluble P. This study evaluated the influence of application rates of WTR and P sources on soil P solubility, plant yields, and P concentrations and attempted to identify basis for application rates of the residuals. Bahiagrass (*Paspalum notatum* Fluggae), ryegrass (*Lolium perenne* L.) and a second bahiagrass cropping were grown in that sequence in a P-deficient soil amended with four P sources at two application levels (N and P-based rates) and 3 WTR rates (0, 1, and

2.5% oven dry basis) in a glasshouse pot experiment. Soil P storage capacity (SPSC) increased following application of WTR, and the increase varied with P sources and application rates. Soil soluble P increased with reduction in SPSC with a change point at 0 mg kg⁻¹ SPSC. A change point was also identified in plant yield at bahiagrass P concentration of 2.0 g kg⁻¹ equivalent to 0 mg kg⁻¹ SPSC. Similar result was obtained from a 2-yr field experiment with similar treatments surface applied to established bahiagrass. The 0 mg kg⁻¹ SPSC was shown to be an agronomic threshold, and applying P sources at N-based rate along with WTR sufficient to give 0 mg kg⁻¹ SPSC reduced environmental hazards of P without negative agronomic impacts.

Sugarcane Plant Crop Response to Phosphorus Fertilizer in Two

Locations on Organic Soils in Florida. J. M. McCray¹, Y. Luo¹, R.W. Rice², and I.V. Ezenwa³

¹EREC, UF/IFAS, Belle Glade, FL ²Palm Beach County Extension Service, UF/IFAS, Belle Glade, FL

³SWREC, UF/IFAS, Immokalee, FL.

Phosphorus concentration in water draining to the Everglades is a primary environmental concern in south Florida. Of the 283,500 ha of cropland in the Everglades Agricultural Area (EAA), over 162,000 ha are in sugarcane production. This study is being conducted to update the UF/IFAS soil test calibration used for P fertilizer recommendations for sugarcane on organic soils in the EAA. Two small-plot studies (Everglades Res. and Educ. Ctr, EREC, and a grower's field) were established in fall 2004 to investigate the effects of P fertilizer rate (0, 9.2, 18.4, 36.6, 73.4, and 146.7 kg P ha⁻¹) and placement (band and broadcast) on sugarcane production. Pre-application acetic acid extractable P index was 50 at the EREC site and 25 at the grower site and the soil type at each location is Dania (Euic, hyperthermic, shallow Lithic Medisaprist). At the grower site there were increases in stalk population at the higher P rates. However, there were no differences in sugar production (Mg ha⁻¹) between rates. At the EREC site there were no responses to P fertilizer application. Fertilizer placement was not a significant factor in sugar production in the first year at either location. Previous work has shown more responses in the ratoon crops than with plant cane, so following these tests for two more years will be important. Results will then be combined with previous research to update UF/IFAS recommendations.

Soil and Subsoil K and S Fertility Effects on Bermudagrass. C.L. Mackowiak¹, A.R. Blount²,

and P. Mislevy³ ¹NFREC, UF/IFAS, Quincy, FL ²NFREC, UF/IFAS, Maianna, FL ³P. Mislevy, RCREC, UF/IFAS, Ona, FL.

Increasing mineral fertilizer costs and nutrient losses to the environment puts pressure on producers to reduce forage fertilization. High yielding Tifton-85 bermudagrass (*Cynodon dactylon* L.) was studied at 3 different locations (soil types) using 3 m x 6 m plots. Fertilizer was split applied at three different K (0, 90 or 180 kg ha⁻¹), Mg (0, 11 or 22 kg ha⁻¹), and S (0, 22 or 44 kg ha⁻¹) concentrations. Nitrogen was non-limiting for all but the check plots, which received no fertilizer. Grass forages were clipped every four weeks to a 7 cm height.

