

## Citrus Section Abstracts

### **Factors Affecting Brix and Other Quality Attributes of Indian River Grapefruit**

*L. G. Albrigo and W.S. Castle, Citrus Research and Education Center, IFAS, University of Florida, Lake Alfred, FL*

Nutrition, cultivar, rootstock, climate/weather, and irrigation are all established factors that influence grapefruit internal and external quality, but only the latter four are considered herein. The importance of rootstock has been reinforced of late because of juice quality problems with trees on the very popular rootstock, Smooth Flat Seville. A comparison of juice quality among sized fruit samples from trees on this rootstock and sour orange showed that regardless of fruit size, samples from the Smooth Flat Seville trees always had lower Brix values. The weather in recent years has resulted in earlier blooms, faster fruit development (warmer Springs) and earlier maturation (warmer Falls). These conditions would normally be expected to lower internal quality. Excessive irrigation also results in lower concentrations of brix and acidity. Growers can consider spot picking South and West top-halves of trees for early harvests in order to have higher brix and ratio. Irrigation rates to maintain a slight water deficit in the Fall and early Winter may improve concentrations of brix and acidity without undue effects on fruit size. Deficit irrigation at critical times in the Winter also may delay the bloom period and provide a longer maturation period in the following Fall & Winter, which would allow more time for sugar accumulation before the fruit matures.

### **Water Requirements for Flatwoods Citrus**

*Brian Boman, Indian River Research and Education Center, UF; and Sanjay Shukla, Southwest Florida Research and Education Center, UF*

The driving forces of evaporation and transpiration are directly related to temperature, humidity, and wind velocity. During extended droughts, the typical combination of warmer than average temperatures, lower than average humidity, and often times higher wind velocities tend to result in higher than normal evapotranspiration (ET) rates. As a result, calculations based on monthly averages will tend to under estimate water use during dry periods. This paper summarizes some of the most important factors relating to water use by citrus trees grown on flatwoods soils: soil physical properties, root systems, salinity, rainfall patterns, uniformity and efficiency, and upflux from the water table. The daily historical rainfall records at the Indian River Research and Education Center over the last 50 years were evaluated to determine frequency and extent of drought periods. There were 33 periods of 4 weeks or more that had less than 0.25 inches of rainfall, 34 periods with less than 0.05 inches of rain, and 52 periods with less than 1.0 inch of rain. When rainfall in the spring dry season was analyzed, it was found that 34% of the years had periods of 4 weeks or longer during March-May that had 0.25 inches of rain or less. In addition, 48% of the years had periods of 4 weeks or more with 0.5 inches or less, and 68% with 1.0 inch or less. Calculations show that the combination of shallow rooting, sandy soils, and lack of perched water table during the dry season requires irrigation on a 1-2 day frequency during peak ET periods to provide adequate soil moisture for trees. Therefore, irrigation systems for citrus should be designed for complete ET replacement during the critical March to mid-June period. If saline irrigation water is used, additional water will be required for frequent irrigations to leach salts below the root zone.

## **Irrigation Templates for Florida Citrus**

*Chet Townsend, Agrilink Florida Inc., Alva, Florida*

After more than two years of examining continuous soil moisture data, using capacitance soil moisture probes, in Florida citrus groves, the author has developed an "irrigation template" for growing Florida citrus. Using site specific data, and applying recommendations from the University of Florida, repeatable irrigation templates can be followed each growing season to maintain different levels of soil moisture at different times during the year, for each variety of citrus. With proper monitoring, growers can maintain proper moisture levels in the spring and summer to promote fruit set and fruit sizing, set much lower moisture levels in the fall and winter, using much less water. This drying down process should help increase brix and pounds solids and enhance the induction of bloom, while improving overall production. Examples of Irrigation Templates for Florida Citrus will be presented.

## **Root Systems of Healthy and Declining Citrus Trees Growing in Flatwoods Soils**

*Mace Bauer, Indian River Research and Education Center, UF; Brian Boman, Indian River Research and Education Center, UF; Bill Castle, Citrus Research and Education Center, UF; Tom Obreza, Soil and Water Science Department, UF; and Ed Stover, Indian River Research and Education Center, UF.*

The variable performance of trees on Swingle citrumelo rootstock appears related to differences in root growth and soil characteristics. For this study we observed the root systems of trees at several locations in the Indian River and Southwest Florida production areas. Roots were examined by trenching between adjacent trees using a small backhoe with a 16 in. wide bucket. The exposed roots were observed and the quantities and relative proportions of fibrous and secondary roots noted. The soil morphology of each profile was described and samples were collected for lab analysis that included tests for organic matter, pH, Ca, Mg, P, K. All of the trees observed in this study were over 10 years old, apparently healthy, and ranged in size from small trees to large, hedged and topped trees. We also studied the root systems of trees in decline which had chlorotic leaves, small fruits, and twig dieback. Roots of healthy growing trees had the typical "pancake" distribution with an even proportion of fibrous and secondary roots primarily in the A horizon and distributed 2/3 on the crown side and 1/3 on the furrow side. Declining trees frequently had less typical root distributions. In sites with Riviera depressional soil, root size was usually less than 1/4 inch in diameter and the outer sheath of roots easily sloughed off. Roots were typically dark brown or dark gray and there was decaying root material in the root zone. The root systems in declining trees on Riviera/Basinger/Malabar/Pineda soils with bright soils and deep clay did not appear damaged. The root systems were composed primarily of fibrous roots with a healthy pale brown appearance, with root diameter rarely greater than 1/4 inch. In sites with declining trees on Riviera/Pineda soils with a thick dark grayish brown A horizon that appeared to have adequate drainage, there were many secondary roots up to 3/4 inch diameter but an absence of fibrous roots. In these cases, it appeared the sites were adequate for tree growth for several years and some event damaged the roots. There was little correlation between tree vigor and any of the measured soil chemical parameters. Adequate soil drainage and the presence of a thick, dark surface horizon appeared to be the most important characteristics influencing the development of the root systems.

## **Evaluating Variable Rate Fertilizer Technologies in Florida Citrus**

*W. M. Miller, A. W. Schumann, and J. D. Whitney, Citrus Research and Education Center, UF*

Granular fertilizer applications utilizing VRT (variable-rate technology) for Florida citrus can be implemented through real-time or GIS-map based control. Evaluations have been undertaken to establish the response of both systems. A test program, using ASAE S341.3, has been established for standardized conditions. Two units with different hydraulic configurations and real-time tree sensors have been tested. Additionally, field trials have been undertaken to ascertain fertilizer distribution under grove conditions. In these field trials, both spinner disc and pneumatic discharge units have been evaluated. Fertilizer distribution under grove conditions yielded distributions quite different from the Gaussian distributions found in open-field standardized tests. Coefficient of variation values in tray distribution tests were lower, 32.1% (grove conditions) versus 93.9% (open-field conditions) in comparing the same spreader unit. Effects of various electronic, mechanical, pneumatic components on VRT system performance are considered.

### **A Solution for the Anionic/Cationic Balance Problem in Mineral Nutrition Studies**

*Randall P. Niedz and T.J. Evens. Agricultural Research Service, U.S. Horticultural Research Laboratory, Ft. Pierce, FL*

Designing culture media for mineral nutrition studies is a complicated problem. A primary reason is that in order to change the concentration of a single anion or cation it is generally necessary to change the complementary cat-/anion of the salt complex, thereby making it difficult to devise media that differ only in the concentration of a single ion. Consequently, it often becomes necessary to simultaneously alter both the type and/or concentration of multiple salts to achieve a final set of media that differ only in the concentration of a single ion; when the objective is to alter the concentration of multiple ions the problem's complexity is increased considerably. The anion/cation balance problem is easily solved by linear programming (LP), a technique of applied mathematics devised specifically for solving a wide range of practical, complex, resource allocation problems such as scheduling, mixing, blending, and routing. The anionic/cationic balance problem, how it is easily solved using LP techniques, and a public domain software program designed for nutrient formulation research will be presented.

### **Improving Efficiency of Field Trials through Optimizing Experimental Design**

*Ed Stover, Indian River Research and Education Center, UF; and Ken Portier, Department of Statistics, UF*

Simulations were used to contrast the ability of different experimental designs to distinguish defined treatment differences. In all cases, a single experimental treatment was compared to a control treatment and each treatment was applied to twelve trees. Experimental designs compared were twelve blocks with a single tree per treatment, six blocks of two trees per treatment, four blocks of three trees per treatment, and two blocks with six trees per treatment. In each case, analyses were compared in which data was collected on each tree (each tree was an experimental unit or individually sampled within a multiple tree experimental unit), or data was pooled on a group of trees. Trees were blocked according to a specified factor, which was quantified for these comparisons but could represent a qualitative factor such as spatial position. The probability of rejecting the null hypothesis was computed for a range of situations including small and large values for the following parameters:

treatment response, standard deviations of the response, blocking factor effects, and blocking factor standard deviations. In all cases, power of the test was significantly greater when data was collected on individual trees, and decreased as the number of trees pooled per data point increased. Analyses indicated that use of one or two trees per treatment per block with data collected on individual trees provides the greatest efficiency in distinguishing treatment effects, and that two trees per treatment per block is superior when there is a significant treatment by blocking factor interaction.

### **Preparing Trees for Citrus Mechanical Harvesting - Cost and Enhancing Harvesting Performance**

*F.M. Roka and R.E. Rouse, Southwest Research and Education Center, UF*

UF/IFAS personnel have been collecting performance data on citrus mechanical harvesting systems since the 1999-00 season. In addition, data were collected on tree characteristics including skirt and clear trunk heights. Working in typical southwest Florida grove conditions, trunk shakers and continuous canopy shakers with catch frames remove 95% and recover 90% of the on-tree fruit. Removal indicates the percentage of fruit detached from the tree. Recovery measures the percentage of on-tree fruit that the harvesting system delivers to the bulk trailer. Removal and recovery rates are dependent upon adequate tree preparation. Current recommendations for citrus mechanical harvesting systems with catch frames suggest that trees be skirted to a height of 36 inches at the drip line and lower scaffold limbs pruned for at least 18 inches of clear trunk height. This paper presents typical costs associated with preparing trees for mechanical harvesting systems. Data are presented that indicate how removal and recovery percentages are affected by skirt and clear trunk heights.

### **The History of Sulfur Use on Florida Citrus and its Effect on Scale Populations and the Environment**

*Paul J. Driscoll, Grove Manager, Fort Pierce, FL*

The long history of heavy sulfur use on Florida citrus had detrimental effects on both scale populations and the environment. These effects are described and quantified. What took place to change things and create our present situation, which is almost scale-free, is outlined in detail. Subject will be presented as experienced by the author during his 50 plus years in the Florida Citrus Industry.

### **Copper Toxicity on Florida Citrus – Why Did it Happen?**

*Paul J. Driscoll, Grove Manager, Fort Pierce, FL*

Copper has been used on Florida citrus for both nutritional and disease control for about 80 years. About 30 years after the start of its use, a widespread toxicity problem developed. Why that happened, who discovered it, and what was recommended to correct it is discussed.

### **The Use of Serenade® Biofungicide to Control Foliar Fungal Diseases of Florida Citrus**

*H. Brett Highland AgraQuest, Inc, Nokomis, FL. and L. W. Timmer, University of Florida, Lake Alfred, FL.*

Serenade® *Bacillus subtilis* biofungicide (QRD 137, QRD 131, QRD 132, QRD 141) is a new biologically based fungicide/bactericide registered for use against a variety of fruit pathogens, including fire blight, scab and powdery mildew of apples and pears, mummy berry of blueberry, and gray mold (sour rot), powdery mildew and downy mildew of grapes. Serenade has been shown to inhibit plant pathogens by stopping spore germination, disrupting germ tube and mycelial growth and producing a zone of inhibition through secondary metabolites to restrict pathogen growth. Field trials were conducted in Florida citrus demonstrating the activity of Serenade against postbloom fruit drop (*Colletotrichum acutatum*), Alternaria brown spot (*Alternaria alternata*), citrus scab (*Elsinoe fawcetti*), and greasy spot (*Mycosphaerella citri*). Serenade biofungicide can be viewed as a viable, effective, safe, and IPM acceptable alternative for foliar disease control in Florida citrus.

## **Efficacy of Envidor™, A New Acaricide from Bayer CropScience, against Eriophyidae Mites on Florida Citrus**

Marco A. Toapanta<sup>1</sup>, John Bell<sup>2</sup>, Joby Sherrod<sup>3</sup>, Roy Morris<sup>2</sup>, and Richard Rudolph<sup>4</sup>

<sup>1</sup>

Bayer CropScience, 19046 Bruce B Downs Blvd. PMB 221. Tampa, FL. 33647. <sup>2</sup> Bayer CropScience, 2 T.W. Alexander Dr. RTP, NC. 27709. <sup>3</sup> A. Duda and Sons, P.O. Box 788. LaBelle, FL. 33975. <sup>4</sup> Bayer CropScience, 8400 Hawthorn Road, Kansas City, MO. 64120.

Envidor™ contains a novel acaricidal active ingredient, spiroadiclofen, from the new chemical class of tetronic acids. This new contact acaricide is active against the citrus rust mite (CRM), *Phyllocoptruta oleivora* (Ashmead), the pink citrus mite *Aculops pelekassi* (Keifer), the only two mite species recognized as economic pests on Florida citrus, and other mite species. In field tests conducted between 1996 and 2003 in Florida to control the CRM, Envidor, as a 2 lb AI/gallon suspension concentrate (SC) formulation, at rates ranging from 175.1 to 350.2 g AI/ha with and without horticultural spray oil provided levels of efficacy similar to or greater than commercial standards in the marketplace. In addition, Envidor 2 SC applied with different water volumes and at different mite population densities resulted in excellent control and residual efficacy for more than 3 months compared to commercially available acaricides. Envidor 2 SC provided excellent control of all developmental stages of Eriophyidae and Tetranychidae mites, including eggs and adult females, through a new mode of action, inhibition of lipid biosynthesis. Moreover, Envidor has no cross-resistance to acaricides currently available in the market, which offers a powerful tool for pest management in citrus.

## **Drift Potential of Citrus Air-Carrier Sprayers**

M. Salyani and M. Farooq, Citrus Research and Education Center, IFAS, UF

The off-target drift of pesticides could build up residues on residential areas, surface water reservoirs, or on non-target crops. These pesticide residues might create health, environmental, and economic problems. For these reasons, spray drift from agricultural operations has generated worldwide concern about the safety of pesticide applications. In Florida, the rapid expansion of urban developments and proximity of the residential developments to citrus groves has made the drift issue more critical than ever. In some cases, it has become a limiting factor for the continuation of certain operations. Therefore, it is necessary to minimize spray drift from citrus pesticide applications. The

objective of the paper is to identify factors that affect spray drift from commonly practiced spray applications. Experiments with different citrus air-carrier sprayers have shown that all sprayers are capable of generating spray drift but the magnitude of drift depends on sprayer design, operating variables, and weather conditions during the application. In general, low-volume sprays, high ground speeds, and small droplets appear to be more drift-prone than other application conditions; however, the extent of drift largely depends on prevailing wind direction. The paper will discuss the effects of sprayer design, spray volume rate, and nozzle size on drift potential of the applications.

### **Preliminary Evaluation of Nonsynthetic Herbicides for Weed Management in Organic Orange Production**

*C. A. Chase, Horticultural Sciences Department; J. M. Scholberg and G. E. MacDonald, Agronomy Department, UF*

A method of using cover crops for suppression of weeds in the row middles of organically grown oranges is being developed. However, weed control within the tree rows is currently accomplished by cultivation, which is time consuming and tedious. Alternative weed management methods are being sought that would be less labor intensive and equally effective or more effective than cultivation. The objectives were to compare the efficacy of three nonsynthetic, postemergence, contact herbicides (Alldown, Matran 2, and Xpress) with that of corn gluten meal applied preemergence, and flaming for weed control in organically grown oranges. Also of interest was whether weed control could be improved by a pretreatment of mowing or tillage. The most effective treatments were flaming and a 20 % concentration of Matran 2, providing better than 60% weed control within the first three weeks after application (WAA), and up to 5 WAA for Matran 2 applied to tilled plots. The 10 and 15 % Matran 2 sprays effectively suppressed only young weed growth in tilled plots. Corn gluten meal was effective only in tilled plots and provided good control for more than five weeks. Efficacy with Alldown was initially good within 1 WAA, but declined to less than 60 % by 3 WAA. Inconsistent results obtained with Xpress may be because its two component oils are not miscible and not equally herbicidal.

### **Effects of Soil Liming on Citrus Seedling Growth and *Diaprepes* Root Weevil Larval Survival**

*Hong Li, James P. Syvertsen, Clay W. McCoy, Robin J. Stuart, and Arnold W. Schumann University of Florida, IFAS, Citrus Research and Education Center Lake Alfred, FL 33850*

We conducted a study of soil liming x flooding x *Diaprepes abbreviatus* (L.) root weevil larval feeding in citrus in the greenhouse in 2003. The objectives were to determine the effect of flooding events on the outcome of soil liming, and the interaction of soil liming and flooding on citrus growth and *Diaprepes* larval survival. We used a Floridana sandy soil (mean pH 4.8) from a citrus grove damaged by *Diaprepes* root weevil in Osceola County, Florida. The treatments consisted of three soil pH levels (non-limed, and target pH 6 and 7), two citrus varieties (Swingle and Carrizo), two flooding durations (0 and 40 days), and two larval rates (0 and 5 neonate larvae feeding for 55 days). Dolomite (75%CaCO<sub>3</sub> and 18%MgCO<sub>3</sub>) was used for liming. There were 15 replicates (one seedling in a 150-ml container) arranged in a completely randomized design. The results showed that soil pH increased 0.5-0.9 units for the target pH 6, and 0.7-1.1 units for the target pH 7. The linear effect of liming rate was significant ( $P < 0.001$ ). Flooded soil pH was 0.3 units higher than non-flooded soil. Seedling stem growth increased significantly from 2.8 cm in non-limed soil to 3.6-4.3 cm in limed soil ( $P < 0.01$ ). Larval

survival rate increased significantly with low soil pH (4.5-5.1), then decreased from 80% to 60% with high soil pH (5.2-5.7). Total larval weight decreased significantly from 60 mg to 12 mg per seedling when the soil pH increased from 5.1 to 5.7. It is suggested that increasing soil pH by 0.5-1 units could improve citrus growth and lower *Diaprepes* larval survival rate.

### **Effect of Chemically Treated and Untreated Populations of *Diaprepes abbreviatus* on the Growth, Development and Survival of 'Hamlin' Orange Trees Budded to Five Rootstocks**

*C. W. McCoy, W. S. Castle, J. H. Graham, J. P. Syvertsen, A. W. Schumann, and R. J. Stuart, Citrus Research and Education Center, UF, IFAS*

A pest management study was initiated in a bedded planting of 2-year-old 'Hamlin' orange trees budded on five rootstocks. The experimental site was located within a mature grove harboring a high *Diaprepes* root weevil (DRW) population and with poorly drained, fine-textured sandy soil. After 2 - years on a young tree care program that included insect and mite control, *Diaprepes* root weevil DRW was allowed to infest more than one-half of the new 'Hamlin' rootstock planting. In 2003, we compared the effect of foliar and soil-applied chemicals recommended for DRW to no pesticides in a seasonal control program that included monitoring adult emergence and tree canopy abundance. In the winter of 2003-2004, tree health was determined by measuring rate of tree trunk growth, and canopy volume, tree decline, and leaf injury for 'Hamlin' trees budded to different rootstocks. The incidence of *Phytophthora nicotianae* was monitored but not treated during the 3 years. Foliar and soil-applied chemicals, timed according to adult DRW emergence and abundance on the tree, were effective in suppressing weevil populations. In addition, treated trees had a faster rate of growth, larger tree canopies, less foliar injury and less tree decline than untreated trees. 'Hamlin' trees on rootstocks such as C-32 and C-35 had higher growth rates and weevil population. In assessing overall root health, it appeared that DRW root injury was creating site(s) for infection and bark damage by *Phytophthora* based on the resistance of the rootstocks. Tree decline was most apparent among trees on Cleopatra mandarin and it was not reduced by DRW control; tree decline was lower with DRW control for certain *Phytophthora* resistant rootstocks (C-22, C-32).

### **Web-Based Reporting of Abundance of Adult *Diaprepes* Root Weevils from Six Sites in Florida Using Tedders Traps, 2001-2003**

*S. H. Futch, L. W. Duncan, Citrus Research & Education Center, UF, M. Zekri, Hendry County Extension Service, LaBelle*

*Diaprepes* root weevil (*Diaprepes abbreviatus*) is a serious pest in Florida's horticultural and agronomics crops. Cost-effective methods to determine adult emergence patterns are limited, expensive and time consuming. Basic information as to the current and seasonal patterns is essential for the development of control strategies. To determine the emergence patterns of *Diaprepes* root weevils, un-baited pyramidal traps, commonly referred to as Tedders traps, are being used as a method to determine the seasonal abundance patterns of the weevils. At each of the six sites throughout the State of Florida, 100 un-baited traps are distributed within the location where data is collected weekly as to the number of weevils captured. Collected, weekly data is posted to a web-site to allow for rapid dissemination of the information as to the emergence patterns at each location with time. While actual emergence numbers vary with location and within a given grove, trends within each geographical region should have similarities. Data can be accessed via the web at <http://www.lal.ufl>.

edu/Diaprepes /diaprepesemergence.htm .

## **Soil, Rootstock, and Climatic Factors Affect Populations of *Phytophthora nicotianae* in South Florida Citrus Plantings**

<sup>1</sup>

*D. B. Bright, <sup>2</sup>M. S. Irey, <sup>2</sup>L. E. Baucum, and <sup>1</sup>J. H. Graham, <sup>1</sup>Citrus Research and Education Center, UF, Lake Alfred and <sup>2</sup>U.S. Sugar Corporation, Clewiston, FL*

*Phytophthora nicotianae* (*Pn*) is endemic in Florida citrus groves and causes fibrous root rot. Annual surveys of rhizosphere populations of *Pn*, soil characteristics, and plant nutrient status were conducted in two citrus plantings: Grove 1 from 1998-2000, and Grove 2 in 1999 and 2001. In Grove 1, *Pn* populations on rootstocks over 3 yr ranked: Cleopatra mandarin > Carrizo citrange > sour orange >> Swingle citrumelo = Palestine sweet lime > Volkamer lemon (n = 31-159). *Pn* populations were highest on Myakka fine sand, intermediate on Immokalee, Margate, Holopaw, Basinger, and Riviera fine sands, and lowest on Holopaw LS, Boca and Oldsmar fine sands (n = 16-225). *Pn* populations were positively correlated with % clay, and negatively correlated with % sand and saturated hydraulic conductivity (SHC); *Pn* populations were weakly correlated with soil and plant nutrient status. SHC was highly predictive of *Phytophthora* populations when rainfall was high in the 1998-99, but not predictive in relatively dry years. In Grove 2, ranking of *Pn* populations on rootstocks was similar to that in Grove 1. Relationships with rootstock susceptibility, soil drainage, and rainfall patterns define where and when *Pn* populations reach damaging levels, as well as the management tactics that are most effective to maintain root health.

## **Status of the Citrus Canker Eradication Program in Florida and University of Florida Citrus Canker Extension Program**

*H.L. Chamberlain, P.D. Roberts, Southwest Florida Research and Education Center, UF, L.W. Timmer, Citrus Research and Education Center, UF, and M. Zekri, Southwest Florida Multi-County Citrus Extension, Hendry County Extension Office, UF*

Citrus canker, caused by *Xanthomonas axonopodis* pv *citri*, was detected in Florida for the third time in 1995 near the Miami International Airport on a residential citrus tree. Since detection, citrus canker has spread to sixteen different counties in central and south Florida. Various legal battles in the residential sector have halted eradication efforts in some areas of Florida. However, recent decisions from the Florida State Supreme Court have upheld the eradication process and procedures. Over two million commercial citrus trees and nearly 800 thousand residential trees have been removed. Eradication continues in residential areas and in commercial groves where canker is detected; quarantines are being removed from areas following successful eradication. A citrus canker extension program was developed to lead and coordinate education for the commercial citrus industry, homeowners, and non-citrus commercial businesses. The mission of the program is to reduce spread by eliminating transport of infected citrus plant material and encouraging decontamination of vehicles and personnel. The Division of Plant Industry continues to address legal issues where necessary and conduct extensive survey and control efforts. Public and private agencies have partnered to continue statewide education activities meeting the needs of various audiences.

## **Organic Citrus Production in Florida: Results of a 2003-2004 Survey**

Kevin Athearn, *Food and Resource Economics Dept., UF*

Organic production has grown rapidly in recent years. According to USDA data, certified organic citrus land in Florida increased from 2,296 acres in 1997 to 6,056 acres in 2001. In response to the need for data on existing organic production and marketing, a survey of more than 30 organic citrus growers in Florida was conducted between July 2003 and March 2004. Through a combination of in-person and telephone interviews, data was collected on organic acreage, varieties, grove care practices and costs, farm characteristics, incentives for adopting organic practices, difficulties associated with growing citrus organically, market outlets, information sources and research needs. This paper presents results of the survey research, which is intended to benefit growers, agricultural researchers, extension agents, and others interested in the organic citrus industry.

### **Gene Promoters and Their use in Citrus and Other Horticulture Crops**

Michael G Bausher , *US Horticultural Research Laboratory, USDA-ARS, Fort Pierce, FL.*  
mbausher@ ushrl.ars.usda.gov

We have come a long way to being able to produce “designer plants.” These plants will be created with specific traits and characteristics according to the needs and wishes of growers and consumers. The regulation of the new genes needed to produce these desired horticultural traits requires gene switches called promoters. Promoters are what turn “on” or turn “off” a gene. During the lifecycle of a horticultural crop, there are constant changes in the physiology of the plant that are caused by its reaction to the environmental, feeding insect pests, or when infected by disease-causing organisms. These changes occur when different genes are turned on and off. The gene promoters determine which and when genes are on or off. Current research is underway to discover promoters that turn genes on in specific tissues (e.g., for use in creating seedless fruit) and those which turn genes on when the producer or consumer wishes the trait to be “activated” (e.g., stimulate resistance to pests and diseases). The importance of promoters, and how they will be used to produce crop plants with specific characteristics or correct problems in current but excellent varieties will be discussed.

### **Evaluation of New Citrus Rootstocks for ‘Bearss’ Lime Production in Southern Florida**

W.S. Castle, *Citrus Research and Education Center (CREC), UF, IFAS, Lake Alfred, R.J. Schnell*, *USDA Subtropical Horticulture Research Station (SHRS), Miami, J.H. Crane*, *Tropical Research and Education Center, UF, IFAS, Homestead, J.W. Grosser*, *CREC, F.G. Gmitter Jr.*, *CREC, T. Ayala-Silva*, *SHRS*, and *K.D. Bowman*, *USDA, Horticultural Research Laboratory, Fort Pierce, FL*

Two ‘Bearss’ lime (*Citrus latifolia* Tan.) trials were planted in Miami-Dade County to evaluate the performance of new rootstocks specifically selected for their potential on the highly calcareous limerock soils common to the area. The first trial consisted of two replications of 10-tree plots planted in 1997 with a grower-cooperator. There were 20 rootstocks including various sexual and somatic hybrids plus Rangpur lime (*C. limonia* Osb.) for comparison. Yield was measured three times over 2 years and the cumulative results ranged from < 20 to nearly 160 lbs. of fruit/tree. The highest yielding trees were those on Volkamer lemon, Rangpur, *C. ambylcarpa*, US-801, and US-897. This trial was terminated and removed because of canker. The second trial of 52 sexual and somatic hybrid rootstocks was planted in 2001 at the USDA, Subtropical Horticulture Research Station, Miami, with six

replications of single-tree plots. Yield and tree size were measured once in 2004 before further data collection was suspended by the appearance of canker. Most trees were about 6 to 7 ft. tall and produced from < 1 to about 11 lbs. of fruit/tree. Among the higher yielding trees were those on the commercial standard for comparison, *C. macrophylla*, some selections of *C. limonia* (including Rangpur lime), several somatic hybrids, and Volkamer lemon. Tree condition and appearance (canopy greenness) were rated as a single variable to express apparent differences in nutritional adaptation to the soil. Trees on macrophylla, US-801, US-812, US-897, several somatic hybrids, the *C. limonia* selections, Rangpur lime, rough lemon, and Volkamer lemon were among those with the best ratings.

### **Importance of Postharvest Evaluations in a Fresh Fruit Breeding Program: USDA 77-19 A Case In Point**

*T.G. McCollum and J.X. Chaparro, USDA, ARS, USHRL, 2001 South Rock Road, Ft. Pierce, FL*

Development of new citrus fruit cultivars for the fresh market is recognized as essential for the US citrus industry to remain competitive. The breeding selection USDA 77-19 is a new grapefruit-like hybrid developed by the USDA citrus breeding program. The original hybrid, USDA 75-8 was selected in 1973 from a population of 'Pearl' tangelo x grapefruit hybrids. Budwood of USDA 75-8 was irradiated in 1980 to generate seedless mutants and USDA 77-19 was a low seed content selection made from the irradiated material. Fruit of USDA 77-19 are non-bitter and reach commercial maturity in early September. USDA 77-19 has the potential to fill a niche for an early-ripening low acid non-bitter grapefruit. The fruit have been evaluated in taste tests and have good consumer acceptance. In an effort to determine the market potential for USDA 77-19, we conducted trials to determine the postharvest performance of fruit. We found that USDA 77-19 fruit were highly susceptible to stem end rot, and that the disease was aggravated by exposing the fruit to ethylene. Fungicide treatment reduced the amount of stem end rot, but not to acceptable levels. In addition, in one trial we observed that USDA 77-19 fruit were highly susceptible to chilling injury. Such postharvest problems suggest that USDA 77-19 may only be suitable for local marketing. Results of this work demonstrate the crucial importance of postharvest trials in the development of new fresh market citrus fruit cultivars to ensure the marketability of the fruit.

### **Comparison of Citrus Rootstock Performance upon artificial Infestation with Phytophthora**

*U. Albrecht, K. D. Bowman, US Horticultural Research Laboratory, USDA, ARS, Fort Pierce, FL*

Phytophthora is one of the most economically important soil-borne pathogens affecting Florida's citrus industry. The most effective control in the field is based on the use of tolerant rootstocks in connection with sound management strategies. This study describes the rapid greenhouse evaluation of seven rootstocks for tolerance to Phytophthora root diseases. Seedlings of the rootstocks Sun Chu Sha, Cleopatra mandarin, US-897, Sour Orange, Pineapple sweet orange, Carrizo citrange, and Swingle citrumelo were inoculated with citrus roots derived from a field site known to be heavily infested with Phytophthora and maintained in tubs containing a commercially available potting mix. The experiment was terminated after four weeks and shoot length, shoot mass, and root mass were determined. Infestation with Phytophthora was quantified using enzyme-linked immunosorbent assays (ELISA), and species were identified with polymerase chain reaction (PCR). Shoot length, root mass and shoot mass were significantly reduced in Pineapple, Carrizo, and Swingle, exhibiting mean values of 39 %, 44 %, and 58 %, whereas Sun Chu Sha, Cleopatra, and US-897 displayed average reductions of only

27 %, 30 %, and 22 %. Values for Sour Orange were intermediate between the two groups. Results obtained in this study are in accordance with results obtained from field trials and provide valuable information to aid in the development of new citrus rootstocks that are tolerant to Phytophthora.

### **Nursery Performance of New Citrus Rootstocks**

*K. D. Bowman<sup>1</sup> and L. Faulkner<sup>2</sup>, <sup>1</sup>United States Horticultural Research Laboratory, USDA, ARS, Ft. Pierce, <sup>2</sup>Becker Citrus Nursery, Ft. Pierce, FL*

Two new citrus rootstocks have recently been released by USDA for commercial use in Florida. Several other promising new rootstocks are undergoing the final stages of testing in anticipation of possible release for commercial use within a few years. Little information has been reported on the important nursery traits for these new rootstocks. The objective of this study was to compare the nursery performance of some new rootstocks with that of several common and commercially used rootstocks. The rootstocks examined were Cleopatra mandarin, Smooth Flat Seville, Volkamer lemon, Benton citrange, Swingle citrumelo, US-812, US-852, US-802, US-897, and US-942. The nursery traits compared included seed germination, trueness-to-type, proportion of multiple seedlings, seedling vigor, stem straightness, and bud survival. There were clear differences among the rootstocks for most traits measured, including several with critical importance to commercial nursery efficiency. For example, Smooth Flat Seville and US-852 had much higher frequencies of off-type seedlings than the other rootstocks. The information reported on relative nursery performance of the different rootstocks will be of significant value to citrus nurseries as they begin to use these new rootstocks.

## **Handling & Processing Section Abstracts**

### **Relocations in the Florida Fresh Fruit Industry**

*David J. Hall, Fresh Mark Corporation, 622 E. Myers Blvd, Mascotte, FL*

During the last century the Florida citrus industry has experienced an accelerating relocation southward. This has been due, in the main, to the effects of weather and urbanization. While production areas have been relocated rather rapidly, merely planting further south as groves are lost in the northern areas, fresh fruit packing facilities are less portable. This has resulted in the necessity of hauling fruit further distances to the packinghouse. At the same time there has been a gradual decline in the amount of fresh fruit packed, this has resulted in the closing of many packinghouses and changing use patterns in those remaining.

### **Degreening in the 1950's: Establishing Basic Principles**

*Bill Grierson, 18 Golf View Circle N.E., Winter Haven, FL*

On my arrival at the Citrus Experiment Station, Lake Alfred in July 1952 I was assigned a specific project, to find something better than ethylene, which "everybody knew" caused ugly fruit blemishes and horrendous decay. While apparently chasing this fantasy, I studied ethylene degreening. Ethylene was being used in incredible amounts, some packinghouses weighing in several pounds of ethylene to start a room. Constant fear of losing ethylene led to sealed rooms with periodic

ventilation schedules. A valuable clue was that using kerosene fumes blown in from a "smokehouse" worked rather well. This was due, not to a magic component in the kerosene fumes, but to the large quantities of air blown into the rooms. Even without any analytical equipment it became apparent that very little ethylene was actually needed.

Some basic principles became apparent. Adequate space MUST be left for air circulation. It is impossible to blow air through a stack of boxes. Airflow through stacks of fruit depends on establishing a slight pressure differential that will draw the air through. High humidity, just short of precipitation, was helpful, but hard to achieve. "Ethylene burn" was due to contaminants, usually fertilizer dust, on the fruit and boxes. Much peel injury blamed on degreening was due to the popular use of heated polisher brushes.

That much established, some solid facts with regard to the fruit itself became apparent. 85°F was a sharp optimum for degreening oranges, but far less precise for grapefruit. Color change of Hamlin oranges ceased abruptly on leaving the degreening atmosphere, but Valencia oranges and Duncan grapefruit continued to degreen for up to 48 hours. Regreened areas on Valencia oranges were not "degreenable." Degreening could be impaired by ANY prior treatment, even manual handling. Payment of market claims for decay were costly. However, inappropriate accounting methods almost totally obscured other considerable financial losses due to poor degreening, thus providing little incentive for packers to spend money on needed improvement of degreening facilities.

### **Growth Conditions Affect Sheepnosing in Grapefruit**

*J.P. Syvertsen<sup>1</sup>, L. G. Albrigo<sup>1</sup>, M.A. Ritenour<sup>2</sup>, R. C. Vachon<sup>3</sup>, J.M. Dunlop<sup>1</sup>, R.R. Pelosi<sup>2</sup> and M.S. Burton<sup>2</sup> UF, IFAS, <sup>1</sup>CREC, Lake Alfred, FL and <sup>2</sup>IRREC, Ft. Pierce, FL, <sup>3</sup>The Packers of Indian River Ltd., Ft. Pierce, FL*

The mechanisms that cause grapefruit to develop an elongated, sheepnosed shape are not understood but we have manipulated tree growth and fruit yield in a variety of ways to determine effects on fruit shape. We evaluated sheepnosing in a number of grapefruit blocks in the Indian River (IR) and Central Ridge areas over 2 growing seasons. Elevating early season temperature in tree canopies by placing clear plastic tents over trees from before bloom until July, increased the percentage of sheepnosed fruit above that of the uncovered control trees in both areas. The worst sheepnosing was in an IR white grapefruit block where packout of late season round and flat fruit was only 20%. Additional applications of 200 lbs K / Ac (above normal 200 lbs K / Ac) in the spring increased packout to 48%. Overall packout averaged 90% in red grapefruit in the IR area but high K applications increased packout to 94%. In another IR white GF block with only 41% packout, withholding all irrigation increased pack out to 70%. In the 2003-04 season, fruit shape in the IR area deteriorated from Oct. to Feb. The Ridge area generally had much lower percentages of sheepnosed fruit than in the IR area and there was little deterioration of fruit shape between July and Feb. Ruby Red trees on the Ridge fertilized with 250 lbs N /Ac per year had more sheepnosed fruit (14%) than trees that received 100 lbs N/Ac per year (3%). Removing 50% of the crop in June had little effect on fruit shape at harvest but in comparisons of similar trees with low and high crop loads, low yielding trees had 21% sheepnosed fruit whereas only 4% of fruit were sheepnosed in high yielding trees. There were only small differences in the percentage of sheepnosed fruit in different grapefruit cultivars and rootstocks but sheepnosing was worse on the south side than on the north side of the tree canopy. If we can understand the interactions between fruit growth, weather, management practices, yield and

fruit shape, we should be able to minimize the sheepnosing problem and increase packout.

## **Preparation and Properties of Carnauba Wax Coatings Made with Ammonia Rather than Morpholine**

*R. D. Hagenmaier, Citrus and Subtropical Products Research Center, USDA/ARS*

Virtually all citrus and apple coatings now in use in the United States contain morpholine. This chemical is not permitted as an ingredient of coatings used in Europe, presumably because it is known to be a precursor of N-nitrosomorpholine, a carcinogen. Morpholine-containing coatings are relatively easy and cheap to make, stable and have relatively low odor. Ammonia may be substituted for morpholine, but ammonia based-coatings are difficult to make, less stable, and of course have an ammonia odor. However, these properties are advantages only to the middlemen, not the consumer. Although ammonia-based microemulsions of carnauba wax are normally made in pressure cells, a method was developed for making these with very simple laboratory equipment. Many ammonia-based, carnauba-wax coatings were made and tested in our laboratory. The successful formulation of these coatings required use of a combination of oleic acid and a saturated fatty acid, preferably lauric or myristic. They were tested on citrus fruit with good results.

## **Postharvest Peel Pitting in Citrus is Induced by Changes in Relative Humidity**

*Fernando Alferez, Citrus Research and Education Center, UF, Lorenzo Zacarias, Instituto de Agroquímica y Tecnología de Alimentos (CSIC), Valencia, Spain, and Jacqueline K. Burns, Citrus Research and Education Center, UF/IFAS, Lake Alfred*

Peel pitting at non-chilling temperatures remains an important problem during postharvest handling and storage of several citrus species, including Spanish varieties 'Navelina' and 'Navelate' oranges and Florida varieties 'Marsh' grapefruit and 'Fallglo' tangerines. The disorder is characterized by sunken areas on the flavedo and collapse of oil glands, followed by browning in advanced stages. Postharvest peel pitting results in decreased external quality and reduced value for fresh market fruit. Although the fundamental cause for this disorder has been not well defined, recent work in Spain and Florida have shown that altering peel water status through sudden changes in relative humidity during postharvest handling and storage can promote peel pitting. Our data indicate that a period of low humidity followed by storage at high relative humidity triggers peel pitting. Several observations suggest that preharvest environmental factors may increase susceptibility of citrus fruit to peel pitting and enhance disorder severity during handling and storage. It was of interest to define threshold conditions necessary to promote peel pitting at the time of harvest and during postharvest handling and storage. Studies were conducted to determine the effect of cumulative hours of dehydration before storage at high relative humidity on peel pitting, and to associate climatic conditions at the time of harvest with the incidence and severity of peel pitting. Our results demonstrated that 3 hours of storage at low relative humidity were necessary to induce peel pitting in 'Marsh' grapefruit and 'Fallglo' tangerines. We also demonstrated that harvesting fruit when relative humidity was high greatly reduced postharvest peel pitting.

## **Granulation of Florida Citrus**

Mark A. Ritenour<sup>1</sup>, L. Gene Albrigo<sup>2</sup>, and Jacqueline K. Burns<sup>2</sup>

<sup>1</sup> Indian River Research and Education Center, UF/IFAS, Fort Pierce; <sup>2</sup> Citrus Research and Education Center, UF/IFAS, Lake Alfred

Granulation (also called crystallization or section drying) is a physiological disorder in citrus that results in reduced extractable juice and vesicle shriveling. While segments appear dry, the disorder is not primarily caused by drying, but by gel formation within the vesicles. Though many citrus varieties may develop granulation (i.e., 'Valencia' orange, tangerines, and grapefruit), it was a particular problem in Florida navel oranges during the 2003-04 season. Navel oranges are unique in that granulation often extends through the center of the fruit, whereas in the other varieties, granulation develops mostly at the stem end. Many factors have been associated with the development of granulation in citrus, including advanced fruit maturity, large fruit, excessive tree vigor, sun exposure/high fruit temperature during growth and development, severe mite damage, compositional changes of juice, and cool, dry, windy weather conditions. Tree water status and irrigation have also been reported to affect granulation with some researchers reporting increased granulation under dry conditions, and others reporting less granulation with less irrigation. During the 2003-04 navel orange season, the relatively high temperatures during bloom, low fruit set, and associated larger fruit likely played an important role in the excessive development of granulation in the fruit. In addition, changing cultural practices (i.e., fertilization and irrigation) and use of rootstocks that encourage vigorous tree growth may have promoted the development of granulation.

### **Postharvest Quality, Nutritional Benefit, and Acceptance of LB8-9 as a New Fresh Fruit Variety**

*Huating Dou (FDOC), Fred Gmitter (UF/IFAS), Gary Coates (FDOC), and Wendy Wei (FDOC). Citrus Research and Education Center, 700 Experiment Station Road, Lake Alfred, FL*

A new mandarin cultivar currently designated as selection LB8-9, soon to be released by the UF-CREC breeding program, has been evaluated for postharvest fruit quality, nutritional benefit, and consumer acceptance. Comparisons were made with Minneola and Sunburst, which overlap the LB8-9 maturity season. LB8-9 and Sunburst fruit stored two weeks at 70 F developed similar decay percentages (34-36%), while Minneola showed only 16% decay. Pitting incidence was zero in LB8-9 and Minneola, and 3% in Sunburst tangerines. No differences were found in fruit color or postharvest losses among three cultivars stored at 40 F after 4 weeks. However, juice color number was 38, 40, and 44 for Minneola, LB8-9, and Sunburst, respectively. Wax formulation studies indicated that carnauba wax was the best formulation for coating LB8-9. Taste panels were conducted one week and 8 weeks after fruit were stored at 40 F. No difference was found in fruit acceptance one week after packing, while a better score of acceptance was recorded for LB8-9 than Minneola after 8 weeks. Generally, fruit of this new cultivar was characterized by the panelists as having a rich flavor. LB8-9 fruit had higher Brix (14.2) and acid (1.12) than Minneola or Sunburst, both having a Brix and acid lower than 11.7 and 0.86, respectively. Particularly, sucrose concentration was higher in the new variety (7.14 g/100ml) than the Minneola (5.29 g/100ml) or Sunburst (6.09 g/100ml). Vitamin C concentration was 42.43 mg/100ml for the new cultivar which was considerably higher than Minneola (23.27 mg/100ml) or Sunburst (26.25 mg/100ml). Overall, LB8-9 has good potential as a new fresh fruit for the consumer, and no serious problems were noted with typical post-harvest handling.