Treatment K and S fertilization was reflected in forage K and S concentrations for all locations. However, Mg fertilization had little effect on forage Mg concentrations and no effect on yield. Bermudagrass fertilized with K and S had greater yields than N only fertilization by the second season, particularly with the spodic soil location. The spodic (alaquod) soil had the lowest plant available S ($< 20 \text{ mg kg}^{-1}$ in the upper 15 cm). In contrast, the kandudult soil had increasing plant available S with increasing soil depth (nearly 80 mg kg^{-1} Mehlich-3 extractable S at 120 cm depth). It is interesting to note that leaf spot (*Bipolaris* spp.) disease was most visible in the alaquod plot receiving only N fertilization (no K, Mg or S). These data suggest that soil type and/or subsoil ($> 20 \text{ cm}$ depth) should be considered in a bermudagrass hay fertilization plan.

Loading of Heavy Metals in Runoff Water from Citrus Groves and

Vegetable Fields in the Indian River Area. Z. L. He¹, P. J. Stoffella¹, X. E. Yang², D. V. Calvert¹, and Y. C. Li¹ ¹IIRREC, UF/IFAS, Fort Pierce, FL ²Ministry of Educ. Key Laboratory of Environ. Remediation and Ecol. Health, Zhejiang Univ., Hangzhou, China.

The input of heavy metals into surface water through runoff water from agricultural area is a potential problem. The objective of this study was to monitor and assess heavy metals in surface runoff from agricultural production systems in the Indian River area. Five citrus groves and two vegetable fields on commercial farms in the Indian River area were selected for this monitoring study. Runoff water samples were collected and analyzed for the concentrations and loadings of copper (Cu), zinc (Zn), nickel (Ni), lead (Pb), cadmium (Cd), and cobalt (Co). The concentrations of Cd, Ni, and Pb in runoff water from the fields were minimal, but those of Cu and Zn were relatively high. The annual mean concentrations of Cu from the seven field sites ranged from 0.01 to 513 mg L^{-1} , with a mean (2000-2005) of 64.4 mg L^{-1} , and Zn from 0.02 to 179 mg L^{-1} , with a mean of 21.0 mg L^{-1} . The annual loads of Cu and Zn ranged from 0.004 to 664 and 0.002 to $281 \text{ g ha}^{-1} \text{ y}^{-1}$, with a mean of 104 and $45.9 \text{ g ha}^{-1} \text{ y}^{-1}$, respectively. Runoff water discharge rate and concentrations in runoff water were the main controlling factors for the transport of heavy metals from agricultural fields.

Cool-season Forage Production in Silvopastoral Systems in North Florida.

S.K. Bambo¹, J. Nowak¹, A.R. Blount², A.J. Long¹, and R.O. Myer² ¹School of Forest Resources and Cons., UF/IFAS ²NFREC, UF/IFAS, Marianna, FL.

Little information is available about winter forage production in silvopastoral systems in the southeastern U.S. The objectives of this research were to evaluate the quantity and quality of winter forage combinations under silvopastoral versus open pasture systems in north Florida. Ryegrass (*Lolium multiflorum* Lam.) (R), crimson clover (*Trifolium incarnatum* L.) (C), and red clover (*Trifolium pretense* L.) (D) in combinations of R, RC, and RCD forage treatments were overseeded into an 'Argentine' bahiagrass (*Paspalum notatum* Flügge.) sod under a thinned 18-year old ($200 \text{ trees ha}^{-1}$) loblolly pine (*Pinus taeda* L.) stand, composed of two tree configurations (scattered and double-row), and in a pasture (no tree cover) in November 2003 and 2004. Forage treatments were replicated four times in a randomized complete block

design. Samples were clipped in the spring of 2004 and 2005. Dry matter (DM), crude protein (CP), and *in vitro* organic matter digestibility (IVOMD) were determined on oven-dried samples. Overall, pasture (7,417 kg ha⁻¹) produced 20% and 34% more DM than double-row (5,924 kg ha⁻¹) and scattered (4,866 kg ha⁻¹) tree configurations, respectively. Double-row produced 18% more DM than scattered tree configuration. Forage from the pasture treatment had approximately 3% greater IVOMD (77.4%), but similar CP (19%) compared to silvopasture. Both RC (6,238 kg ha⁻¹) and RCD (6,177 kg ha⁻¹) had increased DM production compared to R (5,792 kg ha⁻¹), but IVOMD (75.5%) and CP (19.5%) were similar. Based on forage yield and quality, a mid-rotation loblolly pine stand can be converted to productive silvopasture.