## **Influence of Ethylene on Natural Resistance of Citrus Fruit to Stem-End Rot Caused by *Diplodia natalensis* and Postharvest Control of this Decay**

*Jiuxu Zhang, Florida Department of Citrus, Citrus Research and Education Center, 700 Experiment Station Road, Lake Alfred, FL*

Ethylene degreening of early season citrus fruit is a common practice in Florida for marketing purposes. This practice greatly enhances stem-end rot caused by *Diplodia natalensis*, and the mechanisms for this increase in decay are largely unknown. Study to determine the influence of ethylene treatment on the natural resistance of 'Valencia' oranges to this decay was conducted. After fruit were de-buttoned and subjected to ethylene treatment at 0, 5, and 50 ppm for 60 hrs, fruit were then inoculated with *D. natalensis* at the button area and incubated at 30°C for up to 2 weeks. Fruit treated with ethylene at 0, 5 and 50 ppm showed a decay incidence of 10.0, 33.3 and 73.3%, and a disease index of 0.3, 0.8, and 2.5, respectively. Ethylene appeared to reduce the natural resistance of fruit tissues to *D. natalensis*, and the degree of tissue susceptibility was positively correlated to the ethylene concentration. Evaluation of chemical control for this disease showed that fruit drench with thiabendazole (TBZ) or imazalil before fruit degreening was much more effective than packingline applications of these chemicals after degreening treatment. Therefore, to effectively control *Diplodia* stem-end rot on early season fruit, fruit should be drenched with TBZ or Imazalil prior to degreening, and ethylene concentration and duration of degreening should be the minimum necessary to achieve successful degreening.

## **Effect of Exogenous Ethylene Exposure on the Postharvest Quality of Beit Alpha Cucumbers (*Cucumis sativus* 'Manar')**

*Alfredo M. Villalta and Steven A Sargent, Horticultural Sciences Department, UF/IFAS, Gainesville, FL*

Deleterious effects of exogenous ethylene during storage, as well as its role in ripening and senescence, on fruits and vegetables are well-documented. Dutch-type cucumbers (*Cucumis sativus*), also known as English or European cucumbers, produce between 0.1 – 1.0  $\mu\text{l kg}^{-1} \text{hr}^{-1}$  of ethylene at 20 °C (68 °F). They are highly sensitive to exposure to exogenous ethylene; concentrations as low as 0.1 ppm are reported to cause a loss of chlorophyll while higher concentrations are needed to cause fruit softening. There are no published reports on ethylene sensitivity of Beit Alpha-type cucumbers, which were recently introduced to Florida and are considered a specialty cucumber. Beit Alpha cucumbers (mini cucumbers) will be stored at 10 °C and exposed to ethylene concentrations ranging from 0 (control) to 100 ppm and to evaluate the effects on fruit quality during storage.

## **Impact Thresholds to Maximize Postharvest Quality of Roma-Type Tomato**

*Eunkyung Lee, Adrian D. Berry, and Steven A. Sargent, Horticultural Sciences Department, UF/IFAS, Gainesville, FL*

Tomato (*Lycopersicon esculentum* Mill.) is one of the highest volume vegetables sold for fresh consumption. In recent years, the consumption of specialty tomatoes, e.g., roma, cluster, grape, and mini pear types, is increasing. However, there is little reliable postharvest information available for growers and shippers to maintain the quality of specialty tomatoes. Damage from bruising due to improper handling and shipping is one of the major causes of poor quality of fresh tomatoes.

Experiments were conducted to determine the effect of impact force on roma tomato quality. Fruits were harvested at mature-green stage and treated with ethylene (90 microL/L<sup>-1</sup>; 20°C, 90% relative humidity (RH)) for 60 hr to initiate ripening. Breaker-stage fruits were suspended and impacted by a pendulum (230 g) with angles equivalent to vertical drops of 20 cm, 40 cm or 60 cm, and then stored at 20°C with 90% RH. Fruits impacted with force equivalent to 40 or 60 cm drop ripened to full red color stage (Hue angle = 36-38°) 2 to 3 days faster, and had 60% more peak ethylene and 15% more peak CO<sub>2</sub> production than control. Roma tomatoes impacted with the force equivalent to 20 cm height drop were not significantly different from the control fruits. However, impact force caused no significant differences in electrolyte leakage, total titratable acidity, pH, or total soluble solids content. Internal bruising was not observed in any treatment. Therefore, it can be concluded that a drop of 40 cm caused significant loss of postharvest life but did not affect the quality of fresh, roma-type tomato.

### **Short-Duration, Hot Water Treatment for the Control of Chilling Injury and Postharvest Decay in Citrus**

*Karthik Joseph John Karupiah*<sup>1</sup>, *Mark A. Ritenour*<sup>1</sup>, *Jeffery K. Brecht*<sup>2</sup>, *T. Greg McCollum*<sup>3</sup> and *Michael S. Burton*<sup>1</sup>. <sup>1</sup> Indian River Research and Education Center, UF/IFAS, Fort Pierce, <sup>2</sup>Horticultural Sciences Department, UF/IFAS, Gainesville and <sup>3</sup>USDA ARS US Horticultural Research Laboratory, Fort Pierce

Hot water treatments have been studied and used as a non-chemical method to reduce postharvest decay and chilling injury (CI) in fresh citrus fruit. While studies have been performed in Mediterranean climates, there remains relatively little work evaluating the effects of hot water on Florida grapefruit quality and quality retention during postharvest handling. In the current studies, dipping grapefruit in water at 56°C or 59°C for 30s reduced the development of CI by 18% or 32%, respectively, compared to the control after storage at 5°C for 6 weeks plus 1 week at 16°C. The fruit were not washed or coated with wax and no fungicides were used. Heat treatments had the greatest effect reducing CI of inner-canopy fruit (32%), compared to outer-canopy fruit (10%). In a separate experiment, washing and coating the fruit with shellac wax immediately after the 30s heat treatment significantly reduced scalding by 45% or 37% in fruit treated at 56°C or 59°C respectively, compared to unwashed and unwaxed fruit. Heat-treated fruit at 56°C or 59°C developed less total decay after 3 months of storage at 10°C than did control or 53°C or 62°C-treated fruit. None of the treatments resulted in consistent differences in total soluble solids or titratable acidity. Higher electrolyte leakage and lower peroxidase activity were observed in heat-treated fruit, but there was no correlation with visible heat injury. Heat treatment did not affect total phenolics or total protein content. Therefore, grapefruit treated at 56°C or 59°C for 30s can reduce CI and total decay.

### **In Vitro Evaluation of Selected Essential Oils as Fungicides against *Penicillium digitatum***

*David J. Hall* and *Y. Janet Fernandez*, Fresh Mark Corporation, Mascotte, FL

Several essential oils were evaluated for their efficacy as potential fungicides against *Penicillium digitatum*. Potato dextrose agar plates were streaked with a suspension of the spores of *P. digitatum*, then 10µl of various essential oils were placed into a well in the center. After a period of growth the

zone of inhibition was measured. Oils of *Cinnamomum zeylancium*, *Syzygium aromaticum*, *Cumminium cyminum* and *Mentha spicata* displayed larger than average zones of inhibition while the oils of *Citrus sp.* and *Gaultheria procumbens* displayed minimal inhibition. While most plates displayed strong mycelial growth and sporulation outside the zone of inhibition, on the plates treated with *Cumminium cyminum* and *Gaultheria procumbent*, mycelial growth was weak and no spores developed.

### **Delay in Color Changes and Softening of 'Florida 47' Tomato Fruit Treated with *SmartFresh*<sup>®</sup>**

*B. M. Hurr, D.J. Huber, Horticultural Sciences Department, UF/IFAS, Gainesville, FL*

In this study, ripening characteristics including color and softening were determined for tomato (*Lycopersicon esculentum* cv. Florida 47) fruit harvested at immature green through light red stages of development and treated with 1  $\mu\text{L}\cdot\text{L}^{-1}$  *SmartFresh*<sup>®</sup> (1-methylcyclopropene, AgroFresh, Inc.) for 24 h at 20 °C. Surface color and fruit firmness were measured every other day. *SmartFresh* delayed color changes and softening in fruit at each maturity stage, with differences between control and *SmartFresh*-treated fruit becoming evident within 24 h at 20 °C. Fruit treated with *SmartFresh* at early maturity stages (immature green, mature green and breaker) exhibited an initial delay in color change of 6, 4 and 4 days, respectively, compared with control fruit. Color change in fruit treated with *SmartFresh* at later maturity stages (turning, pink and light red) did not exhibit a delay as with earlier maturity stages; however, the rate of color change was reduced. Fruit of all maturities treated with *SmartFresh* eventually reached the color of control fruit when fully ripe. Softening of *SmartFresh*-treated fruit was significantly delayed in fruit at early maturity stages and exhibited a reduced rate of softening in fruit at more advanced maturities. *SmartFresh*-treated fruit from all maturities remained slightly but consistently firmer than control fruit. This study examined the effects *SmartFresh* using only a single tomato cultivar (Florida 47); however, other work has shown that *SmartFresh* may be beneficial for controlled ripening of a number of tomato cultivars.

### **Differentiating Orange Juices Using Routine Analyses as Compared to Instrumental Methods**

*K.L. Goodner, USDA-ARS Citrus and Subtropical Products Laboratory, Winter Haven, FL*

Standard citrus laboratory procedures, such as °Brix, acid, ratio, color, Scott oil, vitamin C and pulp, are compared to various instrumental methods for differentiating commercial orange juices. Statistical models were generated using the data from an electronic nose, a head space gas chromatograph, and a mass spectrometer based chemical sensor. The separation was similar to that obtained from the instrumental methods, but has the advantage that these tests are already being performed by industry and there is likely available data for modeling. Additionally, there would be no extra costs involved unlike with the other instrumental methods. Seven not-from-concentrate and 3 from-concentrate orange juices were analyzed with excellent separation using the data from standard procedures. This compares favorably with the other methods examined in previous years.

### **Microflorae of Orange Surfaces and Juice from Fruit in Processing Facilities and the Effect of Grading**

*R. M. Goodrich and M.E. Parish, Citrus Research and Education Center, UF/IFAS, Lake Alfred, FL*

Fruit surfaces and juice from such fruit was evaluated in order to better understand the effect of grading at a citrus processing facility and to investigate the prevalence of specific microorganisms. Testing included aerobic plate counts (APC), total coliforms (TC), fecal coliforms (FC), *E. coli* and *Salmonella*. Fruit from three points was collected in the processing plant and tested at the laboratory: The fruit were segregated into 3 groups: Group 1 (washed, pre-grade), Group 2 (washed, graded), and Group 3 (culls that were washed but graded out). Fruit surface results were obtained by washing the fruit with sterile buffer, which was then plated, while fruit juice results were obtained by surface sterilization of the fruit with subsequent aseptic juicing and plating of the juice sample. Group 3 fruit surface APC were 10 to 500 times higher than either Group 1 or Group 2 fruit surfaces APC, with recovery of *Salmonella* from the fruit surface occurring 3 times over the course of the sampling with Group 3 fruit. These results were consistent with significantly greater APC, TC, FC and *E. coli* detected in the juice of Group 3 fruit, indicating that contamination can occur on the surface as well as within the fruit. This research highlights the importance of grading in producing a wholesome, safe fresh juice, and also supports the use of grading as a critical control point (CCP) in a fresh juice HACCP plan.

### **Features of the UF Worker Health and Hygiene Training Program for Fresh Produce in Florida**

*Amy Simonne*<sup>1</sup>, *Jeffrey K. Brecht*<sup>2</sup>, *Mark A. Ritenour*<sup>3</sup>, *Steven A. Sargent*<sup>2</sup>, and *Keith R. Schneider*<sup>4</sup>;  
<sup>1</sup>*Department of Family, Youth & Community Science,* <sup>2</sup>*Horticultural Sciences Department,* <sup>3</sup>*Indian River REC- Ft. Pierce,* <sup>4</sup>*Food Science and Human Nutrition Department, University of Florida/IFAS*

Fresh produce consumption in the U.S. has increased steadily in recent years with per capita consumption ranging from 283 pounds in 1987, to 326 pounds in 2000. This increase may be due to the fact that fruits and vegetables are recognized as a good source of phytochemicals with potential health benefits and the increased marketing of fresh-cut fruits and vegetables. In parallel, reported outbreaks of foodborne illness related to the consumption of fresh and fresh-cut fruits and vegetables are also on the rise. Although contamination of fresh fruits and vegetables can occur at any stage of production, harvest, or postharvest handling (from farm to table), the Centers for Disease Control and Prevention lists poor personal hygiene as one of the most common causes of foodborne illness. Thus, worker health and hygiene is critical for preventing foodborne illness. This paper presents features of a new training program for packinghouse managers and workers featuring materials developed by University of Florida researchers and extension specialists, along with the current status of adoption and implementation of food safety practice recommended in the *FDA Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables* for selected produce in Florida.

### **Characterization of Esterified Blocks in Pectin Homogalacturonan Regions After De-esterification with the Thermally Tolerant Pectin Methyltransferase from Citrus Fruit**

*R. G. Cameron, G. Luzio, S. W. Kauffman, K. Grohmann, U.S. Department of Agriculture, Agricultural Research Service, Quality Improvement in Citrus and Subtropical Products Laboratory, Winter Haven, FL*

The functional properties of pectin are dependent on structural features of the individual pectin molecules in a solution. The primary structural components responsible for pectin functionality are the proportion of galacturonic acid (GA) residues in the homogalacturonan (HGA) region that are methyl

esterified, the distribution of the esterified GA residues within the HGA (block vs. random) and the average molecular weight of the pectin molecules that make up the population. The thermally tolerant pectin methyltransferase (TT-PME) from citrus fruit is well known for its detrimental effects on juice cloud and is primarily responsible for cloud loss in under-pasteurized juice. We are using a mono-component TT-PME to demethylate pectin and determine its affect on methylated block size and pectin molecular weight. Data will be presented on average molecular weight and the size and frequency of methylated blocks after controlled demethylation with both the TT-PME and a random demethylating fungal PME.

### **In Vitro Response of *Penicillium digitatum* and *Geotrichum candidum* to Ultraviolet (UV-C) Exposure**

Y. Janet Fernandez and David J. Hall, Fresh Mark Corporation, Mascotte, FL

*Penicillium digitatum* (*P.d.*) and *Geotrichum candidum* (*G.c.*) are the major organisms causing decay in Florida citrus fruit due to postharvest infection. There are existing agrochemicals that successfully aid in controlling these diseases, but there is a growing interest in non-chemical methods. Since these organisms often infect the fruit at the packinghouse methods of reducing the inoculum load non-chemically are of interest. Short wave ultraviolet light (UV-C @ 254 nm) has been used in many applications as a method of sterilization. In these trials culture plates with Potato Dextrose agar were inoculated with *P.d.* and *G.c.* then exposed to a UV-C light for various time intervals. Inhibition of *P.d.* was noted at 40 milliwatt seconds per square centimeter.

### **The Development and Use of a Sensory Lexicon for the Evaluation of Coconut (*Cocos nucifera*) Water Beverage**

R. M. Goodrich, Citrus Research and Education Center, UF/IFAS, Lake Alfred, and R.P Bates and C. A. Sims, Food Science & Human Nutrition Department, UF/IFAS, Gainesville

Language (a lexicon) was developed to discuss the sensory aspects of coconut water (CW), which has some potential refreshment and nutritional benefits. In order to develop a well-accepted product and to subsequently manufacture it, one must be able to describe the desired, as well as not acceptable, characteristics that define the products. Generally, the first step in lexicon development is evaluating and brainstorming descriptors that characterize a broad range of potential products. In this project, we used both commercial and freshly-prepared CW and developed a list of descriptors. Descriptors include: coconut; soapy, bitter; watery, metallic, green, oxidized, sweet, salty; floral, musty, cloying, vanilla.

These specific flavor descriptors then were benchmarked at various levels, using standards, so that the terminology is quantitative, specific and repeatable over the course of CW commercial product development. Quantitative descriptors of various CW samples allows detailed and reproducible sensory description of these samples.

### **Effect of Polysaccharide Coatings on Quality of Fresh Cut Mangoes (*Mangifera indica*)**

Anne Plotto, and Elizabeth Baldwin, USDA/ARS, Citrus & Subtropical Products Laboratory, Winter Haven, FL; Jinhe Bai, Oregon State University, Mid-Columbia Agricultural Research and Extension

*Center, Hood River, OR; Nithiya Rattanapanone, Department of Food Science and Technology, Chiang Mai University, Thailand*

Mango, the “king of the fruits”, has a great potential as a fresh-cut product. However, preliminary tests showed that stored cut fruit become dry and lose flavor. Fruit coatings may decrease gas exchange, thereby retaining moisture and flavor. Ripe mango fruit (cv. Tommy Atkins), were washed, peeled and cut into 2x2 cm pieces. Pieces were dipped for 20 sec. in 5 ppm chlorine dioxide then in 2% calcium ascorbate and 0.5% acetyl cysteine (antioxidants), and finally in a coating solution of 1% carboxymethylcellulose (CMC) or CMC and 0.5% maltodextrin (CMM). Two controls were used: no dip, and chlorine dioxide dip only. Cut pieces were drained and stored on trays in zip-lock bags at 5 or 10 °C. Coated fruit and fruit treated with antioxidants stored at 5 °C maintained good visual quality after three weeks as compared to controls. L\* value and hue angle were the highest for CMC-treated fruit. When stored at 10 °C, visual quality of the two controls was the lowest, but overall, none of the treatments were acceptable after 14 days. There were no differences between treatments for color measurements. Likewise, CMC-treated fruit were firmer when stored at 5 °C but not at 10°C. Taste panels did not detect any difference between treatments. In a second experiment, more coatings were investigated, including chitosan, potato starch, whey protein, and soybean oil emulsion. CMM coating was rated highest, and the two controls and whey protein were rated lowest for visual quality and flavor.

### **Pre- and Postharvest Application of ReTain® to ‘Red Lady’ Papaya: Effects on Harvest Maturity, Ripening and Quality**

*Adrian D. Berry, Steven A. Sargent, Horticultural Sciences Department, University of Florida/IFAS, Gainesville, Craig A. Campbell, Valent BioSciences Corp., Orlando, and Carl W. Campbell, Tropical Research & Education Center, Homestead*

Papaya (*Carica papaya* L.) is becoming an important fruit for fresh and processed products. Tropical fruits, such as papaya, encounter greater problems during transport and storage due to increased perishability. ReTain®, a commercial formulation of aminoethoxyvinylglycine (aviglycine HCL, or AVG), inhibits the synthesis of ethylene. AVG has been reported to delay abscission which increased fruit color, retarded softening, and increased vegetative growth when applied as a preharvest spray in apple; it also delayed softening and decreased ethylene production in peach when applied pre- or postharvest. The first experiment investigated the postharvest application of ReTain® (0, 250, 500, and 750 ppm) on subsequent fruit ripening and quality of ‘Red Lady’ papaya, an elongated, red-fleshed type. Fruits were harvested at colorbreak stage and held overnight at 20°C; the next day they were immersed, stored for 7 days at 13°C, and then transferred to 20°C and 90% relative humidity for ripening. The papaya fruit reached full-ripe stage >15 days after harvest and there were no significant differences between treatments for the quality parameters tested. Total soluble solids content was 10.8 to 10.9 °brix, pH was 5.2 to 5.3, total titratable acidity was 0.14 to 0.17%, and firmness was 13.2 to 17.4 N. In a related experiment, ReTain® was applied at 300 ppm (0.5 g/tree) to papaya plants in a commercial orchard. The objective was to determine if ReTain® application delayed harvest maturity. For the next 21 days fruit maturation was assessed every three days until the fruit reached commercial harvest maturity (colorbreak). Preharvest ReTain® sprays had only a slight tendency to delay papaya fruit maturation under the conditions tested, not enough to be commercially important. Results from both studies indicated that AVG applications had little effect on delaying harvest maturity or postharvest ripening of ‘Red Lady’ papaya.

## **Drying Wildflower Seeds Using Tobacco Barns**

*Michael T. Talbot, Agricultural and Biological Engineering Department, Institute of Food and Agricultural Sciences, UF*

The Wildflower Tobacco Education Project explored alternative crops for tobacco farmers. As part of development of a postharvest processing system for wildflowers, a modular drying bin system was designed and constructed for drying wildflower seeds in existing rack and box style tobacco drying barns. The smallest modular component was a drying bin with metal sides and stainless steel mesh bottom and tops with the top hinged to allow placement and removal of wildflower seeds. The second modular component was a metal frame the same dimensions of a standard tobacco barn rack. Two of the drying bins slide into the rack-sized frame. Four of these frames with a total of eight bins are fitted into the frame of a standard tobacco barn box. The existing tobacco barn air handling and drying systems provide the drying potential. The individual drying bins can also be used with small independent drying systems. Results are reported for initial tobacco barn system testing and a heat pipe dehumidification unit used to dry flower seeds in the drying bins during the 2004 spring growing season.

## **Krome Section Abstracts**

### **The National Plant Germplasm Repository System: The Case of The Subtropical and Tropical Horticultural Research Stations Germplasm Repositories in Miami, FL, Mayaguez, PR and Hilo, HI**

*Tomas Ayala-Silva, Raymond Schnell, and Alan Meerow USDA, ARS, National Germplasm Repository, Subtropical Horticultural Research Station, Miami, FL*

Germplasm collections are viewed as a source of genetic diversity to support crop improvement and botanical research, as well as support conservation efforts. The United States Department of Agriculture's National Plant Germplasm System (NPGS) is responsible for managing plant genetic resources in the USA. Despite patterns of use that indicate that gene source and wild species are requested as frequently as cultivated species in NPGS collections, the contents of most NPGS collections continue to reflect the historic objectives of plant introduction and crop enhancement. The unrestricted national flow of genetic resources from national and international genebank collections is one of the greatest achievements of international and national agricultural research. This paper examines the distribution of benefits generated by the genetic resources held by the three subtropical and tropical germplasm repositories. These three repositories are part of the NPGS. They are, the Subtropical Horticultural Research Station (SHRS, Miami, FL) 4,744 accessions, the Tropical Agriculture Research Center (TARS) in Mayaguez, PR (603 accessions) and the Tropical Plant Genetic Resource Management Unit in Hilo, HI (675 accessions). The NPGS research programs are dedicated to answering questions that help curators conserve and manage genetic resources in a more effective and cost-efficient manner. In addition, the research on preserving these collections, the cost of maintenance and the procedures on distributing germplasm discussed here.

### **How Much South Florida Consumers Know About the Availability of Florida Grown Lychee and**

## Longan?

*A. R. Rafie, Carlos Balerdi, Miami-Dade County Cooperative Extension Service, UF, and Jonathan Crane, Tropical Research and Education Center, UF*

Two consumer surveys were conducted using Florida grown lychee and longan during the summer, 2003. This survey is part of a promotional campaign for tropical fruits and was designed to determine how much south Floridian know about the production and availability of these locally grown fruits. Consumers were selected randomly in different public places and they were provided a sample of lychee or longan for tasting. The two surveys were conducted separately during the season for each fruit. Consumers were asked, "Do you like lychee?" 84% responded, "Yes". When asked the consumers, "Have you seen lychee in your local supermarkets before?" 75% of respondents said, "No". A similar pattern was observed when consumers were offered longan. When the respondents were asked, "Do you prefer locally grown produce over imported ones?" 75% responded they prefer locally grown produce. These results indicate that there is a need for educating and promoting locally grown tropical fruits in south Florida. The results from these surveys will be made available to tropical fruit growers, packers and shippers. A similar study is underway for carambola (star fruit) and mamey sapote and the results will be combined and presented at the 2004 Florida State Horticultural Society meeting.

## Sources of continuous-education and training utilized by Miami-Dade Growers and Golf Course Managers

*R. Muñoz-Carpena, J.H. Crane, Tropical Research and Education Center, UF, G.D. Israel, Agricultural Education and Communication Dept., UF*

As a part of a recent water conservation survey, fruit, vegetable, and ornamental growers and golf course managers in Miami-Dade County were asked about their sources for training and continuous-education, the most common methods by which they become aware of Extension activities, and their frequency of computer and internet use. This information is important if Extension information and activities are to be better extended and utilized. Usable survey responses were obtained from 167 growers in the area across all commodity groups. Background information on survey participants found 55% and 13% of the fruit and ornamental growers were part-time farmers. In contrast, 100% of the vegetable growers and golf course managers worked full-time in their profession. The majority (87-100%) of survey respondents were male. The survey found the University of Florida-IFAS (UF-IFAS) rated as a very important educational source for all crop producers (43-83% of the respondents) and that vegetable producers (67-83%) also heavily utilized commercial representatives and consultants. Golf course managers rated UF-IFAS, USDA-Farm Service Agency, and industry organizations as equally (38%) important sources of information. The most common methods by which producers and managers become aware of Extension programs were newsletters, mailed notices, and word of mouth, respectively. Computer use ranged from 58% by fruit growers, to 75%, 89%, and 100% of the golf course managers and ornamental and vegetable producers, respectively. This knowledge can prove essential for targeting the ever-busier audiences for Extension programming.

## Breeding and Selection of Jackfruit for South Florida

*Richard J. Campbell, S. El-Sawa, J. Wasielewski, N. Ledesma, Fairchild Tropical Garden, 11935 Old*

*Cutler Rd., Coral Gables, FL 33156 and T. Ayala-Silva, USDA, ARS, National Germplasm Repository, Subtropical Horticultural Research Station, Miami, FL*

The jackfruit has been under investigation and development at Fairchild Tropical Garden since 1987. The program has focused on the conservation of genetic resources, generic promotion for jackfruit and the development of viable cultivars for use in estate and patio agricultural systems in South Florida. A modest breeding effort was initiated in 1995 in conjunction with studies on the hand pollination of jackfruit. Reciprocal crosses were made among a subset of the core genetic collections. Cultivars were selected for inclusion in the project based on superior traits of precocity and productivity and the fruit quality traits of aroma, edible percentage, flesh firmness, color and flavor. 'Black Gold', 'Cheena', 'Dang Rasimi', 'Galaxy', 'Golden Nugget', 'Honey Gold', 'Lemon Gold', 'J-30', 'J-31', 'NS-1', 'Tabouey' were used. Controlled crosses were made over 2 fruiting seasons, seed was collected and 15 seedlings of each cross were planted at the USDA-ARS Subtropical Hort. Research Unit-Chapman Field. The total seedling population was 600 trees. Evaluations began in 2003 with the objective of the selection of superior jackfruit cultivars for South Florida estate and patio fruit industries.

### **Determination of Galacturonic Acid Content of Pectin Using a Microtiter Plate Assay.**

*Gary A. Luzio, USDA/ARS Citrus & Subtropical Products Lab., Winter Haven, FL 33881*

The amount of galacturonic acid residues in samples containing pectin is an important parameter in the quantitative and structural analysis of these complex carbohydrates. This paper describes a method to determine the content of galacturonic acids in samples containing pectin, using a glass microtiter plate and microtiter plate-reading equipment with standard interference filters. The assay is a modification of a commonly used procedure involving the hydrolysis of pectin in 80% sulfuric acid containing at 80°C followed by a coloring step with 3,5 dimethylphenol reagent at room temperature. The previous assay was difficult to apply routinely if large numbers of samples must be analyzed due to color changes that are time dependent and transferring of strongly acidic solutions to a cuvette prior to reading. The use of microtiter plate assay has several practical advantages such as an accurate estimate of background absorbance by multiple reading of the plates is possible and many samples can be rapidly assayed in one plate to minimize errors due to fading of the final color. This method is particularly advantageous when a large number of pectin samples must be analyzed for their content of galacturonic

### **Development of Aroma Measurements by Electronic Nose and Gas Chromatography for Mango (*Mangifera indica*) Homogenate and Whole Fruit**

*Marc Lebrun and Marie-Noelle Ducamp, CIRAD, Montpellier, France, Anne Plotto, Kevin Goodner, and Elizabeth Baldwin, USDA/ARS, Citrus & Subtropical Products Laboratory, Winter Haven, FL*

Mango fruit (cv. Tommy Atkins), were homogenized, and sampled for volatile analysis by static headspace method using an electronic nose (e-nose) with metal oxide coated or uncoated sensors and gas chromatography (GC) equipped with a polar carbowax column and a flame ionization detector. Dilution of homogenate and homogenate volume was analyzed to determine effect on e-nose and GC headspace measurements. Mango homogenate (1.0, 1.5, and 2.0 mL) was diluted with DI water to 50, 25, and 12.5% of original concentration. The resulting e-nose signal was analyzed by Principal Component Analysis (PCA) or Discriminant Factorial Analysis (DFA), which resulted in

grouping by dilution factor, regardless of sample size. A combination of 2.0 mL and 25% dilution of mango homogenate were determined to be optimal. These results were compared to analysis of 13 characteristic mango volatiles by gas chromatography (GC) headspace analysis of the mango homogenate for the same volume/dilution combinations. Concentration of volatiles in the headspace generally increased with volume, however, methanol,  $\alpha$ -copaene and  $\alpha$ -caryophyllene did not change with either dilution or sample volume. Acetone and p-cymene did not change with dilution, but increased slightly with volume, while ethanol and  $\alpha$ -terpinolene decreased with dilution, but were not affected by volume. The increase in headspace concentration was not directly proportional to the homogenate volume, indicating matrix effect on aroma partitioning into the headspace, which varied for different compounds. A large volume injected into the e-nose (2000  $\mu$ L) was necessary to get ample signal and reproducible results for intact fruit sealed in buckets.

### **Genetic Variation Among Cultivated Selections of Mamey Sapote [*Pouteria* spp., Sapotaceae]**

*Susan Carrara, Florida International University, Dr. Richard Campbell, Fairchild Tropical Garden, Dr. Raymond Schnell, USDA-ARS*

Mamey sapote [*Pouteria* spp., Sapotaceae] is a tree fruit of economic and cultural importance in Central America, Mexico, and the Caribbean. It contributes to local economies, habitats, and human nutrition, and makes a substantial economic contribution to many Central American households. This study is among the first to analyze genetic variability among cultivated selections of zapote. The Amplified Fragment Length Polymorphism (AFLP) technique was used to estimate levels of genetic diversity and determine relationships between individual specimens in the germplasm collections of Fairchild Tropical Garden and University of Florida. The study showed an overall low level of genetic diversity within the collections. However, higher levels of genetic diversity were found in one particular cluster of selections, indicating areas where future plant collection can capture greater genetic diversity. In addition, 'Pantin' selections were used to investigate the level of variation within supposedly identical selections. This baseline information can be applied to the management and expansion of the germplasm collections by identifying duplicate selections and homonyms, and locating geographical areas for future collection.

### **The 'Torbert' Mango**

*Campbell, C.W., Univ. of Florida, TREC/Fairchild Tropical Garden and R.J. Campbell, Fairchild Tropical Garden, 11935 Old Cutler Rd., Coral Gables, FL*

The 'Torbert' mango originated as a seedling in Miami-Dade County, Florida, USA in the 1940s. Additional trees were propagated and planted in home gardens in the local area, but no commercial plantings were ever made. Graft wood was sent to a few other locations and established in cultivar collections. Brief descriptions of the cultivar were published in journals under erroneous names ('Torbet', 'Tolbert') and place of origin. Grafted trees are precocious and productive and lend themselves well to size control by periodic pruning. The fruit has a unique spherical shape. External color is yellow-orange, with a prominent red blush when exposed to the sun. The skin is thick and resistant to handling injury. The pulp is without fiber and when ripe has a lemon-yellow color and a mild, sweet flavor. The leaves and fruit are relatively tolerant of mango anthracnose and powdery

mildew. Observations in areas where *Anastrepha* fruit flies occur indicate that the fruit is relatively resistant to infestation when compared with other mango cultivars. 'Torbert' has good possibilities as a small to medium-sized patio and estate agriculture mango in Florida. It is also of interest for commercial growers in many regions who are eager to replace seriously over-planted cultivars that have resulted in low prices and poor profits for the industry as a whole.

### **Model for Community Outreach with the International Mango Festival at Fairchild Tropical Garden, Miami, Florida**

*Noris Ledesma and Richard J. Campbell, Fairchild Tropical Garden, 11935 Old Cutler Road, Miami, FL*

The Fairchild International Mango Festival (IMF) has been held in South Florida at Fairchild Tropical Garden for the past 13 years. The objectives of the IMF are the generic promotion of the mango, the celebration of the mango and its products, and education of general and expert audiences. Educational programs are presented for the local and international community, allowing for the development of an appreciation for the diversity of cultivars, the wide range of available flavors, and a diverse range of horticultural subjects. The focus of the event is the living genetic collection of more than 200 mango cultivars that represents the majority of the genetic diversity found throughout the world with mango. The event takes place in July during the peak of the mango season. Using the Marketing Department of Fairchild Tropical Garden we are able to capture the attention of the local, national and international press and deliver the latest in scientific and horticultural advances with mango. Each year since its inception attendance has increased, and in recent years there has been an emphasis placed on children's programs. In 2003 there were 6000 participants for the event. This program can serve as a model in Florida for outreach with other fruit.

### **A New Generation of Mangos for Florida**

*Richard J. Campbell, Fairchild Tropical Garden, 11935 Old Cutler Rd., Coral Gables, FL*

The mango has been an important commercial crop in South Florida, USA for more than a century. However; as the face of agriculture has changed in Florida, the challenges and opportunities for the mango within the state have evolved. Estate agriculture and patio gardening are rapidly expanding market opportunities for tropical fruit in Florida. These horticultural activities have distinct advantages due to the separation from direct foreign competition and land use pressures. A unique horticultural approach is needed in order to adapt the mango to estate and patio garden production. Over the last decade at Fairchild Tropical Garden there has been a concentrated effort into the selection, propagation, study and promotion of mango cultivars uniquely suited for this market. A suite of mango cultivars, including 'Cogshall', 'Fairchild', 'Ice Cream', 'Graham', 'Mallika', 'Manilita', 'Neelum', and 'Rosigold' have been promoted to provide the estate and patio grower with highly manageable, quality alternatives to traditional commercial Florida cultivars. The search continues for additional cultivars offering greater manageability, a smaller size, and superior quality and horticultural traits.

### **Increased Exposure to Cool Ambient Temperatures Increased Yield of 'Mauritius' Lychee (*Litchi chinensis* Sonn.) Fruit in Homestead, Florida**

*Jonathan H. Crane, Tropical Research and Education Center, UF, Homestead, 18905 S.W. 280 St., Homestead, FL*

The lack of reliable flowering is the major world-wide constraint to sustained high crop yields in lychee trees. Insufficient exposure to cool ambient temperatures is the main environmental constraint to flowering in mature lychee trees. In south Florida, the warm subtropical climate is considered marginal to induce lychee flowering. Studies of container-grown lychee trees in controlled-temperature growth chambers have shown that prolonged exposure to ambient temperatures below 68°F was necessary for flower induction. Yield responses to the number of hours exposed to ambient temperatures below 70°, 65°, 60°, 55°, or 50°F was tested in 8 to 11 (depending on year) 'Mauritius' lychee orchards from 1999-2003 in Homestead, Florida.. Annual mean ambient temperatures in Homestead during Nov., Dec., and Jan 1999-2003 as well as the 30 year average temperature were related to annual fruit yields. As the number of hours below a specific threshold temperature (e.g., 50°F, 70°F) increased the average crop yield for any given crop season generally increased. Furthermore, in years when the annual mean Nov. through Jan. temperatures were at or below the 30 year average, crop yields were greater than in years with above average Nov. through Jan. temperatures.

### **Influence of chemical and organic fertilization programs on 'Keitt' mango (*Mangifera indica*) yield**

*Bielinski M. Santos, Gulf Coast Research and Education Center, Univ. of Florida*

Studies were conducted in the Dominican Republic during two years on adult 'Keitt' mango fields to examine the long-term effect of chemical and organic fertilization programs on marketable fruit yield. The treatments were: a) 1.8 kg 15-15-15/tree, one a year; b) 1.1 kg 15-15-15/tree, twice a year; c) 1.4 g 15-15-15/tree, one a year; d) 1.8 g 15-15-15/tree, once a year, plus 13.6 kg compost/tree; e) 1.1 kg 15-15-15/tree, twice a year, plus 13.6 kg compost/tree; and f) 1.4 kg 15-15-15/tree, one a year, plus 13.6 kg compost/tree. The results indicate that the application of 1.8 kg 15-15-15/tree, once a year, plus 13.6 kg compost/tree, and 1.3 kg 15-15-15/tree, twice a year, plus 13.6 kg compost/tree improved marketable fruit number during both harvest years. The addition of compost for two years increased fruit number by averages of 19 and 28% in comparison with the same treatments without compost.

### **Iron Nutrition, Flooding, and Growth of Pond Apple (*Annona glabra* L.)**

*M. G. Ojeda, Horticultural Sciences Department, UF and Universidad Centroccidental "Lisandro Alvarado" Barquisimeto, Venezuela, B. Schaffer, Tropical Research and Education Center, UF and F. S. Davies, Horticultural Sciences Department, UF*

Pond apple (*Annona glabra* L.), a tree species native to wetlands of the Americas, including south Florida, may have potential as a flood-tolerant rootstock for commercial *Annona* species. In its native wetland soils, Fe<sup>3+</sup> is reduced to Fe<sup>2+</sup> which is readily absorbed by plants. In non-flooded, calcareous soils of south Florida, pond apple trees often exhibit symptoms of Fe deficiency. Therefore, the effects of Fe application on plant nutrition and growth of pond apple was studied under flooded and non-flooded conditions. Trees were grown in Krome very gravelly loam soil and fertilized with 0, 0.625, 1.25, 2.5, or 5.0 g/plant of chelated (Sequestrene-138, Fe-EDDHA) or non-chelated (FeSO<sub>4</sub>) Fe under flooded or non-flooded conditions. Morphological adaptations to flooding resulted in 100% tree survival after 12 weeks of flooding. Flooding decreased the concentration of N, P, K, Ca, Mg, Zn, and Cu, and increased the concentration of Fe and Mn in the leaves. For non-flooded trees, addition of chelated Fe to the soil resulted in a higher leaf chlorophyll index and more growth compared with trees fertilized

with non-chelated Fe. The optimum amount of chelated Fe needed to achieve maximum growth in non-flooded trees was 2.5 to 5 g/plant. For flooded trees, the form of Fe did not affect leaf chlorophyll index and growth. To avoid Fe stress when the soil is not flooded, the use of pond apple as a flood-tolerant rootstock will require considerably higher rates of chelated Fe than the amount applied to traditional *Annona* rootstocks.

### **Effect of Foliarly Applied Urea and Boron on Plant Nutrition and Yield of 'Booth 7' and 'Lula' Avocado Trees**

*J.H. Crane and Y. Li, Tropical Research and Education Center, University of Florida, IFAS, Homestead*

From 1997 through 2000, a 4.3 acre orchard planted with 54 year old 'Booth 7' and 'Lula' avocado (*Persea americana*) trees at the Tropical Research and Education Center, Homestead, Florida was used to investigate the effect of foliar applications of boron or urea on leaf B and N content and crop yields. The urea trial include a non-urea spray control plus 100 lbs soil-applied N acre<sup>-1</sup>year<sup>-1</sup>, 10 lbs foliarly applied urea acre<sup>-1</sup>year<sup>-1</sup> plus 90 lbs soil-applied N acre<sup>-1</sup>year<sup>-1</sup>, or 20 lbs foliarly applied urea acre<sup>-1</sup>year<sup>-1</sup> plus 80 lbs soil-applied N acre<sup>-1</sup>year<sup>-1</sup>. The effect of four years of foliar urea applications on crop yields of 'Booth 7' and 'Lula' trees at the 0, 10 and 20 lb rate was inconsistent among years and cultivars. In general, leaf N levels increased immediately after urea applications but were similar to non-urea controls after ca. 30 days. Boron treatments consisted of three rates of foliarly applied B (0, 1 or 2 lbs acre<sup>-1</sup>year<sup>-1</sup>) and non-sprayed control. Foliarly applied B at both rates had an inconsistent effect on crop yields of both cultivars. In contrast, B leaf content was higher for trees treated with 1 and 2 lbs acre<sup>-1</sup>year<sup>-1</sup> compared to non-treated control trees. Foliar application of urea and boron at the rates tested did not consistently affect 'Booth 7' and 'Lula' crop yields, increased leaf N content temporarily, and increased B leaf content.

### **Yield and Fruit Quality within the Tree Canopy of 'Arkin' Carambola (*Averrhoa carambola* L.)**

*M.P. Kohout and J.H. Crane, Tropical Research and Education Center, UF, Homestead*

In Florida, carambola has two harvest periods, July through September (summer crop) and November through February (winter crop). Knowledge of the location within the canopy of the highest quality fruit may improve spot picking quality fruit. The effect of position within the canopy on fruit yield and quality was determined for five, ten-year-old 'Arkin' carambola trees at the Tropical Research and Education Center. The canopy of each tree was divided into three horizontal layers (i.e., lower, middle and upper) and four quadrants (i.e., north, south, east and west). Mature fruit was harvested from 4 August to 26 September (summer crop) 2003 and 2 December 2003 to 20 January 2004. At each harvest date, measurements included fruit number, fruit weight and length and total soluble solids (°Brix). Peel color was rated from 1 (green) to 10 (over-mature), and tree yields were estimated from the average weight per fruit and the total number of fruit per tree. In general, summer fruit °Brix was significantly higher in the middle and upper canopy layers than in the lower layer. In contrast, there was no significant difference in °Brix among layers in winter. In general, during summer highest °Brix was found in the south quadrants whereas in winter the highest °Brix was found in the north quadrant. Although not consistently significant, individual fruit weight and length were greatest in the summer and winter from the middle layer. The number of fruit was generally highest in the middle layer followed by

the upper and lower layers, respectively.

### **Growth of purple passion fruit (*Passiflora edulis*) transplants is affected by biostimulants**

*J. Pablo Morales-Payan and William M. Stall. Horticultural Sciences Department. University of Florida. Gainesville, FL*

The effect of gibberellic acid 3 (GA), benzyl adenine (BA), acetylthioprolin (AP), and a commercial glycine-rich mixture of amino acids and short-chain peptides (APC) on the time necessary to produce adequate passion fruit transplants were evaluated. Passion fruit transplants were considered ready for the field when they had at  $\geq$  four leaves,  $\geq$ one tendril, and 25 cm in height ("short transplant") or 50 cm in height ("tall transplant"). Aqueous solutions of BA, GA, AP, and APC were sprayed on the leaves of purple passion fruit seedling 15 days after emergence. When biostimulants were not used, short transplants were ready 60 days after emergence, while tall transplants were ready 75 days after emergence. BA did not affect the time to adequate transplant production. GA (40 mg/L) and AP (400 mg/L) reduced the time necessary to produce short transplants by 10 days and tall transplants by 17 days, as compared to untreated seedlings. APC (4 g/L) shortened the time to produce short and tall transplants by 20 days. These results indicate that APC, AP, and GA may be useful in shortening the time for production of purple passion fruit transplants.