Chemical Composition of Soils Under Forages Grown Between

Tree Rows of Loblolly Pine Trees. O.U. Onokpise, L. Whilby and N.G. Bradley

Agronomy, Forestry and Natural Res. Conservation Program, Florida A&M Univ., Tallahassee, FL.

In 2001 and 2002, 18 to 20 year-old loblolly pine (*Pinus taeda* L.) trees at the Florida A&M University Research and Community Development Center were systematically thinned for the establishment of an agrosilvopastoral system with Boer x Spanish crossbred goats (*Capra hircus*). Prior to seeding tree rows with either bahiagrass (*Paspalum notatum* Flüggé) or bermudagrass [*Cynodon dactylon* (L) Pers.], soil samples were randomly collected at a depth of 15 cm. Thirty-three soil samples per hectare were collected from three separate blocks (2, 3 and 7) before, and 28 and 52 weeks after planting (WAP) using a soil probe. The soil samples were analyzed for macro- and micro- nutrients to evaluate the impact of tree and forage growth on soil nutrients compared to a parallel unshaded site. Overall, there was a significant decline in soil chemical composition over the 52 weeks of sampling in the shaded area for total kjedhal nitrogen (TKN), P, K, Zn, Ca, Mg, and S. However, in the unshaded areas, the reduction in TKN, Zn, Ca and P was non-significant. The implication of the results is that the agrosilvopastoral fields will have to be managed by individual blocks in order to ensure the effective utilization of nutrients not only among trees but also for the pasture grasses.

Effect of Topsin M and Karate on Square Abortion and Incidence of

Hardlock Disease in Cotton. *E. A. Osekre¹, D. L. Wright², and J. Marois²

¹ Agronomy Dept., UF/IFAS ²NFREC, UF/IFAS, Quincy, FL.

Hardlock disease, caused by *Fusarium verticillioides*, is a serious disease that reduced cotton yields in the Florida panhandle by 50-60% in 2002. It was estimated to have caused over \$20 million in lost yield in that year. High plant density, high temperature, and high humidity during the growing season have been associated with the incidence of the disease. It is believed that thrips can help spread *Fusarium verticillioides*. Cotton variety trials conducted showed that the disease affects all varieties currently being grown. The disease is also believed to cause increased abortion of cotton squares, leading to reduced boll set. Field studies were conducted at North Florida Research and Education Center at Quincy to: 1) evaluate

the effectiveness of a fungicide (Topsin-M), an insecticide (Karate), and a combination of the two pesticides for the control of the disease; and 2) determine the effects of environmental factors on the abortion of cotton squares. Results showed that there were no significant differences in the number of aborted squares and yield of the pesticide-treated cotton plants and the control. There were also no significant differences in hardlock incidence in the Karate or Topsin plus Karate treated plants and the control. Hardlock incidence in the Topsin-M treated plants was, however; significantly higher than in the untreated control. Relative humidity appeared to be the single most important environmental factor affecting cotton square abortion.

Preliminary Observations on Growth and Yield of Kenaf in Florida. J. J. Ferguson¹, G. W.

Feaster², and J. J. Sifontes³¹Horticultural Sci. Dept., UF/IFAS ²Kenaf USA, LLC., St. Augustine, FL ³ Sigarca, Inc., Gainesville, FL.

Two kenaf (*Hibiscus cannabinus* L) cultivars Guatemala-4 and India were planted near Citra, FL, on 24 June 2004 using a grain drill and an air planter at plant densities ranging from 143,000 to 334,000 seeds ha⁻¹ based on 4.5 m² samples for both cultivars. All plots were fertilized with 447 kg ha⁻¹ of a 20-16.6- 8.8 fertilizer before planting and 261 kg ha⁻¹ of ammonium nitrate (33.5% N) on 10 Aug. 2004. Seedlings emerged approximately 7 d after planting. By 70 d after planting, height and dry weight of Guatemala-4 plants were generally greater than that of India plants. Ninety days after planting, yield of India plants mowed at 15- and 30-cm height ranged from 353 to 314 Mg ha⁻¹ fresh weight, respectively, based on plants harvested from 0.02 ha samples. Comparisons of growth and yield of cultivars planted at different densities with different planting methods were not possible because of severe root knot nematode damage.

Fertilization, Aeration, and Sewage Biosolid Effects on Kikuyugrass Pasture

Productivity. Bruce W. Mathews¹ and James R. Carpenter² ¹College of Agric., Forestry, and Natural Resource Management, Univ. of Hawai'i at Hilo, Hilo, HI ²Dept. of Human Nutrition, Food, and Animal Sci., Univ. of Hawaii at Manoa, Honolulu, HI.

There are few data available for responses of old kikuyugrass (*Pennisetum clandestinum* Hochst. *ex* Chiov.) pastures to fertilization and aeration. The productivity of grazed kikuyugrass was evaluated for 2 yr in response to aeration with and without fertilizer N (300 kg ha⁻¹ yr⁻¹ in five split applications) and fertilizer N + P (single 300 kg P ha⁻¹ application). The pasture had not been fertilized in 36 yr, but fertility of the volcanic ash-derived silt loam soil (Hydrudand) was of good except for a low (12 mg kg⁻¹) extractable P concentration. Forage production was increased only by N fertilization despite marginal kikuyugrass-P concentrations for the treatments without P fertilization. A simultaneous 2-yr study was conducted on an adjacent long-term (30 yr) fertilized kikuyugrass pasture for the same N alone and N + aeration treatments, an annual 300 kg N ha⁻¹ yr⁻¹ sewage biosolid application (B-A1N), or a single 600 kg N ha⁻¹ sewage biosolid application at study initiation (B-S2N). During the first year, cumulative forage yield ranked the treatments B-S2N>B-A1N>N + aeration or

N alone. The first year, total annual N uptake mirrored forage DM production but over half the annual N uptake for the biosolid treatments occurred during the first three defoliations. There were no differences among the N and biosolid treatments for yield or N uptake in the second year. Based on these studies, use of spiked tine aeration equipment on kikuyugrass cannot be recommended, but the potential of sewage biosolids as a slow release N source should be further investigated.

Influence of Grazing Frequency on Cynodon Grasses Grown in Peninsular Florida.

P. Mislevy, Agronomy Dept., RCREC, UF/IFAS, Ona, FL.

Bermudagrass (*Cynodon doctylon* L. Pers.) and stargrass (*C. nlemfuensis* Vanderyst var. *nlemfuensis*) are among the most important of the warm-season perennial grasses used in warmer regions of the world. The purpose of this experiment was to test four lines each of stargrass and bermudagrass at different grazing frequencies (GF) for dry biomass (DB) yield, nutrient value, and persistence. A split-plot arrangement of a RCB with three replicates with GF (2, 4, 5, and 7 wk) as the main plot and grass entries/cultivars (Stargrass 2000, Florona, Okeechobee, and Ona Pasture No. 2 stargrass; Bermudagrass 2000, Jiggs, World Feeder, and Tifton 85 bermudagrass) as subplots was used. Dry biomass yield was monitored during the warm (May - December) and cool (December - March) seasons over a 3-yr period. Crude protein (CP) and in vitro organic matter digestion (IVOMD) was monitored June to November 2002 and April to October 2003. Warm season annual fertilization (four split N applications) consisted of 224-15-56 kg ha⁻¹ N-P-K + micros. At the beginning of the cool season 56 kg ha⁻¹ N was applied. Warm season DB yield of grass entries interacted with GF. Decreasing GF from 2 to 7 wk resulted in a linear increase in DB yield. Bermudagrass 2000 and Jiggs bermudagrass were among the two highest yielding entries at GF of yield between 7.6 and 6.9 Mg ha⁻¹, respectively, at 2 wk and 20.8 and 18.4 Mg ha⁻¹, respectively, at 7 wk. Winter forage production after 12 wk regrowth averaged 2.5 and 2.4 Mg ha⁻¹, respectively, for these same two entries.