### **Papaya (*Carica papaya*) transplant growth is affected by a *Trichoderma*-based stimulator.**

*J. Pablo Morales-Payan and William M. Stall. Horticultural Sciences Department. University of Florida. Gainesville, FL*

The effects of a *Trichoderma* spp.-based growth stimulator (TGS) on papaya transplants were evaluated. The TGS was applied as a soil drench, root-dip, and soil drench plus root-dip at different concentrations and drench times of application. In general, TGS treatments increased papaya root and shoot dry weight accumulation, and increased potassium and nitrogen in nitrate concentration in the transplant leaves. The extent of growth stimulation was dependent on TGS concentration and method of application.

### **Resistance to Papaya Ringspot Virus in Transgenic Papaya Breeding Lines**

*M. J. Davis, T. L. White, J. H. Crane. Tropical Research and Education Center, UF/IFAS, Homestead, FL*

The resistance of transgenic papaya breeding lines to papaya ringspot virus (PRSV) was examined. Resistance was conferred by non-translatable transgenes derived from the coat protein (CP) gene of a PRSV isolate (H1K) from Florida. To render the CP gene non-translatable, either a stop-codon (D6 lines) or frame-shift (X17-2 lines) mutation had been introduced into the CP gene. Non-transgenic and transgenic papaya lines (R<sub>3</sub> generation) were mechanically inoculated with three isolates (H1A, H1C, and H1K) of PRSV representing the genetic diversity of the virus in Florida. The mean severity of symptoms evaluated weekly for 8 weeks post-inoculation was consistently lower in the transgenic lines regardless of the PRSV isolate, and transgenic resistance to the different virus isolates did not differ noticeably. Ten or more plants each of 12 transgenic papaya lines and 23 non-transgenic accessions,

including named varieties and advanced selections, were planted in a field in May 2003 and evaluated for the incidence and severity of PRSV following natural infections. Within 6 months, all of the non-transgenic papaya plants became infected by PRSV and exhibited moderate to high levels of disease severity. In contrast, only a few plants of five of the 12 transgenic lines developed mild symptoms of PRSV. Thus, although not immune to PRSV infection, especially when mechanically inoculated, transgenic lines exhibited a high level of resistance to natural infection in the field.

### **Somatic Embryonic Line Establishment from Ovules of Muscadine and Seedless Bunch Grapes**

*Xia Xu, Jiang Lu, and Zhongbo Ren, Center for Viticulture and Small Fruit Research, Florida Agriculture and Mechanical University, 6505 Mahan Drive, Tallahassee, FL*

Somatic embryogenesis is an efficient tool for rapid propagation, genetic transformation, and somatic hybridization. It can be induced from leaves, petioles, anthers, and ovules. A study was initiated to induce somatic embryos from immature ovules of muscadine (*V. rotundifolia*) and seedless bunch (*V. vinifera*) grapes. Somatic embryogenic cell lines were obtained from somatic embryogenic callus originating from immature ovules extracted from berries of muscadine grape 'Alachua', 'Summit', and 'Tara' on Murashige and Turcker (MT) medium supplemented with 1 $\mu$ M 2, 4-D and 1 $\mu$ M NAA and seedless bunch grape 'Autumn Royal', 'Crimson Seedless', and 'Orlando Seedless' on Chee and Pool (CP) medium supplemented with 1 $\mu$ M NOA and 0.2  $\mu$ M BAP. The induced somatic embryo cell lines were stable and maintained on CP medium. Plant regeneration was successfully achieved from those embryogenic lines when transferred them to the Woody Plant (WP) medium supplemented with 1 $\mu$ M BA. The induction of embryogenic lines was highly genotype-dependent and thus far was confined to these cultivars.

### **Effects of Rootstock on Yield and Fruit Soluble Solids Content (SSC) of Florida Hybrid Bunch Grapes**

*Z. Ren, J. Lu, S. Leong and X. Xu, Center for Viticulture, Florida A&M University*

'Conquistador' is the only red wine hybrid bunch grapes commercially grown in Florida. To study the effects of rootstocks on productivity and fruit quality, vine vigor, yield and fruit soluble solids content (SSC) of 'Conquistador' grapes grafted on two rootstocks and self rooted vines were evaluated in 2002 and 2003 growing season. The data indicated that 'Conquistador/Florilush' had higher yields in both years than 'Conquistador/Tampa' and self rooted vines. No significant difference of fruit SSC was found among the vine with or without rootstocks. The 'Conquistador' grafted on both 'Florilush' and 'Tampa' rootstocks also had significant larger trunk diameter.

### **Influences of Pollinators on Fruiting and Fruit Qualities of Muscadine cv 'Pam'**

*Z. Ren, J. Lu, X. Xu and S. Leong, Center for Viticulture, Florida A&M University, Tallahassee, FL*

'Pam' is a muscadine grape for its large fruit size, nice appearance, good flavor, and disease resistance. This cultivar, however, requires pollinators since it is pistillated. Our previous research showed that for a certain female muscadine variety, some male pollinators gave higher yield than the others. To select a better pollinator for 'Pam', three perfect flower cultivars were used as pollinators

and open pollination was used as control. The preliminary results indicated that 'Nesbitt' pollination resulted in 100% cluster fruiting, while pollination with 'Noble' and 'Alachua' produced 70% cluster fruit setting. 'Nesbitt' pollination also increased fruit numbers per cluster by about 20% over 'Alachua' and 'Noble' pollination. No difference in fruit soluble solids content (SSC) was found among fruits derived from these different pollinators.

### **A Method to Screen Weed-Suppressing Allelochemicals in Florida Biomass**

*James J. Ferguson, Bala Rathinasabapathi, and Mark Gal, Horticultural Sciences Department, UF*

Wood chip mulches derived from woody tree species grown in Florida are often used for weed suppression in citrus, blueberry, and other perennial fruit crops, especially in sustainable and organic production systems. Such mulches containing weed-suppressing allelochemicals may be more effective for weed control than mulches without such properties. Methods for testing allelopathic qualities of these materials include wood chip incubation and filtering followed by bioassays of lettuce seed germination and growth and application of promising mulch materials to targeted weed species as well as non-targeted citrus host species in greenhouse tests. Eluates of wood chips from red maple (*Acer rubrum*), swamp chestnut oak (*Quercus michauxii*), red cedar (*Juniperus cilicicola*) and sweet bay (*Magnolia grandiflora*) highly inhibited germinating lettuce seeds, as assessed by germination percentage, hypocotyl and root length. The effects of eluates from these four species were more than or equal to, that found for eluates from wood chips of black walnut (*Juglans nigra*), a species previously identified to have weed-suppressing allelochemicals.

### **The Florida Blueberry Industry: A Decade of Growth**

*J.G. Williamson, P.M. Lyrene and E.P. Miller, Horticultural Sciences Department, UF*

Florida produces the earliest ripening blueberries in North America. The harvest season begins about 1 April and extends through mid-May until North Carolina's harvest begins. Crop values for the Florida blueberry industry were estimated at \$18,200,000 and \$18,560,000 for the 2002 and 2003 seasons, respectively. This is a 30% increase in value over the two previous years. Commercial acreage and production have steadily increased throughout the 1990's and southern highbush varieties have gradually replaced rabbiteye varieties on commercial farms. Despite increased production and acreage, fruit prices have remained high. The average fruit price for the 2003 season was \$5.20 per pound. New varieties and improved cultural practices have enabled growers to increase yields and quality without substantially increasing production costs. Factors contributing to the growth of this industry and potential challenges for its future will be discussed.

### **The Impact of Training/Trellis System and Canopy Management on Production Efficiency and Fruit Quality of Florida Grapes**

*V. Colova and S. Leong, Center for Viticulture & Small Fruit Research, CESTA, Florida A&M University, 6505 Mahan Drive, Tallahassee, FL*

Florida's major constraint in grape growing is the outstanding fact that the fruit grows and ripens during the rainy season. It is known that plants are more susceptible to diseases during the fruiting season and also during moist and hot weather. This constraint is faced by all grape growers in Florida, and requires the utmost ingenuity in viticultural skill and science to overcome. Training/trellis system and

canopy management are an integral part of vineyard management because of their impact on the canopy microclimate and respectively efficient pest and disease control of the grapevine. Florida grape growers are aware of the importance of canopy management in grape production but faced lack of specific knowledge to create the desired microclimate for their grapevines and in most case try to adapt practices that has been developed specifically for the temperate and cool climate grape. The current study at Florida A & M University was designed to provide essential information to some of the fundamental questions on the use of most suitable training/trellis system and canopy management practices for Florida grapes. The preliminary results of the evaluation of several training/trellis system and vineyard management practices showed that the production efficiency of selected Florida grape varieties could be improved to enhance their economic competitiveness.

### **'UFSun' Peach Released for Subtropical Central and South Florida**

*Robert E. Rouse, Southwest Florida Research and Education Center, UF, and Wayne B. Sherman, Department of Horticultural Sciences, UF*

'UFSun' peach, [*Prunus persica* (L.) Batsch], is released for grower trial by the Florida Agricultural Experiment Station. Trees produce attractive, sweet tasting, yellow and non-melting flesh, semi-clingstone fruit intended for fresh use. 'UFSun' is suggested for central and south Florida from Tampa to Orlando and south of Interstate 4. It may be used to replace 'UFGold' peach in south Florida because it sets fruit more reliably at Immokalee, especially under night temperatures near and above 56 °F during bloom to shuck split. Trees of 'UFSun' are estimated to require about 100 chill units. We expect 'UFSun' to be grown successfully where 'Flordaprince' and 'TropicBeauty' peaches have been grown. Fruit ripen in late April in Immokalee and in early May at Gainesville. Fruit set is good and with proper thinning (six to eight inches) attain 2 1/4 inch diameter. Fruit are 50 to 70% red over a bright yellow ground color. Eating quality is good, sweet and slightly acid with a pleasing aftertaste with no bitterness.

## **Ornamental Section Abstracts**

### **Conventional vs. Alternative Methods of Weed Control in a Container Nursery**

*E. Duke, Ornamental Horticulture, FAMU/CESTA. G. Knox, North Florida REC UF/IFAS, A. Bolques, Gadsden County Extension, FAMU/CESTA, R. Mizell, North Florida REC UF/IFAS*

Nursery production of landscape plants in Florida relies heavily on the use of synthetic chemicals – rooting hormones, pesticides, fertilizers, etc. This reliance on non-indigenous materials is costly as well as unsustainable. Practices leading towards sustainable production of nursery/landscape plants could foster the development of new specialty organic nurseries, thus creating a new market niche for small farms, as well as promoting sustainability of existing conventional nurseries. Weed control in container-grown ornamental crops is one of the most important cultural concerns. Weeds compete with crop plants for space, water, light and nutrients. In this study three organic weed control methods (Bio-Weed, Bio-Weed + bark mulch, and Geodisc) were compared with a synthetic herbicide to evaluate their efficacy under a typical North Florida production system. Three crops (*Evolvulus glomerata*, *Cuphea hyssopifolia* and *Lagerstroemia indica*) were used in the study. Treatment with the copper-impregnated Geodisc resulted in the best weed control for all three crops. The synthetic

herbicide and the Bio-Weed (corn gluten) alone gave the poorest control, while the Bio-Weed + bark mulch performed intermediately.

### **Impact of Soilborne Pest Problems on Field-Grown Snapdragon**

*Robert McSorley, Koon-Hui Wang, Department of Entomology and Nematology, UF, Gainesville; Gregory Church, Nancy Kokalis-Burelle, USDA, ARS, US Horticultural Research Lab, Ft. Pierce*

Effect of several soil fumigants on snapdragon (*Antirrhinum majus* L.) production were evaluated in a commercial site in southeast Florida in 2003-04. Treatments consisted of methyl bromide (98%) + chloropicrin (2%), metam sodium, metam sodium + chloropicrin, solarization, and a nontreated control. All fumigant treatments and solarization initially reduced ( $P < 0.05$ ) weed populations compared to the nontreated control. Stubby-root nematode (*Paratrichodorus* spp.) numbers were reduced initially by methyl bromide + chloropicrin and by metam sodium + chloropicrin, but numbers resurged in solarized and fumigated plots after 4 months. Plant heights and flower yields were greater ( $P < 0.05$ ) in fumigated or solarized plots than in control plots. Early in the experiment, rain washed soil from an untreated border area into the experimental plots, and as a result, many plants became infected by a pathogen tentatively identified as *Fusarium* spp., which caused crown and stem rot symptoms. Losses in fumigated or solarized plots averaged 34.1%, whereas losses in nontreated control plots averaged 67.3%. These results illustrate the magnitude at losses that can occur if soilborne problems are not managed in cut flower production, as well as the potential for crop infection from untreated areas bordering the production site.

### **Managing Newly Introduced Pests in the Nursery and Landscape**

*Catharine Mannion, Tropical Research and Education Center, University of Florida, IFAS*

Florida appears to be a "hotbed" of introduced pests and must learn to manage these pests quickly and aggressively. This is particularly important in ornamental crops in which whole plants and plant parts are shipped not only throughout the state and the U.S., but also worldwide. Most times biological and management information is limited on new pests, yet because of the potential impact the new pest could have, it is important to respond promptly to the introduction. Eradication of a pest can be difficult particularly if it has already become well established. Strategies must be put in place to respond to a new introduction as well as management tools for those pests that cannot be eradicated. It is not uncommon for the first detection of a new pest to be in the landscape. So it is critical to develop awareness and/or a system of recognition and reporting unfamiliar or new pests. Key examples of recently introduced pests that can impact the nursery industry and their management will be discussed.

### **Management of Cycad Aulacaspis Scale, *Aulacaspis yasumatsui***

*C. Emshousen, Montgomery Botanical Center, Miami, C. Mannion, H. Glenn, Tropical Research and Education Center, UF*

Since it was first introduced into south Florida in 1995, *Aulacaspis yasumatsui* (cycad aulacaspis scale) has been attacking popular landscape cycads and spreading rapidly. This pest is now found in Florida, Texas, Puerto Rico, U.S. Virgin Islands, and Hawaii. Plant death and damage caused by *A. yasumatsui* is having a marked affect on the ornamental cycad industry and has become a major

concern for nursery professionals. The spread of *A. yasumatsui* to other countries through plant sale and trade is also a serious concern as it could threaten native cycad populations. Previous research on 1 gallon potted cycads indicated that an insect growth regulator, pryproxifen, applied as a foliar spray provided excellent control of this pest and did not cause any plant tissue damage. Additional tests were conducted to evaluate the effectiveness of pryproxifen on controlling *A. yasumatsui* on cycads ranging in size from 1 foot to approximately 10 feet tall growing in a landscape situation. Experiments were conducted to examine the effectiveness of pryproxifen on both light and dense infestations of *A. yasumatsui*. Overall, we observed that pryproxifen provided excellent control of *A. yasumatsui* on lightly infested plants, adequate control on densely infested plants, and did not cause any plant tissue damage.

### **Integrated Pest Management in Pinellas County Nurseries**

*Alleyne J.C.<sup>1</sup> and M. Apgar University of Florida, IFAS, Pinellas County Extension, Largo, FL*

In 2003, an outreach educational program was initiated to teach the fundamentals of Integrated Pest Management (IPM) practices and its overarching effects to ornamental nursery growers in Pinellas County. The program strategy consisted of (i) developing and using five teaching modules representing the basic steps of a successful Integrated Pest Management program, (ii) conducting a five-day IPM workshop to impart instruction on each of the respective steps, (iii) establishing a demonstration garden at The Florida Botanical Gardens to serve as an interactive outdoor teaching tool, (iv) developing a web page to discuss the five steps of Integrated Pest Management and show step-by-step progress of the program at the demonstration garden, and (v) conducting on-farm research in cooperation with other Extension personnel. Results from this research/extension program will impact the entire Tampa Bay region. Widespread adoption is further assured as growers are reporting significant reduction in pesticide use and costs. The program is actively exploring ways to share achievements as progress ensues.

### **Shade House and Green House Bromeliad Production, Pest and Diseases**

*Jim Steele and Robert T. McMillan, Jr., Kerry's Bromeliad Nursery, Inc., Homestead, FL*

At Kerry's Nursery current bromeliad production consists of four genera each with their own susceptibility to pests and diseases. Two genera will be discussed as to production, insect pest and plant pathogens and their control.

### **Phytotoxicity Evaluation of Milbemectin on Ferns**

*Robert H. Stamps, Annette L. Chandler and Diane K. Rock, University of Florida, Institute of Food and Agricultural Sciences, Environmental Horticulture Department, Mid-Florida Research and Education Center, 2725 Binion Road, Apopka, FL*

Milbemectin, a mixture of natural compounds (milbemycins) derived from the soil microorganism *Streptomyces hygroscopicus* subsp. *aureolacrimosus*, is a miticide/insecticide used for selective arthropod management. The objective of this study was to test spray applications of milbemectin (Ultiflora™ 1E) for phytotoxicity on a variety of ferns. Nineteen ferns representing 14 genera and 18

species were treated just to the point of runoff with aqueous foliar sprays containing 0, 12 or 24 oz/100 gallons Ultiflora™. Plants were held on raised benches in a double polyethylene covered greenhouse with additional internal shading. Treatments were applied twice at a 14 day interval. Acute phytotoxicity was determined visually for two weeks following each spray application and rated on a scale of 1 = no visible damage to 5 = death. In addition, top fresh weights were determined 50 days after the initial treatment to assess chronic damage. For many genera—*Arachniodes*, *Athyrium*, *Davallia*, *Dryopteris*, *Osmunda*, *Pellaea*, *Platycerium*, *Polystichum*, *Pteris cretica* and *Rumohra*, no damage was detected. For almost all the other genera, significant acute phytotoxicity was observed only at the 24 oz/100 gallons (2×) rate. Despite visual stunting of *N. biserrata* ‘Macho’ at the 2× rate, milbemectin treatments had no effect on fresh top weights of the ferns. Even though this was an EC formulation, and they are often phytotoxic to ferns, Ultiflora™ caused relatively little phytotoxicity in this experiment.

### **Investigating the Identity of Rose Varieties Utilizing Randomly Amplified Polymorphic DNA (RAPD) Analysis**

*Angela Lewis, Mary Caroniti, and Nancy Morvillo, Florida Southern College, Lakeland*

RAPD-PCR analysis was used to answer questions regarding the identity of numerous varieties of roses. We had previously reported that the DNA profile of “Bremo Double Musk” did not match any of the other musk (*Rosa moschata* Herrmann) varieties; however, upon further analysis, it was determined that “Bremo” is indeed a true musk. A parentage analysis of ‘Xanadu’, a recently registered modern rose, indicates that it probably resulted from a self-pollination of ‘Carefree Beauty’. Numerous samples of “Found Noisettes” were analyzed, showing multiple genetic differences among the varieties, but similarities to their assumed ancestors, ‘Blush Noisette’ and ‘Champneys’ Pink Cluster’. Utilizing ‘Katie Bell’s Devonianthus’, it was determined that roses grown today as “Tradd Street Yellow” and ‘Devoniensis’ are very likely the real, original, ‘Devoniensis’. Finally, the question of the identity of ‘Spray Cecile Brunner’/‘Bloomfield Abundance’ was investigated, indicating that the plant currently grown under both names is truly a sport of ‘Cecile Brunner’, and should be classified as ‘Spray Cecile Brunner’. As shown here, RAPD-PCR can be a useful tool in determining the heritage of historic and modern roses.

### **Phytophthora Wilt of New Cultivars of *Catharanthus roseus***

*Robert T. McMillan, Jr. and Joe F. Garofalo, University of Florida/IFAS, TREC and Miami-Dade Extension Service, Homestead, FL*

Reports of Periwinkle (*Catharanthus roseus*) plants wilting in landscape beds planted to the new colored cultivars were common over the past 10 years. Plants were collected and isolates were made to determine the cause of the wilt. Ten plants were cut in to sections and planted on acidified Potato Dextrose Agar. The organism isolated consistently from the plant tissue was found to be *Phytophthora nicotianae*. To confirm that the *Phytophthora* isolated was the cause of the wilt cultivars; ‘Atropurpurea’, ‘Double Blue’, ‘Double Purple’, and the white flowered indigenous to south Florida were challenged with the *Phytophthora*. All of the cultivars screened with the exception of the indigenous white line showed the typical wilt that was noted in the landscape beds. *Phytophthora nicotianae* was consistently isolated from the wilted new cultivars; however the white line that showed no wilt symptoms was free of *Phytophthora*.

## **Rhizoctonia Blight of Impatiens and Its Control**

*Robert T. McMillan, Jr. University of Florida/IFAS, TREC, Homestead, FL*

Rhizoctonia Blight and root rot caused by *Rhizoctonia solani*, are serious and continuous problems for bedding plant nurseries as well gardens and landscape plantings. The climate and soil are conducive to year round disease caused by *R. solani*. Current fungicides and their use for the control of *R. solani* will be discussed.