Utility of Mehlich 1 and Mehlich 3 Soil Tests to Predict Citrus Tree Nutritional

Status. T.A. Obreza¹, R.E. Rouse², and K.T. Morgan² ¹Soil and Water Sci. Dept., UF/IFAS ²SWREC, UF/IFAS, Immokalee, FL.

Florida citrus growers want to use soil testing to guide fertilization, but UF-IFAS soil test P, K, and Mg interpretations for citrus were not established using a rigorous, standard calibration method. The objective of this experiment was to determine if Mehlich 1 or Mehlich 3 soil tests are suitable for predicting citrus tree nutritional status. In November 1998, we planted 'Flame' grapefruit (*Citrus paradisi*) trees on previously non-cultivated Immokalee fine sand. In subsequent years, dolomitic lime and varying rates of P/K fertilizer were applied to establish a range of soil test values. The recommended N fertilizer rate was applied each year. Soil and leaf tissue samples were taken each August to track soil test changes and tree nutrition. Leaf tissue nutrients for a given year were correlated with soil test values from the previous year. The two extracting solutions provided roughly equal values of soil test P and K, but Mehlich 1 extracted substantially

more Mg compared with Mehlich 3. Soil test K did not increase with K fertilizer application so correlation between leaf and soil K could not be attempted, but tree nutrition did respond positively to K-fertilizer rate. A relationship between leaf P and soil test P emerged in 2002 and became stronger in subsequent years. Leaf tissue P concentration below 1.2 g/kg (considered “low” nutrition) occurred only where soil test P was less than 10 mg/kg (a “very low” soil test). Leaf and soil test Mg were not sufficiently correlated to allow estimation of a critical value.

Developing a Sweet Corn Simulation Model to Predict Fresh Market Yield and Quality of Ears. J.I. Lizaso¹, K.J. Boote¹, J.J. Casanova², C.M. Cherr¹, J. Judge², J.M. Scholberg¹, J.W. Jones², A. Garcia³, and G. Hoogenboom³

¹Agronomy Dept, UF/IFAS ²Agricultural and Biological Engineering Dept., UF/IFAS; and ³Univ of Georgia, Dept. of Biological and Agricultural Engineering, Griffin, GA.

Typically crop simulation models calculate growth and yield on a dry matter basis. Yet, horticultural crops are commercialized on a fresh weight basis. Also the fresh market size of harvestable organs is important for quality purposes. The objective of this work was to develop and test a Sweet Corn simulation model able to calculate fresh market yield and quality of ears. The maize model distributed with the current DSSAT suite of models was modified to better simulate ear growth. Ear dry matter accumulation is assumed to begin 250 growing degree days before silking, with quadratically increasing sink strength. By silking, 30% of the daily available assimilates are partitioned to the ear. Ear growth concludes at the end of the lag phase, and during the linear grain filling only the seeds grow. The model calculates ear-plus-grain dry matter concentration as a sigmoidal function of the thermal time accumulated after silking. At silking, dry matter concentration is 10%. The model also estimates total fresh market yield of ears, marketable fresh weight (removing culls), and number and yield of ‘Fancy’ ears. The model was tested against four years of field measurements in experiments in Florida, where N doses varied between zero and 420 kg/ha. Our results indicated that ear dry weight and market fresh weight were simulated more accurately at medium and high N doses than at low N doses.

Detection of Bacterial Wilt Stress via Spectral Reflectance of Leaves in Crop Plants. G. Hacisalihoglu¹ and K. Milla² ¹Biology Dept., Florida A&M Univ., Tallahassee, FL ²GIS Remote Sensing Lab., Florida A&M Univ., Tallahassee, FL.