## **Propagation of Delonix Regia (Boger.) RAF (Royal Poinciana) Var. 'Yellow Kampong' Via Somatic Embryogenesis**

*Alba R. Myers and Wagner A. Vendrame, University of Florida, IFAS, Tropical Research and Education Center, Homestead, FL*

*Delonix regia* (Royal Poinciana) var. 'Yellow Kampong' is a very attractive ornamental flowering tree with showy yellow flowers. In South Florida, Royal Poincianas have commercial value and interest for nursery production and potential for use in the landscape. Although Royal Poincianas grow best from seed, seed propagation has several limitations and rooting of cuttings is reportedly inefficient. Furthermore, the 'Yellow Kampong' has very low seed production. We have successfully induced somatic embryogenesis in Royal Poinciana. Cultures were initiated from immature seed tissue, comparing two levels of plant growth regulators for the rate of embryogenic induction, based on preliminary studies: 0.5 mg/l of 2,4-D + 0.100 mg/l of 6 BA (D1) and 1.0 mg/l of 2,4-D + 0.125 mg/l of 6 BA (D2). Although some contamination was observed at culture establishment, contaminated cultures were discarded and somatic embryos developed for both treatments. Treatment D2 had a somatic embryo formation rate of 26.2% compared to 2.4% for D1. Future perspectives include additional studies with plant growth regulators aiming higher embryogenic rates. Currently, regenerated plantlets are being acclimatized and hardened-off for subsequent transplanting to greenhouse. This technique provides a means for the propagation of Royal Poinciana and a model for other woody species that are difficult to propagate by conventional methods.

## **Response of Rumohra Adiantiformis to a Combination of Calcium, Urea, Magnesium and Boron**

*Dana M. Venrick, University of Florida, Volusia County Extension Service, DeLand, Florida*

An experiment was conducted using leatherleaf fern (*Rumohra adiantiformis*) to evaluate production benefits of a commercially available product containing urea, calcium nitrate, magnesium sulfate and boric acid. Two adjacent sites, owned by one grower, were selected that use the same water source and have been maintained by the same UF/IFAS recommended practices for the past five years. The test site received, in addition to standard inputs, 10 oz. per acre per week of the test material for nine weeks. The control site received only standard inputs. Fronds with stems and frond tissue samples were collected before, during and after the study. Average stem size, measured just below the first "leaf", increased by 148.4% in the test site and by 36.8% in the control site. Average bunch weight increased by 148.4% in the test site while the control site had a 37.5% increase. Tissue analysis showed a 74.4% increase in calcium in the test site and a 20.9% increase in the control site.

Magnesium in tissue from the test site increased 11.3% and 52.6% in the control site. Boron increased 38.7% in tissue from the test site and 27.9% in the control site. Visually, the foliage in the test site was a darker green color than the control site. Visually, the test site had fewer symptoms of disease than the control site. The use of this nutritional supplement offers leatherleaf fern growers an opportunity to increase production and improve sales with fern that has a more appealing appearance.

### **Thielaviopsis Diseases of Palms**

*Joe F. Garofalo and Robert T. McMillan, Jr., University of Florida Extension Service, Miami-Dade and University of Florida, TREC, Homestead, FL.*

Palm trunk rot, caused by the vascular pathogen *Thielaviopsis paradoxa* has the potential to devastate global palm resources. Palm rot is found in three states in the continental USA. This range encompasses the subtropical and arid regions where palms are an important landscape tree. At least 23 species of palms are susceptible to *T. paradoxa*. Factors relating to stand composition and structure directly influence the incidence and severity of palm trunk rot. Host susceptibility, the potential for inoculum production, and spatial distributions of different Palm spp. are all important in determining disease progress. Localized outbreaks have been associated with environmental stress and mechanical damage. The pathogen adapts to all of the palm ecotypes as illustrated by its occurrence in the dry desert environments of Arizona and California. There are many aspects of palm trunk rot that are poorly understood, hampering the ability to predict the course of this pathogen. The pathogen can be controlled in the early stages of the disease by applying the systemic fungicide thiophanate methyl.

### **The Response of Blood-lily, *Scadoxus multiflorus* ssp *katherinae*, to Daylength, Shade, and Other Production Practices**

*Joseph F. Garofalo, Cooperative Extension Service, Homestead, UF; and Wagner A. Vendrame, Tropical Research and Education Center, UF*

Geophyte production in Miami-Dade nurseries, in USDA hardiness zones 10 and 11, is limited mainly to tropical and subtropical species, including *Crinum*, *Hippeastrum*, *Hymenocallis*, *Agapanthus*, several "elephant-ears," and a few others. Several studies were initiated in 1995, in Fort Lauderdale and Homestead, to determine the potential of blood-lily, *Scadoxus multiflorus* spp *katherinae*, as a blooming pot-plant crop for South Florida nurseries. Because this species has been little studied, little information is available. Studies were conducted to determine the effects of the percentage of shade and length of the daily light/dark period on production and timing of the crop. The potential for early and late forcing and local propagation were also investigated.

### **Consumer Acceptance of an Organically-grown Ornamental**

*A. Bolques, Gadsden County Extension, FAMU/CESTA, E. Duke, Ornamental Horticulture, FAMU/CESTA, G. Knox and T. Hewitt, North Florida Research and Education Center UF/IFAS*

Organically grown greenhouse herbs have been successfully produced and marketed. We believe this success indicates a potential market for organically grown ornamentals to environmentalist consumers and for use in landscapes requiring plants grown with minimal synthetic inputs. Organically grown

crops have a higher perceived value by consumers and also are often more costly to produce than conventional crops. Currently organic herbs and nursery crops compose only 90 acres in Florida out of the estimated 14,500 acres in the US organic crop. Methods for organic container plant production were studied by comparing conventional and alternative production components such as substrates, organic fertilizers, and alternatives to chemical weed control. *Lantana* 'New Gold' and *Buddleia* 'Royal Red' were successfully grown using these organic production methods. Based on plant salability, *Lantana* 'New Gold' was used in a consumer acceptance and pricing study at a retail garden center. Conventional and organically grown lantanas were marketed side by side in the garden center at different prices. Garden center staff recorded the number of each group purchased each day for a two-week period. Based on sales records, consumers chose conventionally grown lantanas in preference to the higher priced organically grown lantanas.

## Tea and China Roses as Own Root Specimen Shrubs in Extreme South Florida

*John McLaughlin and Joe Garofalo, UF/IFAS- Miami-Dade Extension Service*

Roses have been neglected as landscape specimen shrubs, as opposed to bedding or show plants, in the south Florida landscape. There is widespread interest in growing roses, but more often than not this is either in containers or (raised) beds. Most of these are modern roses: hybrid teas with some floribundas and a few shrub roses. Even on a *Rosa fortuniana* rootstock many of these roses struggle with disease problems, and are perceived as high maintenance plants. As part of a renewed interest in what are often termed 'old' roses, we have, over the past 10 years, assessed the growth and appearance of various Tea and China roses and some of their affiliates. South Miami-Dade County, where the roses were grown, is one of predominantly oolitic limestone in contrast to the sandy soils of much of south Florida. We therefore surmised that since plant parasitic soil nematodes should not be as prevalent, it was also worthwhile investigating the use of own-root roses. We have been able to identify several roses that have proven to be vigorous, floriferous and suffered little loss of foliage, all without the need for any pesticides. An added bonus has been the need for less water, and far less fertilizer. We conclude that several Tea and China roses can be recommended as useful addition to the range of specimen shrubs available for full sun locations in south Miami-Dade.

## Effects of Light Intensity on Flower Development in Blood Lily (*Scadoxus Multiflorus* L.)

*W. A. Vendrame*<sup>1</sup>, *J. F. Garofalo*<sup>2</sup> and *A. W. Meerow*,<sup>3</sup> <sup>1</sup>*Tropical Research and Education Center Institute of Food and Agricultural Sciences Environmental Horticulture Department, University of Florida, Homestead, FL,* <sup>2</sup> *Miami-Dade County Cooperative Extension Service Institute of Food and Agricultural Sciences University of Florida, Homestead, FL,* <sup>3</sup> *USDA-ARS-SHRS National Germplasm Repository Miami, FL*

The response of container-grown Blood Lily (*Scadoxus multiflorus*) to three light intensity treatments was evaluated. Treatments included exposure of plants to 8-h light, 12-h light, and 16-h light. The treatment consisting of 16 hours of light was the most efficient in producing uniform floral development (time to anthesis and plant height). The amount of light provided on average for 16 hours was similar to that provided under 40 to 60% shade conditions, corresponding to an average of 29.95 to 44.93 mol. m<sup>-2</sup>.day<sup>-1</sup>, respectively. Therefore, in zones ranging from 9 to 11, Blood Lily could be commercially produced under partial shade. Likewise, Blood Lilies could be cultivated as bedding plants for

landscape use. For northern areas below zone 9, Blood Lily would be a good candidate for use as a cut flower and/or a potted plant. Long days could possibly have a positive effect on Blood Lily uniform floral development based on the results obtained. However, additional studies are needed on floral initiation, effects of photoperiod on flowering, and flower longevity. Such studies will be essential to provide further information for cultivation and commercial production of Blood Lily.

### **Fort Lauderdale Trial Garden – Year 2**[\[1\]](#)

*Wagner Vendrame University of Florida, IFAS Tropical Research and Education Center 18905 SW 280 Street Homestead, FL, Kimberly K. Moore and Eva C. Worden, University of Florida, IFAS Fort Lauderdale Research and Education Center 3205 College Avenue Fort Lauderdale, FL*

On December 10, 2003, 18 plants of 89 bedding plant cultivars were transplanted into the trial garden located at the University of Florida Fort Lauderdale Research and Education Center. The plants were planted as 3 groups of 6 plants, with the groups being randomly placed in the garden. All of the cultivars were planted under 30% shade. Plants were watered 3 times per week for 30 minutes using overhead irrigation. Monthly evaluations were conducted to observe plant height and width (size), flower number, number of plants with flowers, insect and disease damage, and quality rating. Quality was rated on a scale of 0 to 5 with 5 = top performance, 1 = poor performance, and 0 = dead. Two consumer preference surveys also were conducted with the first survey in January and the second in March.

## **Garden and Landscape Section Abstracts**

### **Tropical Fruit Tree Size Control in the Backyards**

*C. Balerdi, Commercial Tropical Fruit Crops Agent, Miami-Dade County Extension*

Backyard growers have three ways of controlling tree size. The first one is to choose species or cultivars that are small by nature. The second one is by using dwarfing rootstocks. The third method is by pruning. Several tropical fruit crops species are genetically small. Other tropical fruits others are medium sized and many others are large sized. By using different methods of controlling tree size, backyard growers may be able to fit many of these different size species to their available space. This paper discusses how backyard growers can control tree size.

### **Maintaining and Protecting the Estuarine Environment, an Educational Landscape Maintenance Program for Parks and Recreation Personnel**

*E. A. Skvarch, St. Lucie County Extension Service, UF, A.S. Neal, St. Lucie County Extension Service, UF*

St. Lucie County encompasses 588 square miles, contains three municipalities and impacts over one hundred miles of estuarine environment, including the Indian River Lagoon and the Saint Lucie Estuary. Within these boundaries, there are three municipal golf courses, 57 recreational parks, 63 baseball fields, and 3 football stadiums all of which are managed by over 200 full time city and county parks and recreation landscape maintenance people. Throughout the year these employees have significant impact on the county estuarine environments through their daily landscape practices.

These practices include pesticide and fertilizer applications, as well as irrigation, mowing and pruning. As a result, a six part educational training program was developed to assist parks and recreation workers to upgrade their landscape skills and knowledge. The classes for this program were conducted in 4-hour segments, twice a week for three weeks. Topics that were taught included: botany, entomology, ornamental and turfgrass management, pruning, irrigation, integrated pest management and fertilizing. The completion of the six-segment class for some participants was rewarded by a 3-5 percent pay increase.

### **A Prevocational Horticulture Program Serving Students with Special Education Needs**

*E. Duke, G. Leland, F. Lorenzo, Ornamental Horticulture Program, FAMU/CESTA, and J. Barnard, L.I. T.E. Program, Leon County Schools*

Horticulture is both a vocation and an avocation appealing to diverse groups of individuals of various cultural backgrounds, education levels, and physical and mental abilities. Working in conjunction with representatives from the Leon County School system, faculty and staff in the Ornamental Horticulture Program at FAMU have developed a pilot prevocational horticulture program serving area students with special education needs. The ultimate goals of the program are to promote job-related skills and to assess job abilities in order to find competitive employment for graduating students. The prevocational horticulture program helps to span a gap between regular special education classes and a horticulture vocational training or rehabilitation program. The objectives are to help develop an awareness of horticulture in the home and daily living, develop prerequisite skills for employment in the community and develop basic skills necessary for further horticulture study. A regular class-room approach is not utilized; rather a broad-subject approach is used encompassing math, language, and other aspects of daily life as they relate to horticulture.

### **Landscape Irrigation Evaluation as a Water Conservation Practice**

*J.B. Bargar, UF Indian River County, D.F. Culbert, UF Okeechobee County, and E. Holzworth, USDA/NRCS Vero Beach*

In 2001, Indian River County's Town of Orchid was unable to continue new home construction because they exceeded their consumptive use permit with only 60% of the lots being built. An evaluation of their irrigation systems and landscapes was conducted by the USDA/NRCS Mobil Irrigation Lab and County Extension Agents. Analysis of irrigation systems revealed that time clocks were set at initial landscape installation rates, and continued to operate at these levels for several years. Recommendations were developed including the use of these key irrigation practices: calibrating irrigation equipment, correcting distribution problems, cleaning sprinkler heads, and installing or repairing automatic rainfall shut-off devices. Recommendations were implemented during the late spring high water demand period, and still resulted in a 57% drop in annual water use. Presentations were made to the property owners and landscapers. A follow-up of practice adoption and water consumption shows that this community education program continues to save water.

### **Utilizing Biological Control Agents to Control *Melaleuca quinquenervia* In Florida's Natural And Man-made Landscapes**

*K T Gioeli, St. Lucie County Cooperative Extension, UF, A S Neal, St. Lucie County Cooperative*

*Extension, UF*

*Melaleuca quinquenervia* is an invasive plant found throughout central and south Florida's natural and man-made landscapes. *Melaleuca* forms dense monocultures that out-compete native species. Integrated pest management is an effective strategy to partially or fully control melaleuca. This strategy involves the combined use of control techniques including the utilization of *Oxyops vitiosa* (*Melaleuca* weevil) and *Boreioglycaspis melaleucae* (*Melaleuca* psyllid) as biological control agents. In 2001, Gioeli and Neal established a melaleuca biological control agent honeypot at the St. Lucie County Cooperative Extension Office. The purpose of this honeypot is to provide an easily accessible supply of melaleuca biological control agents for redistribution to landscapers and the general public. An internet-based ordering system was developed. The public could order these biological control agents via the website and pay a minimal \$20 shipping and handling fee or personally harvest the biological control agents for free. During 2003, 39 participants collected or received one or both of these biological control agents to assist them with their melaleuca integrated pest management strategy. The effectiveness of this program will be evaluated in mid-2004; thereby, giving the redistributed biological control agents an opportunity to build their population levels. Overall, program participants have indicated a high level of satisfaction with this program and they have indicated they are pleased to have easy access to these agents.

### **Growing and Marketing Chinese Radishes and Turnips at Local Green Markets in Southeast, Florida**

*K. D. Shuler, S. J. S. Nie, and P-A. N. Shuler, Stephen=s Produce, Jupiter, FL*

Stephen=s Produce began in 1995 as a 0.03 acre market garden to supply the Jupiter Farms Green Market with a Saturday supply of Agarden fresh@ produce. The garden was expanded each year. In 2003-2004, 0.35 acres were under cultivation and clientele were being served at two weekend green markets. Chinese radishes and turnips are two of the 26 crops grown and have been included in the crop mix for four seasons. Planting schedules, growing and harvesting methods, yields, and sales figures will be discussed. For the 2003-2004 season, 31 plantings were scheduled to correspond to the 31 week sales season beginning 18 Oct and ending 16 May. Turnips were sold at \$1 per bunch and Chinese radish at \$1-2 per radish. Turnip bunch size varied with size of turnip and availability.

### **Organizing Plant Materials in Designed Residential Landscapes Using CITYgreen**

*A.B. Lorenzo and G. Salazar, Landscape Design and Management and Ornamental Horticulture Program, Florida A&M University, Tallahassee, FL*

Landscaping is both practical and aesthetically demanding. While a well-conceived landscape should be beautiful, it should also be functional. Well-designed landscaping could solve wide-ranging problems such as cooling in the summer, warmth in the winter, breaking winds, and protection from rain or snow while controlling the surface drainage, to merely providing colors and fragrances. Landscaping is commonly considered not an expense but a capital im-provement that will increase property values significantly. It is an investment that likely provides an excellent return if properly designed, built, and maintained. From an environmental standpoint, it results in savings on utility bills. Perhaps the most important contri-bution of landscaping has to do with the feelings people have for it and not the money. Spaces made useful, comfortable, relaxing, and stimulating contribute much to

enjoyable living. The quantity and quality of the benefits accrue from well-designed landscaping influenced by the plants used and their spatial arrangement in the landscape. In this study, landscape designs with varying levels of plant diversity and spatial arrangement were generated using CITYgreen. CITYgreen is GIS-based mapping technology used to measure, display, and analyze spatial data. A process using decision matrices and weighting summation was adapted to evaluate the benefits generated by each of the design scenarios evaluated and the spatial arrangement which optimizes desired landscaping functions is selected. This procedure might be applied to evaluating alternative spatial organizations of plant materials in designed residential landscapes.

### **Growing and Marketing Arugula at Local Green Markets in Southeast, Florida**

*K. D. Shuler, S. J. S. Nie, and P-A. N. Shuler, Stephen=s Produce, Jupiter, FL*

Stephen=s Produce began in 1995 as a 0.03 acre market garden to supply the Jupiter Farms Green Market with a Saturday supply of Agarden fresh@ produce. The garden was expanded each year. In 2003-2004, 0.35 acres were under cultivation and clientele were being served at two weekend green markets. Arugula was one of the 26 crops grown and has been included in the crop mix for four seasons. Planting schedules, growing and harvesting methods, yields, and sales figures will be discussed. For the 2003-2004 season, 31 plantings were scheduled to correspond to the 31 week sales season beginning 18 Oct and ending 16 May. Arugula was most usually packaged in plastic storage bags containing 120+ grams. Prices ranged from \$2 - \$2.50 per bag depending upon availability.

### **Do Designed Landscapes Deter Crime?**

*A. B. Lorenzo, D. Wims, and B. Davis. Ornamental Horticulture and Landscape Design and Management Program, Florida A&M University, Tallahassee, FL*

Green open spaces and designed landscapes like parks have been linked to healthier and safer urban and urbanizing communities. These vital, well-designed neighborhood common spaces serve to encourage: (1) stronger ties among neighbors, (2) greater sense of safety and adjustment, and (3) more use of neighborhood common spaces. In residential areas, barren, treeless spaces often become "no man's lands," which discourage resident interaction and invite crime. Designed landscapes with well maintained trees and other vegetation can transform these "no man's lands" into desirable and welcoming spaces. Although vegetation has been positively linked to fear of crime and deterring crime in a number of settings, recent findings in urban residential areas appear to indicate a potential negative relationship. Residents living in "greener" surroundings report lower levels of fear, fewer incivilities, and less aggressive and violent behavior. This study used police crime reports to examine and define the relationship between vegetation and crime in inner-city neighborhoods. Crime rates for 10 subdivisions in Tallahassee, Florida with varying levels of green open space and proximity to parks were compared. Results indicate that the greener a subdivision's surroundings were, the pattern of property crimes was lower. The influence of the number of households per subdivision, types of homes, and social and economic demographics of residents on the relationship of vegetation to crime was evaluated.

### **Florida Native Ferns: Ptropical Pteridiphytes**

*Carol Alberts, Student, UF, Anita Neal, Director/Environmental Horticulture Agent, UF - St. Lucie County Cooperative Extension and Sandy Wilson, Assistant Professor, University of Florida, Indian River Research & Education Center*

Plants are considered native to Florida if they were here at the time of European contact in the early sixteenth century (1516). Using plants native to Florida in our landscapes helps to maintain the natural look of our state and can lead to more energy efficient landscaping. Florida has over 2,400 native species of plants, with some found only in Florida. They have survived through the years because they are adapted to our soils, temperature, and rainfall patterns. Each is associated with natural plant communities or ecosystems that occur throughout Florida such as the coastal strand, sand scrub, sandhills, hammocks, flatwoods and swamps. Although only about 25% of our native flora is in commercial production, interest in native landscaping continues to increase. Commercial and homeowner landscapers can benefit from learning more about native plants and how to use them in the landscape in formal beds, understory plantings or as specimen plants. Multi-media tools offer an easily accessible way to promote the use of native plants and their availability in the nursery trade. A PowerPoint presentation focusing on the use of ferns in understory plantings was developed to address these needs. The presentation begins with a key to fern identification features to assist viewers in distinguishing between different species. Featured native ferns are discussed with relation to origin, cultural requirements, availability, and landscape uses. Terrestrial and epiphytic ferns are included.

### **Developing a System to Produce Organic Plug Transplants for Organic Strawberry Production**

*Ashwin Paranjpe, Daniel J. Cantliffe, Rose Koenig. Horticultural Sciences Department. University of Florida, Gainesville, FL.*

The USDA National Organic Standards require growers to use organically-grown transplants for growing strawberries as an annual crop. However, organically-grown strawberry plug transplants are not presently available in the U.S. or Canada. A study was conducted during fall 2002-03 wherein three types of plug mixes and fertilizers were evaluated for organic plug transplant production. Runner tips of 'Camarosa' strawberry were obtained from a nursery in North Carolina and planted in propagation trays. Our research demonstrated that good quality organic plug transplants can be produced under low-cost polyhouses by using organic plug mixes and organic fertilizers. Plants grown in plug-mix containing ¼" pine bark and worm castings (1:1 v/v) needed to be irrigated more frequently as compared to those grown in plug mixes that contained untreated peat moss, coarse perlite, and medium vermiculite (2:1:1 v/v). Both Fertrell Super-N (4-2-4) and Fish-O-Mega (4-2-2) when used alone produced healthy transplants but caused 'leaf burn' when used together. Therefore, when used in combination, the concentrations of Fertrell Super-N and Fish-O-Mega may need to be reduced in order to avoid leaf burn. Disinfection of the runner tips prior to plug production by dipping in dilute solutions of Oxidate® and Chlorox® bleach may help reduce the incidence of this disease, and may ultimately result in improved yields.

### **Effects of Aminolevulinic Acid and Acetylthioprolin on Weed-free and Weed-infested St. Augustinegrass Turf**

*J. Pablo Morales-Payan and William M. Stall. Horticultural Sciences Department. University of Florida. Gainesville, FL*

Experiments were conducted to determine the effect of the biostimulants acetylthioproline (AP) and aminolevulinic acid (ALA) on the growth and quality of St. Augustinegrass turf. AP and ALA application improved above- and belowground biomass, leaf color, and density in weed-free and weed-infested St. Augustinegrass. However, AP and ALA also enhanced the growth of emerged weeds. AP and ALA may be useful in enhancing St. Augustinegrass growth and quality, providing adequate weed suppression is implemented before biostimulant application.

### **Teaching Entomology to Youth Through a Bug's Life Summer Camp**

*A. S. Neal, E. A. Skvarch, St. Lucie County Extension, UF*

The 4-H Bug-A-Boo Camp focused on entomology, providing each day camper with the materials needed to collect, preserve, identify, and pin their specimens. Each day was selected as an insect "class" day (Monday - Coleoptera, Tuesday - Diptera, etc.) and tied into the day's activities. The curriculum included basic entomology, a game "All in Order", "How do Insects Grow" activity, a behind the scenes tour of Epcot's The Land Insectory and planting a butterfly garden at a State Park. It's a Bug's Life Jeopardy game was a fun way to measure knowledge gain. This program allowed 21 campers to learn about the natural and man-made habitats that their collections were gathered in. Each camper developed an insect collection and identified each specimen according to class. An evaluation tool was designed and mailed out to each parent to evaluate their child's knowledge gain and suggestions for improvements in the camp. 100% of respondents (7/7) indicated an increase in knowledge of entomology. 75% of respondents also stated that the children were continuing their interest after camp. The camp participants rated most of the activities as "cool or way cool".

### **An Overview of the Tree Trimmer Licensing Program in Broward County**

*Henry Mayer, Commercial Horticulture Agent, Miami-Dade County Extension, UF*

The Tree Trimmer program started in Broward County in September 2001 with the goal of improving the level of professionalism in the industry. Phase I of the program consists of 4 hours of class followed by a 50 multiple-choice questions exam; phase II is designed to augment the material presented in the initial curriculum in order to satisfy the continuing education needs of licensed tree trimmers by exploring topics such as hazard tree assessment, tree repair and customer relationships. In order to pass the exam for phase I the participants need to have a 70% score rating (35 out of 50). As of 2/24/04, 2,007 participants have taken the class, 1,633 passed and 174 failed. After the applicant passes the exam a certificate of completion is issued with his/her name that certifies his/her successful completion of the Tree Trimmer Training Program.

Phase I training is now being implemented, it consists of 150 slide shows and an ISA video, covering basic tree terminology and biology, good and bad pruning practices, a pruning exercise on paper, and a quick field review. Broward County Extension Division is responsible for the training, Building Code Services Division is responsible for issuing the license, and the Biological Resources Division from the Department of Planning and Environmental Protection is in charge of the enforcement. The training is offered in English, Spanish and Creole. In order to obtain the Tree Trimmer License the applicant needs to submit to Building Code Services Division the following documents: Proof of experience, credit references, corporation/ partnership verification, insurance, two photos, and license fee.

## **Adopt a Drop: A Collaborative Environmental Water Quality Action Program**

*F. Burkey, Multi-County FYN, UF and C. C. Bailey, Martin County Extension, UF*

The Adopt a Drop Program (AAD) was begun in 2000 by the St. Lucie River Initiative as a method of improving stormwater management at the residential neighborhood scale. Representatives of SFWMD, FDEP and IFAS Extension, FYN were the collaborators involved in the program development and delivery. AAD objectives included the mapping of neighborhood stormwater management systems, education of homeowners on what they can do within their own property to improve stormwater discharged, and to provide a report and recommendations on how the common and public lands and related stormwater management systems can be modified or managed to improve stormwater quality discharged to the Estuary. AAD programming as been presented to five neighborhoods in the City of Stuart; four in Martin County; one in St. Lucie County and the Town of Ocean Breeze. The focus was initially on older neighborhoods without modern stormwater management facilities as best opportunities for making low cost improvements. We found that in older neighborhoods, however that most stormwater percolated into the soil rather than running off into streams or storm sewers. ADD programming is now coinciding with SFWMD reports from stormwater sampling data that indicate "hot spots" for non-point source pollution thereby focusing our efforts the on watershed-level where the data suggest the most serious problems exist.

## **Establishing Perennial Peanut as a Landscape Groundcover**

*Robert E. Rouse, Southwest Florida Research and Education Center, UF, Elan M. Miavitz, Collier County Extension Service, UF, and Fritz M. Roka, Southwest Florida Research and Education Center, UF*

Rhizomal Perennial peanut (*Arachis glabrata*, Benth) originated in tropical South America in tropical conditions and is adapted to subtropical and warm temperate climates. Perennial peanut was first introduced to the USA from Brazil in 1936. Perennial peanut has recently shown promise as an ornamental groundcover due to its high resistance to drought, nematodes, insects, diseases, and its minimal fertilizer needs. Cultivars 'Ecoturf' and 'Arblick' are available cultivars for landscape use. The cultivar 'Florigraze' released for use in pastures also appears to be suitable for landscape use. Several systems can be used for planting perennial peanut in a landscape setting. Plants can be established from solid set sod, sod strips, sod plugs, or from plants grown in nursery containers. Comparison of cost when planting solid set sod and containers on 12 to 18-inch centers found solid set sod to be advantageous. Sod provides instant 100% groundcover. Planting strips, plugs, and containers require up to two years to achieve 100% groundcover.

## **Vegetable Section Abstracts**

### **A History of Commercial Vegetable Production in Central and Southern Florida**

*Alicia Whidden, Hillsborough County Cooperative Extension, UF; Mary Lamberts, Miami-Dade Cooperative Extension, UF; Elizabeth Lamb, Indian River REC, UF, Ft. Pierce; Richard Tyson, Seminole County Cooperative Extension, UF; Gene McAvoy, Hendry County Cooperative Extension,*

*UF; Phyllis Gilreath, Manatee County Cooperative Extension, UF; and Kenneth Shuler, Stephen's Garden, FL*

Commercial agricultural production began in central Florida in the mid 1800s and in southern Florida towards the end of the same century. The back-to-back freezes of 1894 and 1895 devastated all commercial agriculture with the exception of Dade and Broward Counties in the extreme southeastern corner. Early transportation was by rail, which extended as far south as Palm Beach prior to the great freezes, and by ship for the other two counties. Early crops included celery (central) and tomatoes. Areas such as Homestead became famous for winter tomatoes as early as the late 1890s, with production peaking in the 1920s at 35 train carloads per day. Central Florida has seen a loss of 90% of vegetable land in the area to the north of Orlando. West central Florida which includes the Palmetto-Ruskin area has gone from growing celery to tomatoes and Plant City has been growing strawberries as a major crop for over 100 years. Production in eastern Palm Beach County has shrunk considerably with increasing urbanization, while Homestead has seen a shift from tomatoes to snapbeans as the major crop.

### **Effect of Mixed Populations of Yellow and Purple Nutsedges (*Cyperus esculentus* and *C. rotundus*) on Eggplant Yield**

*J. Pablo Morales-Payan and William M. Stall, Horticultural Sciences Department, UF, Gainesville*

Yellow nutsedge (*Cyperus esculentus*) (YN) and purple nutsedge (*Cyperus rotundus*) (PN) are troublesome weeds that may occur in pure or mixed stands in Florida vegetables. Experiments were conducted in Citra, FL, to determine the combined effect YN and PN on the yield of polyethylene-mulched eggplant. YN and PN (total density of 80 tubers/m<sup>2</sup>) emerged 3 days after crop transplanting (DAT) and grew with the crop until the end of the season. The YN:PN stands were 0:80, 20:60, 40:40, 60:20, and 80:0. When eggplant competed with pure stands of YN, marketable yield loss (MYL) loss was 22%. MYL loss decreased as the amount of PN in the weed stands increased. Average fruit size tended to decrease as the amount of YN in the weed stand increased. These results indicate that in terms of eggplant yield, interference from YN (in pure or mixed stands) may be more important than PN interference.

### **Effect of Mulch Types on 1,3-Dichloropropene + Chloropicrin Retention and Nutsedge (*Cyperus* spp.) Control**

*James P. Gilreath, Bielinski M. Santos, Timothy N. Motis, and Marcel von Hulten, Gulf Coast REC, UF, Bradenton*

Field trials were conducted to examine the effect of different 1,3-dichloropropene + chloropicrin (Inline) concentrations and mulch types on the fumigant retention and nutsedge control. Inline concentrations were 600, 800, 1000, 1200, and 1400 ppm. Mulch types were: a) Pliant High Barrier<sup>TM</sup> white on black, b) IPM Bromostop<sup>TM</sup> white on black, c) Pliant<sup>TM</sup> metallized, and d) Klerk's<sup>TM</sup> green. Soil air in the beds was sampled at 1, 2, 3, 4, 6 and 7 days after Inline injection. During the first 3 days, the Klerk's green and IPM Bromostop had the highest fumigant retention. With 1400 ppm of Inline, Klerk's green, IPM Bromostop, and Pliant metallized had 120, 41, and 76% more retention than Pliant High Barrier white on black, respectively. With the same concentration and 12 weeks after injection, Klerk's green, IPM Bromostop, and Pliant metallized had 7, 2.5, and 4 times less nutsedge than Pliant High Barrier.

## **Soil Fumigant, Mulch Types, and Herbicide Treatments Affect Pepper (*Capsicum annuum*) Vigor and Yield, Purple Nutsedge (*Cyperus rotundus* L.), and Root Knot Nematodes (*Meloidogyne* spp.)**

*R.C. Hochmuth, W. L. Laughlin, S.S. Kerr, and L.L. Davis, North Florida REC, UF, Live Oak; E.H. Simonne, W.M. Stall, and C.A. Chase, Horticultural Sciences Department, UF, Gainesville; A.W. Weiss, J. Nance, and J. Mirusso, Dow AgroSciences, Indianapolis, IN*

Purple nutsedge (*Cyperus rotundus* L.), yellow nutsedge (*Cyperus esculentus* L.), and root-knot nematodes (*Meloidogyne* spp.) are serious pests in vegetable production in Florida. Soil fumigation with methyl bromide in plasticulture systems has traditionally provided excellent control of these pests. This trial was conducted to evaluate alternative soil fumigants, methods of application, and other cultural practices as possible replacements to methyl bromide due to the reduced availability and increased cost of methyl bromide. Plots were established in a Lakeland fine sand at the UF/IFAS North Florida Research and Education Center – Suwannee Valley, near Live Oak, FL in the fall of 2003. Five soil fumigant treatments, two plastic mulches, and two herbicide treatments were used in the study. Pepper (*Capsicum annuum*) yield and vigor was affected by soil fumigation and mulch treatment. Purple nutsedge populations were affected by soil fumigation, mulch type, and herbicide treatment. Root-knot nematode populations were affected by soil fumigation treatment, but not mulch type or herbicide treatment.

## **Purple Nutsedge (*Cyperus rotundus*) Control with Drip-Applied Metam Potassium**

*Bielinski M. Santos and James P. Gilreath, Gulf Coast REC, UF, Bradenton*

Over the years, recommendations on K-Pam rates and efficacy have been inconsistent. Many of these inconsistencies are due to the lack of knowledge about application techniques. Therefore, multiple field trials were conducted to determine: a) the effect of K-Pam delivery water volume on weed control, and b) the influence of K-Pam concentration on nutsedge control. Pepper was included as the test crop. In the K-Pam and water volume trial, treatments were the untreated control, and six combinations of two K-Pam concentrations (3000 and 6000 ppm) and three water flow rates (2.75, 4.10 or 5.50 L/min/100 m) [0.22, 0.34 or 0.45 gl/min/100 ft]. The application rate was 570 L/ha. Results indicate that all K-Pam treatments effectively controlled purple nutsedge, regardless of the flow rate or the concentration. In the K-Pam concentration plus rate study, treatments were the non-fumigated control, K-Pam at 285, 570 or 1040 L/ha (30, 60 or 120 gl/A) applied as 3000 ppm, and K-Pam at 570, 1040 and 2080 L/ha (60, 120 and 240 gl/A) applied as 6000 ppm. Regardless of the rate and total water volume, applying 6000 ppm was more effective on nutsedge than 3000 ppm. Finally, in the two K-Pam concentration studies, a fix rate of 570 L/ha was applied in concentrations of 1000, 2000, 3000, 4000, 5000, and 6000. Results indicate that at 10 weeks after treatment, nutsedge densities decline linearly as concentration increases ( $y=503.7-0.0695x$  in early Fall trial, and  $y=290.57-0.0409x$  in late Fall trial). The data indicates that K-Pam concentration is more important than delivery water volume.

## **Soilborne Disease and Weed Management with Methyl Bromide Alternatives in Fresh Market Tomato**

*James P. Gilreath and Bielinski M. Santos, Gulf Coast REC, UF, Bradenton*

Two field trials were conducted with multiple fumigant and herbicide combinations in search for methyl bromide (MBr) alternatives for soilborne pest and nutsedge control in tomato. The treatments were: a) a non-treated control; b) MBr + chloropicrin (Pic) 67/33 at 350 kg/ha; c) 1,3-dichloropropene + Pic (Telone C-35), napropamide (Devrinol), and halosulfuron (Sanda) at 350 L/ha, 2 kg ai/ha, and 0.7 kg ai/ha; d) Pic and liquid metam sodium (MNa) at 150 kg/ha and 750 L/ha; e) propoxone at 450 L/ha; f) furfural + isothiocyanate (Multiguard FFA) at 1500 kg ai/ha; g) furfural (Multiguard Protect) + liquid MNa at 500 L/ha and 500 L/ha; h) Multiguard FFA at 1000 kg ai/ha followed by four biweekly Multiguard Protect applications of 50 L/ha; i) Multiguard Protect + liquid MNa at 400 L/ha + 300 L/ha followed by four biweekly Multiguard Protect applications of 50 L/ha; j) Telone C-35 at 350 L/ha with virtually impermeable film (VIF), k) Telone C-35, S-metolachlor (Dual Magnum), and trifloxysulfuron (Envoke) at 350 L/ha, 840 g ai/ha, and 5.3 g ai/ha; l) sodium azide (SEP 100) through drip irrigation at 75 kg ai/ha followed by three biweekly water applications; m) SEP 100 through drip irrigation at 150 kg ai/ha followed by three biweekly water applications; and n) pebulate (Tillam), Pic, and fosthiazate at 4 kg ai/ha, 150 kg ai/ha, and 4.5 kg ai/ha. At the end of the tomato season, the combinations of Telone C-35 + Devrinol + Sandea; Pic + MNa; Telone C-35 + VIF; Telone C-35 + Dual Magnum + Envoke; SEP 100 at 75 kg ai/ha; SEP at 150 kg ai/ha; and Tillam + Pic + Fosthiazate had the same nutsedge counts as MBr. The same pattern occurred for Fusarium wilt incidence. In terms of marketable fruit yield, all treatments, except the untreated control and SEP 100 at 150 kg ai/ha, were equal to MBr.

## **Effects of Augmenting Populations of Predacious Insects on Aphid and Whitefly Pests of Muskmelon**

*Susan E. Webb, Entomology and Nematology Department, UF, Gainesville*

Melon aphid, *Aphis gossypii*, and silverleaf whitefly, *Bemisia argentifolii*, are major pests of cucurbits. An early infestation of melon aphid can lead to severe damage to new growth, stunting, and yield loss. Heavy whitefly populations also contribute to poor growth of young plants. Early in the season, natural populations of insect predators may be low, and artificially increasing the population with insectary-reared predators might keep pest populations from reaching damaging levels. Two predacious insects, *Coleomagilla maculata*, a lady beetle, and *Geocoris punctipes*, a big-eyed bug, were released onto muskmelon, 'Athena' that had been previously infested with aphids. Whiteflies infested the crop from nearby potatoes. Immature stages of predators were used to prevent dispersal from the release site. Within a week of the release, aphids were almost eliminated by another lady beetle (*Coccinella septempunctata*) that moved into the melons when the adjacent potato vines were killed. Big-eyed bugs persisted for the rest of season. Surprisingly, whitefly populations were higher on plants infested with the highest rate of big-eyed bugs. It is possible that these predators interfered with other naturally occurring predacious insects. Releasing predacious insects may thus have unexpected effects. It may be more worthwhile to plant an earlier, unrelated crop to generate natural enemies for a second crop and conserve naturally occurring predators by avoiding broad-spectrum insecticides.

## **Protected Agriculture as a Methyl Bromide Alternative? Current Reality and Future Promise.**

*Margaret L. Smither-Kopperl and Daniel J. Cantliffe, Horticultural Sciences Department, UF, Gainesville*

Despite extensive and expensive research into methyl bromide alternatives over the past decade there is no one product that is an acceptable alternative. Methyl bromide was applied to 99% of the pepper

acreage, 100% of the strawberry acreage, and 77% of the tomato acreage in Florida in 2002. Cucurbits, either cucumber or squash are planted directly after these crops and so are indirectly dependant upon methyl bromide. Over the same time period, the areas of inexpensive, low-energy, passive-ventilated, plastic-covered greenhouses have expanded dramatically worldwide, for example the Mediterranean Basin is estimated to have 100,000 ha, and the area in Mexico is increasing by 30% annually. The greenhouse production area in the US is also expanding rapidly and is estimated at 1,000 ha (~ 2,500 acres). Greenhouse production offers several advantages including up to 10-fold increased yields, improved quality, recycling of water and nutrients and the potential to grow produce as pesticide-free. Soilless media eliminates the need for methyl bromide as it avoids weeds, soil-borne pathogens or plant parasitic nematodes. Imports of quality greenhouse produce from several countries including Mexico, Canada and Spain is sold at a premium over US field-grown produce. The Protected Agriculture Project at the University of Florida adapts available greenhouse technology for Florida conditions and has developed extensive information for the production of most of the major greenhouse vegetable crops.

### **Economic Feasibility of Producing Strawberries in a Passively Ventilated Greenhouse in North Central Florida**

*Ashwin Paranjpe and Daniel J. Cantliffe, Horticultural Sciences Department, UF, Gainesville*

The economic feasibility of a 1-ha greenhouse strawberry enterprise was analyzed. Results from greenhouse studies conducted at the University of Florida Protected Agriculture Project indicated that average yields of 11 kg/m<sup>2</sup> (110 t/ha) can be obtained under north-central Florida conditions. These yields are 3-4 times greater than those obtained from field-grown strawberries in west-central Florida. Based on average yields of 11 kg/m<sup>2</sup> from November to March, and average market prices ranging from 2.10/kg in March to \$3.81/kg in December, a gross income of \$32.31/m<sup>2</sup> or \$323,100/ha can be obtained. The fixed cost (or initial investment) of a 1-ha passively ventilated greenhouse designed for producing strawberries was estimated at \$76.27/m<sup>2</sup> or 762,76/ha, and the annual depreciation cost on the initial investment was estimated at \$6.70/m<sup>2</sup> or \$66,976/ha. The variable cost for producing strawberries in a 1-ha passively ventilated greenhouse at a plant density of 22 plants/m<sup>2</sup> and average yields of 500 g/plant (11 kg/m<sup>2</sup>) was estimated at \$20.91/m<sup>2</sup> or \$209,075/ha. The total cost (annual depreciation on fixed cost + variable cost) for producing 1 ha greenhouse strawberries was \$28.54/m<sup>2</sup> or \$285,351/ha. With average yields of 11 kg/m<sup>2</sup> and monthly market prices ranging from 2.10/kg in March to \$3.81/kg in December, a net annual income of \$3.77/m<sup>2</sup> or \$37,749/ha can be obtained above the total cost. 'Pesticide-free' strawberries and specialty 'stem-berries' could potentially be sold at a premium price, and may lead to substantially higher net returns. Thus greenhouse strawberry production can be considered an economically viable alternative to conventional field strawberry production in Florida.

### **Economic Feasibility of Producing Galia Muskmelons in Passive-Ventilated Greenhouses and Soilless Culture in North Central Florida**

*Juan C. Rodriguezrial; Daniel J. Cantliffe, Nicole L. Shaw, and Cecil E. Shine, Horticultural Sciences Department, UF, Gainesville*

Galia muskmelons (*Cucumis melo* L.) produced in a passive-ventilated greenhouse as an alternative crop to traditional greenhouse like tomatoes and colored peppers can result in profitable returns to

investment. Although, production in vertical greenhouse systems is intensive both in labor and costs, previous reports from trials at the Florida have indicated that yields for Galia of five fruits per plant (approximately 1.0 kg each) can be obtained in greenhouses using soilless culture. These yields are three or more times greater than those obtained under field conditions. When Galia was produced at a plant density of  $3.3 \cdot m^{-2}$ , yields of  $16.5 \text{ kg} \cdot m^{-2}$  per crop were obtained regardless of media or container that was used. Prices of \$0.75 and 1.00 per kilogram per fruit were not enough to cover all costs for producing Galia in a greenhouse. However, when the market price was over \$1.50 per kilogram of fruit, net profits of over  $\$095 \cdot m^2$  were obtained per crop. In an annual double crop system, where media and containers were reused for two growing cycles (fall and spring), profits of over  $\$7 \cdot m^{-2}$  were obtained if the price of the fruit was \$1.50 or more.