Today’s agriculture requires on-time detection of environmental stress which could save plant-based industries millions dollars annually. Rapid diagnostic tests currently are not available for the detection of plant stresses such as nutrient deficiencies or pathogenic diseases. Developing an early detection tool will help to restore the productivity of infested land used for important cash crops such as corn and tomato, as well as make the most use of non-renewable resources. In this study, a series of experiments were carried out to collect quantitative traits and spectral properties of leaves. ‘FL-47’ tomatoes (*Lycopersicon esculentum*)

were grown in soil mix in the greenhouse. Healthy and inoculated plants were grown and kept well watered after inoculation with bacterial wilt (*Ralstonia solanacearum*), which causes severe yield losses in tomato. A spectroradiometer (Field Spec HH) was used to measure reflectance in the range of $R_{325\text{nm}}$ to $R_{1075\text{nm}}$. We have found that bacterial wilt decreases reflectance at $R_{500\text{nm}}$. Overall results showed that spectral reflectance has an advantage over other assays as a non-destructive technique which can be performed both in greenhouse and field. This is the first report of spectral detection of bacterial wilt disease, and this study provides valuable information to assist plant growers in making reliable plant stress measurements on time.

Energy Fluxes and Land Surface Parameters in Grassland Ecosystems:

Remote Sensing Prospective. Assefa M. Melesse¹, Al Frank², Jon Hanson², Mark Liebig², and Vijay Nangia³ ¹Dept. of Environ. Studies, Florida International Univ. Miami FL ²USDA-ARS, Northern Great Plains Research Laboratory, Mandan, ND ³Upper Midwest Consortium, Univ. of North Dakota, Grand Forks, ND.

Characterization of land surface and estimation of energy flux values are required in many environmental studies including hydrology, agronomy, and meteorology. The continuous micro-scale energy exchange between the land surface and the near-surface atmospheric layer can be simulated using surface energy budget models. Spatial variability of energy fluxes in larger areas limits point measurements and necessitates remote sensing for spatial mapping of energy fluxes. A remote sensing-based land surface characterization and flux estimation study was conducted using data from 1997 to 2004 on two grassland experimental sites located at the USDA, ARS Northern Great Plains Res. Lab., Mandan, ND. Spatially distributed surface energy fluxes (net radiation [R_n], soil heat flux [G], sensible heat [H], latent heat [LE], emissivity [ϵ], albedo [α], normalized difference vegetation index [NDVI] and surface temperature [T_{sur}] were estimated. These estimates were then mapped at a pixel level from Landsat Thematic Mapper and Enhanced Thematic Mapper images and weather information using the Surface Energy Balance Algorithm for Land (SEBAL) procedure as a function of grazing land management (heavily grazed, HGP, and moderately grazed pastures, MGP). Energy fluxes and land surface parameters were mapped and comparisons were made between the two sites. Over the study period, H , ϵ and T_{sur} from HGP was higher by 6.7%, 18.2% and 2.9% than in MGP. The study also showed G , LE and $NDVI$ were higher by 1.3%, 1.6% and 7.4% for MGP than in HGP. The results show remote sensing approach to characterize grassland sites was an effective technique.

Importance of Soil Organic Matter in Florida Citrus Production. A.W. Schumann, Q.U. Zaman and K.H. Hostler, CREC, Lake Alfred, FL.

Florida citrus production is strongly affected by soil properties which are not always delineated by soil series. The objective of this study was to investigate the roles of soil organic matter (SOM) and mineral nutrients

affecting production of selected citrus groves. Five grid or transect soil surveys were conducted to collect soil samples for analysis from 4- to 6-profile-depth intervals (0-15, 15-30, 30-60, 60-90, 90-120, 120-150 cm). From a sixth site, soil samples from the same depth intervals were collected as pairs, comparing citrus grove soils with adjacent unplanted soils. Soil organic matter, pH, EC, density and color were measured for all samples, and exchangeable acidity, DTPA-extractable Fe, extractable P, K, Ca, Mg, and CEC were analyzed for selected samples. Tree vigor and size were estimated from color-NIR aerial photographs using the Normalized Difference Vegetation Index (NDVI). Stepwise multiple regression analysis revealed that SOM was correlated with tree performance across all sites. Comparison of citrus with non-citrus soils showed that after more than 40 years of grove monoculture, SOM was significantly depleted by 36.5 Mg/ha in the upper 15 cm of the sampled soil profile. The importance of SOM in Florida's sandy citrus soils was demonstrated, and growers should implement options to conserve this important soil property.

Fertilization of Grazed Bahiagrass Pastures in South Florida. Martin B. Adjei¹, and J.E. Rechcigl² ¹RCREC, Ona, FL ²GCREC, Wimauma, FL.