## **Hydroponically Grown 'Baby' Squash: Gourmet Appeal for the Greenhouse Grower**

*Nicole L. Shaw and Daniel J. Cantliffe, Horticultural Sciences Department, UF, Gainesville*

In the past few years, 'baby' vegetables have become a popular item for restaurant chefs. Baby vegetables are not always special varieties, but merely, common vegetables that have been harvested immature. These types of vegetables demand more intense production operations to insure high quality, and in turn, bring a higher market price. In spring 2003, 18 squash cultivars were grown hydroponically in a passive-ventilated greenhouse. Plants were trellised on individual twine using twist-ties and laterals were removed from all cultivars to encourage indeterminate growth. Bumble bees were used for pollination, therefore, biological control of pests was necessary and applications of pesticides were avoided. Of the 18 cultivars, 7 were zucchini-types (3 green, 3 yellow, 1 round), 5 were yellow summer squash-types, 4 were patty pan/scallop-types, and 2 were couasa-types. Plants were grown from Feb. until May 2003. Squash were harvested every other day (28 total) and graded as fancy or baby depending on size. Unmarketable fruit were culled. Baby squash were less than 8 cm in length for zucchini and summer squash types and less than 4 cm diameter for round and patty pan/scallop types. Marketable fruit larger than those considered baby-size were graded as fancy. The cv. Sunburst (patty pan) produced the greatest number of baby-size fruit per plant at 67 while the cv. Sebring (yellow zucchini) produced the least, 17. The zucchini-types produced between 16 and 25 baby-size fruit per plant (Bareket, Revenue, Raven were green while Goldy, Gold Rush, and Sebring were yellow). The yellow summer squash-types (Seneca Supreme, Supersett, Yellowcrook) produced approximately 45 baby fruit per plant (50 to 84 total fruit per plant). The production of the patty pan/scallop-types (Butter Scallop, Sunburst, Patty Green Tint and Starship) ranged from 50 to 67 baby-size fruit per plant depending on cultivar (70 to 80 total fruit per plant). Magda and HA-187, both couasa-types, produced 27 and 34 baby fruit, respectively. Baby squash can be easily grown hydroponically in a pesticide-free environment of a greenhouse where they can be harvested, packaged, and distributed to buyers daily.

## **What are the Best Selling Produce Items Imported from Overseas to Miami-Dade County? Can They be Produced Here?**

*A.R. Rafie, Miami-Dade County Cooperative Extension, UF, and Edward Evans, Tropical REC, UF, Homestead*

A list of 65 produce importers in Miami-Dade and Broward counties was obtained from the Blue Book. A survey was designed and was sent to these importers to identify five vegetables, five fruits, and five root and tuber items with most demand that they are currently importing. Also, the importers were asked to identify advantages and disadvantages of importing produce to South Florida. Government regulations for imported produce in the United States were mentioned as a disadvantage of importing produce. A longer production season and more volume were mentioned as advantages of importing produce to the United States. Oriental vegetables, green mangoes, French beans, snow peas, and cilantro were among the produce items that were most in demand. When the importers were asked if their buyers in the United States would prefer Florida-grown produce compared to imported produce, the majority of respondents indicated, "At our business level, this is not an issue." This survey is currently continuing, and the detailed results will be presented at the 2004 FSHS meeting.

### **The Role of IFAS and Associations in Florida**

*Danny Raulerson, Florida Fruit and Vegetable Association*

No Abstract

### **The Role of Florida Farm Bureau in Florida Agriculture**

*Carolee Howe, Assistant Director, Agricultural Policy Division, Florida Farm Bureau*

No Abstract

### **The Influence of Calcium Thiosulfate on Yield and Postharvest Quality of 'Sweet Charlie' Strawberry**

*C.E. Esmel and J.R. Duval, Gulf Coast REC, UF, Dover; S.A. Sargent, Horticultural Sciences Department, UF, Gainesville*

Strawberries are a high-value crop with a short postharvest life. Florida is the largest producer of winter strawberries in the United States with 2,790 hectares of production. Supplemental Ca is used on various fruit crops to maintain or increase commodity quality. Many Florida strawberry growers apply supplemental Ca to their crop despite lack of conclusive evidence of an increase in berry quality or yield. Supplemental Ca applied to 'Sweet Charlie' as calcium thiosulfate during production may help increase its shelf life. The objectives of this study were to determine the effects of Ca supplied as calcium thiosulfate on yield, growth and postharvest quality when applied supplementally to a grower's standard fertilization regime and as sole source of calcium through fertigation. 'Sweet Charlie' strawberry plants were grown at the University of Florida, on a Seffner fine sand in Dover, FL. The experimental design was a complete randomized block design with four replications. The treatments consisted of the Florida strawberry grower's standard fertilization ( $\text{Ca}(\text{NO}_3)_2$ ) with and without calcium thiosulfate supplement, and no ( $\text{Ca}(\text{NO}_3)_2$ ) with and without calcium thiosulfate supplement. Yield data was collected twice weekly through out the growing season. Fruits were graded for quality based upon size, disease incidence, frost/water damage, and misshapen form. Calcium content was determined for fruit during January, February and March. Postharvest quality evaluations of pH, total titratable acidity, soluble solids content, and firmness (Instron 4411) were determined in March.

## **Meristem Tip Culture Boosts Yield of Sweet Potato cv. Picadita in South Florida**

*David Q. Ying, Z. Ying, and T.L. Davenport, Tropical REC, UF, Homestead*

'Picadita' is the most important cultivar of sweet potato (*Ipomoea batatas*) grown in Miami-Dade County. Originally introduced from Cuba, it has never been 'cleaned-up' by meristem-tip culture, a practice widely used to remove yield-limiting pathogens from sweet potato cuttings. Meristem-tip culture was investigated as a means to increase yield of this cultivar. It took about five months from initiation of meristem explant cultures to distribution of field-ready cuttings. The smaller the explants, the lower the survival rate. Only 8.5% of explants that were <200 $\mu$ m in length developed into in vitro plantlets, whereas 64.4% of the explants that were 500-1000 $\mu$ m in length successfully developed. In the first growing season, average yields of the <200 $\mu$ m meristem tip-cultured plants were 78.2% and 146.7% greater than non-cultured control plants from experimental plots and adjacent commercial fields, respectively. Yields were 48.3% and 105.5% greater, respectively, if cuttings came from 200-400 $\mu$ m explants and only 5.8% and 46.5% greater if cuttings were derived from 500-1000 $\mu$ m explants. Cuttings were taken from the first season <200 $\mu$ m meristem tip-cultured plants just before harvesting and planted for the second growing season. In this second growing season, the average yields of these plants were 132.1% greater than the adjacent commercial field. The chlorophyll content, leaf area, and number of leaves of the <200 $\mu$ m meristem tip-cultured plants were significantly more than those of control plants. The length of vine, base diameter of vine and number of side vines were also significantly increased compared with that of control. We conclude that meristem tip culture of the smallest size explants successfully eliminated the yield-limiting pathogens from 'Picadita' sweet potato and significantly boosted its yield.

## **Management of Nitrogen for Potato in the Suwannee Valley Area of Northern Florida.**

*Justin Jones and George Hochmuth, North Florida REC, UF, Live Oak*

Rising nitrate concentrations in the Suwannee River and certain springs along the river have caused concern and led to the formation of the Suwannee River Partnership. The Partnership is a team of state, federal, and local governmental agencies, universities, local and state agricultural groups and others interested in developing incentive based strategies for reducing nitrate in these water bodies. In conjunction with the Partnership, UF/IFAS has been conducting research and demonstration projects focused on agriculture production sectors, including dairy, poultry, and row crop operations to find and demonstrate production and management strategies that will lead to reductions in nitrate concentrations along the Suwannee River. Vegetables are a significant part of the agricultural base in this region and potato (*Solanum tuberosum*) is a major crop grown in the Suwannee Valley. Potatoes are often produced with a large portion of total-season N applied preplant, as much as 5 to 6 weeks ahead of crop emergence. The preplant N is subject to leaching from the coarse sandy soils during heavy rainfall before the plants develop a root system capable of absorbing N. We evaluated two approaches to managing early-season N applications, including no preplant N and 60 lb/acre preplant N, a commercial standard practice. Potatoes grew normally and produced equal yields with no preplant N, compared with 60 lb/acre N applied during bed formation and soil fumigation, 3 weeks ahead of crop emergence. Timing N application to coincide with crop growth and N uptake capacity could reduce the risk of N leaching and contamination of groundwater.

## **Controlled Release Fertilizer Potato Production System for Florida**

*Chad M. Hutchinson, Horticultural Sciences Department, UF, Gainesville*

Irish potato (*Solanum tuberosum* L.) is one of the top five valued vegetable crops in Florida. The majority of planted potato acres in the state are irrigated with seepage irrigation. The type of irrigation used, weather conditions during the potato season, and fertilization practices led to the development of best management practices that limit the application of nitrogen fertilizers during the season. BMPs reduce the potential movement of nitrate from potato fields into surrounding watersheds. A controlled release fertilizer (CRF) system was evaluated for potato production in Florida that helps growers meet the nitrogen BMPs while improving nitrogen use efficiency compared to conventional fertilizer practices. Over the past four seasons, 54 'CRF product by rate' combinations were evaluated and compared to a conventional fertilizer program. Two multi-acre grower trials in 2002 and 2003 validated successful treatments. The CRF treatments produced equal or better tuber yields and higher tuber quality while reducing nitrogen application rate by at least 25% compared to conventional fertilizer treatments at the BMP rate (200 lb N/acre). Although no firm product cost is yet set, product cost has dropped from over \$1,200.00/acre to a range between \$100 and \$200/acre in 2003. In comparison, the grower conventional nitrogen program has ranged from \$50 to \$75/acre.

## **Water Movement in Mulched Beds in a Rocky Soil of Miami-Dade County**

*Eric Simonne, Horticultural Sciences Department, UF, Gainesville; Teresa Olczyk, Miami-Dade Cooperative Extension, UF; Rafael Munoz-Carpena, Tropical REC, UF, Homestead; and David Studstill, Horticultural Sciences Department, UF, Gainesville*

Efficient irrigation and fertilizer management for vegetables grown with plasticulture requires an understanding of water movement in mulched beds. Soluble blue dye and controlled irrigation events were used in a dye test conducted on 14 Oct., 2003 on a Chekkika gravely loam soil in Homestead, FL. The objectives were to visualize the wetting patterns of several drip tapes and provide guidelines for scheduling irrigation. The dye test consisted of preparing mulched beds with different drip tapes, injecting dye, irrigating with a predetermined volume of water (V), digging longitudinal and transverse sections of the beds, and taking measurements. Drip tape brands (and number per bed (dpb)) were Aquatraxx (22 gal/100ft/hr (1, 2 dpb)), Eurodrip (35 gal/100ft/hr (1 dpb) and 26 gal/100ft/hr (2 dpb)), Netafim (24 gal/100ft/hr (1,2 dpb)), Queen Gil (4-inch emitter spacing (e.s), 33 gal/100ft/hr (1 dpb) and 16 gal/100ft/hr (2 dpb)), and T-Tape (8-inch e.s., 21 gal/100ft/hr (1 dpb)). After digging, dye patterns appeared as blue rings under each emitter. Increasing V from 21 to 142 gal/100 ft did not significantly increase depth (D), width (W) of the wetted zone, and emitter-to-emitter coverage. All measurements ranged between 4 and 9 inches. For each drip tape, increasing V significantly increased W, but only within the narrow 4 to 9 inch range. After 2 to 3 hours of irrigation, the dye reached the calcium carbonate bedrock and moved into it thereafter. Hence, the flow rate and emitter spacing had no practical effect on the wetted zone of this rocky soil possibly because of shallow soil depth (7 to 10 inches) and high soil heterogeneity. Yet, these results suggest that soluble fertilizers should be applied in small irrigation times and volumes to prevent leaching into the bedrock.

## **Reconciling Water Quality Parameters Impacting Nitrification in Aquaponics: pH**

*R.V. Tyson, Seminole County Cooperative Extension, UF, Sanford; E.H. Simonne, Horticultural Sciences Department, UF, Gainesville; J.M. White, Mid-Florida REC, UF, Apopka; F.A. Chapman, Fisheries and Aquatic Sciences, UF, Gainesville; M. Davis, Tropical REC, UF, Homestead; and E.M. Lamb, Indian River REC, UF, Ft. Pierce*

Combining hydroponics and aquaculture into aquaponics requires reconciling water quality parameters for the survival and growth of the plant, the fish, and the nitrifying bacteria. The plant and fish are grown as cash crops while bacteria are expected to oxidize ammonium (fish by-product) into nitrite and finally nitrate. The objectives of this project were to determine nitrification activity response to pH between 5.5 and 8.5 in biofilters containing perlite media, and assess if temporary nitrite concentrations may be lethal to the organisms present. No nitrification occurred in the biofilters maintained at a pH of 5.5. Ammonium concentration decreased from 5 to 0 mg/L in 12 (pH 8.5) and 20 (pH 7.5 and 6.5) days after introduction of nitrifying bacteria to the perlite biofilters. Nitrite began to be measured in the biofilter water 8 (pH 8.5), 12 (pH 7.5), and 16 (pH 6.5) days after introduction of nitrifying bacteria. These results indicate that ammonium conversion was significantly faster at pH 8.5 than at the lower pH values which is higher than recommended pH for hydroponic plant production (pH 5.8-6.2). Optimum pH ranges in aquaponics will be discussed and results will point to potential problems and solutions in reconciling pH levels between the three organisms.

### **The Horticultural History of the Cooperative Extension Service in Florida**

*Elizabeth Lamb, Indian River REC, UF, Ft. Pierce; Mary Lamberts, Miami-Dade Cooperative Extension, UF; Jack Hebb, St. Lucie County Cooperative Extension, UF; Ed Skvarch, St. Lucie County Cooperative Extension, UF; Phyllis Gilreath, Manatee County Cooperative Extension, UF; Gene McAvoy, Hendry County Cooperative Extension, UF; Richard Tyson, Seminole County Cooperative Extension, UF; Kenneth Shuler, Stephen's Garden, FL; Alicia Whidden, Hillsborough County Cooperative Extension, UF; Eva Worden, Ft. Lauderdale REC, Ft. Lauderdale, UF*

Extension of research started in Florida in 1899 as Farmers' Institutes, conducted by the Agricultural Experiment Station and the College of Agriculture, and Cooperative Demonstration Work, conducted by the Bureau of Plant Industry. In 1909 and 1911 respectively, boys' and girls' clubs were added. On May 25, 1915, following the approval of the Smith-Lever Act by the State Legislature, The Agricultural Extension Division was started. Thirty-nine counties had demonstration agents and 22 counties had home demonstration agents in that year and the first bulletin was issued in April, 1915. Work on citrus has been an important part of Extension's work in Florida since its inception, including the Citrus Advisory Committee (1947-1964) and Florida Citrus Institutes (1930's-1970's), and continues today with work on disease and insect control, best management practices and genetic resources. Even though vegetable crops have been important in Florida for decades, formal Extension programs in vegetable crops did not begin until 1948. This program expanded rapidly in the 1950's and the Production Guides were initiated during this period. Current emphases are in production, marketing, postharvest handling and Integrated Pest Management. Extension programs in Ornamental Horticulture started in 1953 to cover commercial and home owner questions on ornamental plants. The broad range of crops, production systems, and markets requires an expanding emphasis on environmental horticulture in the Florida Cooperative Extension system. As changes in the demographics of the state and market competition in horticultural products continue, Extension will adapt to support the commercial industry and homeowner interest in Horticulture.

## **Fruit Development Period in Strawberry Grown in a Winter, Annual Hill Production System**

*Craig K. Chandler, Gulf Coast REC, UF, Dover and Mark Herrington, Maroochy Research Station, Nambour, Queensland, Australia*

A study was conducted in Queensland, Australia during the winter of 2000 to determine the length of time from anthesis to mature fruit (i.e., the fruit development period) for strawberry grown in an open field, plasticulture system, identical to the system commonly used for commercial strawberry production in Florida. This information could be useful for developing a model that growers could use to predict yield at different points during the season. From June 15 (equivalent to Dec. 15 in the northern hemisphere) to Aug. 17 (equivalent to Feb. 17 in the northern hemisphere), open flowers on several cultivars were tagged. Then the dates on which these tagged flowers became mature fruit were recorded. This information was used to calculate the fruit development period (FDP) for each fruit. FDP ranged from 25 days to 44 days, and appears to be dependent on cultivar and environmental conditions.

## **Effect of Prohexidione-Ca on Establishment and Yield of Green-Top Bare-Root Strawberry Transplants**

*John Duval and Elizabeth Golden, Gulf Coast REC, UF, Dover; Julia Reekie, and Peter Hicklenton*

Bare-root transplants received from high latitude nurseries for Florida production have very long petioles and limited root systems which wilt after planting. Further desiccation occurs when leaves come in contact with black plastic mulch used in the annual production system. Conventional irrigation practices for the establishment of bare-root transplants of strawberry consist of overhead water application for at least 8 hours/day for 10-14 days after planting. Plant growth regulators (PGRs) have been used to modify the growth characteristics of many plants species. A split-block experiment was implemented at the GCREC-Dover, Dover FL, USA to determine the effect of the use Prohexidione-Ca (PC), NAA (naphthaleneacetic acid), and IBA ((indole-3) butyric acid) on growth, yield and establishment of strawberry. Main blocks consisted of over head establishment irrigation for 4, 8, and 12 days, and sub-plots consisted of treatments of PC applied in the nursery at a rate of 62.5 mg L<sup>-1</sup> 4 weeks before digging, PC applied in the nursery at 125 mg L<sup>-1</sup> 2 weeks before digging, a combination of the two previous treatments, a root dip of transplants in 100 mg L<sup>-1</sup> of NAA or IBA just prior to transplanting. Data were recorded for marketable yield, number of marketable berries (> 10g), and disease incidence. Significant differences were detected for duration of establishment irrigation and growth regulator treatment. No interaction was revealed between establishment irrigation and growth regulator treatment.

## **Summer Squash Yield and Fruit Size When Grown on Eight Mulch Colors in Central Florida**

*James M. White, University of Florida, Mid-Florida REC, UF, Apopka*

Summer squash 'cv' Medallion (*Cucurbita maxima*) was grown in the spring of 2001 and 2002 on black, white, black biodegradable, red, blue, silver, silver on black, and white on black colored mulch and compared for yield and fruit size with bare grown plots. Soil temperature and moisture readings were taken over a six week period. Yield ranged from 175 cwt/acre for bare ground to 280 cwt/acre for

white on black mulch. There was no difference in yield for bare ground, black biodegradable, red, or blue treatments. Fruit average weight at harvest ranged from 0.241 lb for black biodegradable mulch to 0.293 lb for silver mulch. No correlation for mulch colors and early plant size or early yield was found. Red, blue, silver on black, and black color mulches had warmer soil temperatures early, but as plants covered the mulch, less differences were found.

### **New Bush Bean Cultivars for Miami-Dade County**

*Teresa Olczyk and Ruben Regalado, Miami-Dade County Cooperative Extension, UF; W. Klassen, M. Codallo, and G. Aleman, Tropical REC, UF, Homestead*

Bush beans are an important and usually profitable vegetable crop produced for the fresh market in Miami-Dade County. Improved cultivars are needed that yield well during the production season from September to mid-April. Growers need to know which cultivar is likely to perform best in a given period of the growing season. Six new or not locally planted cultivars ('Dusky', 'Ambra', 'Capricorn', 'Thoroughbred', 'Choron' and 'Caprice') were compared to 'Leon' and 'Opus' in a completely randomized block design with 4 replications. The beans were planted on December 18, 2003, the harshest period for bean production, and harvested on February 19, 2004. Yields in declining order were 'Leon', 'Dusky', 'Opus', 'Ambra', 'Capricorn', 'Thoroughbred', 'Choron' and 'Caprice', but not all differences were significant statistically. The yields of 'Thoroughbred', 'Choron' and 'Caprice' would have benefited by allowing several additional days prior to harvest. To determine performance during the latter part of the growing, all of the above cultivars plus 'Greenback' were planted on March 4, 2004, and the results will be included in the presentation. Yield and quality data as well as other considerations will be elaborated.

### **Influence of In-Row Spacing on Potato (*Solanum tuberosum*) Seed Yield and Economic Feasibility**

*Bielinski M. Santos, Gulf Coast REC, UF, Bradenton; Persio R. Rodriguez, Dominican Institute for Agricultural and Forestry Research, Dominican Republic*

Field studies were conducted in the Dominican Republic to determine the effect of in-row spacing on 'Granola' potato seed yield and economic feasibility. Vitroplants were transplanted on raised beds with in-row spacings of 0.20, 0.25, 0.30, 0.35, and 0.40 m, and 0.75 m between planting beds. The results indicated that in-row distances of 0.20 and 0.25 m increased total tuber number and weight, and tuber weight per plant. The marginal return rate increased by 12% when in-row distance decreased from 0.35 to 0.25 m.

### **Evaluation of Various Management Strategies for Controlling Melon Thrips, *Thrips palmi* Karny (Thysanoptera: Thripidae)**

*D. R. Seal, UF/IFAS Tropical Research and Education Center, Homestead*

One of the major insect pests of vegetable crops in the South Florida is the melon thrips, *Thrips palmi* Karny. Spinosad is commonly used to control this pest. To avoid development of resistance, various insecticide treatments were used to develop a sound management program against melon thrips.

Spinosad at 7 oz/acre provided satisfactory control of melon thrips on bean, squash and eggplant. Use of spinosad at lower rate in combination with some nonionic spreader and sticker provided similar level of control as spinosad at 7 oz/acre.

**END OF ABSTRACTS**

---

[1] Florida Agricultural Experiment Station Journal Series No. N-XXXX.

-

-