The objective of this 8-yr study was to test the UF/IFAS hypothesis that P or K fertilization was not needed on grazed bahiagrass (*Paspalum notatum*) pastures in south Florida. Sub-plot, fertilizer treatments: 1) 67 kg N ha⁻¹ (N); 2) 67-12-56 kg N-P-K ha⁻¹ (NPK); 3) 67-12-56 kg N-P-K ha⁻¹ plus 22 kg ha⁻¹ of micronutrients mix (NPKM); and 4) control (no fertilizer) were superimposed annually on lime (pH > 5.0) vs. no-lime (pH < 4.5) treatments from 1998 to 2005 on two grazed pastures (71A and 81). The 8-yr mean forage dry matter yield (11.9 Mg ha⁻¹) was not different due to treatment on pasture 71A but was improved with lime vs. no-lime treatment (9.4 vs 7.4 Mg ha⁻¹) and with the NPK treatment over the other fertilizer treatments under liming (10.5 vs 9.9 Mg ha⁻¹) on pasture 87. Plant tissue P averaged 2.6 g kg⁻¹ for the NPK and NPKM treatments regardless of pasture or liming treatment, but declined progressively from 2.5 to 1.8 g kg⁻¹ for the N and no-fertilizer treatments during 8 years. Similarly, tissue K averaged 12.5 g kg⁻¹ for the NPK and NPKM treatments on both pastures and liming situations but declined to 8.1 g kg⁻¹ for the N and no-fertilizer treatments during the same period. These results generally validate the need for little additional K or P on grazed bahiagrass for yield improvement but the huge decline in tissue P and K concentrations over time for the N-only treatment could weaken the sod.

Carbon Balance and Agriculture in Histosols of the Everglades Agricultural Area: Review, Analysis, and Perspectives. Leon Hartwell Allen, Jr. *USDA-ARS, Univ. of Florida, Gainesville, FL 32611-0965*

How does carbon released from oxidative subsidence of Everglades Agricultural Area (EAA) drained Histosols compare with global carbon inputs to the atmosphere? How does carbon content of sugarcane (*Saccharum officinarum* L.) yield in the EAA compare with carbon of oxidative subsidence? Assuming historical subsidence rates of 2.54 cm yr⁻¹, bulk density of 0.23 g cm⁻³, percent organic matter of 87%, and

percent carbon of organic matter as 50%, the carbon mass/soil volume is $0.1000 \text{ g (C) cm}^{-3}$, and the annual efflux would be $25,400 \text{ kg (C) ha}^{-1} \text{ yr}^{-1}$. A molecular weight ratio ($\text{CH}_2\text{O/C}$) of 2.5 gives $63,500 \text{ kg ha}^{-1} \text{ yr}^{-1}$ (biomass CH_2O equivalent to subsidence carbon loss). Using 240,000 ha for the EAA gives $6.1 \times 10^{12} \text{ g (C) yr}^{-1}$ emitted to the atmosphere. Fossil fuel burning in the 1990's released $6.4 \times 10^{15} \text{ g (C) yr}^{-1}$, about 1,050 times more carbon. Based on carbon balance, assuming 2.36 m mean remaining Histosol, the EAA has enough peat to supply global energy needs for only 32 days! Since mean sugar yields are $9,100 \text{ kg ha}^{-1} \text{ y}^{-1}$, then $63,500/9,100 = 7.0$, indicating subsidence carbon losses 7.0 times more than mean sugar carbon. If mean total harvested sugarcane biomass is $17,000 \text{ kg ha}^{-1} \text{ y}^{-1}$, then $63,500/17,000 = 3.7$. Since recent subsidence rates are 1.45 cm yr^{-1} , the respective ratios may be smaller, 4.0 and 2.1. Recovery of trash after harvest, accounting for below-ground biomass, and producing high-yielding crops on shallow watertable soils could potentially decrease the calculated carbon lost/carbon fixed ratio to 1.0 or less. For example, *Typha* spp. growing in nutrient-rich, shallow water accreted peat at 1.1 cm yr^{-1} .

END OF ABSTRACTS
