

# Abstracts of the ASHS Southern Region 70th Annual Meeting

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## J.B. Edmond Undergraduate Student Paper Competition

### The Acidification of Hardwood Bark for the Production of Acid-loving Nursery Crops

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This study was an evaluation of an industrial sulfur by-product for use as an agriculture acidifier and the use of hardwood bark as a soilless growing media. The objective was to determine the influence of acid-forming fertilizers on pH of hardwood bark media and biomass accumulation. *Gardenia jasminoides*, an acid-loving plant, and *Ligustrum japonicum* having a wide pH tolerance range were used in this study. There were 14 acidifying treatments with five replications of each. Treatments included combinations of iron sulfate, sulfur, acidifying by-product, lime, gypsum, and Epsom salt. Two dependent variables were observed: pH and EC of medium, and plant growth. Leachate analysis established pH and EC every 4 weeks, and growth indexes were taken by measuring the plants height, width, and perpendicular width. Leachate EC reading remained within an acceptable range (<1.5 EC). The application of acidifiers reduced medium pH and resulted in commercially acceptable plants. Application of 1/2 lb AP resulted in increased ligustrum biomass and similar plant growth of the hardwood control for gardenia. Further research is needed to confirm results and a study screening a wide range of plant species is suggested.

### Effect of Vine Cutback on Disease Resistance and Severity of Virus Titers on Resistant and Susceptible Varieties

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The most important virus disease in sweetpotato is the Sweet potato virus disease (SPVD), a result of co-infection of *Sweet potato chlorotic stunt virus* (SPCSV) and *Sweet potato feathery mottle virus* (SPFMV). Characteristic symptoms include chlorosis, small, deformed leaves, and severe stunting. Yields can be reduced by 90%. Our objective was to compare symptom development and the pattern of accumulation of the two viruses in mixed infections in SPVD resistant (Nasport 1) and susceptible (Beauregard) cultivars in plants cut back and allowed to grow again. Studies were conducted in the greenhouse on plants graft inoculated with the two viruses. Typical symptoms developed on Beauregard after nearly one month of growth while symptom development Nasport 1 was minimal. Plants were then cut back and allowed to grow for an additional month. Virus symptoms developed on both varieties and leaves were collected for analyses of virus titers using real-time PCR.

### Characterization and Inheritance Assessment of Fruit and Leaf Shape in Unique *Vitis* Seedlings

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From August to Oct. 2009, two separate studies were conducted to assess fruit shape of *Vitis euviitis* hybrid bunch grapes using digital photography (Study 1) and identify inheritance patterns of leaf shape in

unique populations of *V. rotundifolia* hybrids (Study 2). All vines studied were located at the University of Arkansas Fruit Research Station, Clarksville. Study 1 used SigmaScan® digital photography analysis software to calculate area, perimeter, shape factor, major:minor axis ratio, and compactness of highly variable, unique-shaped fruit from a population of 182 *Euviitis* seedlings. SigmaScan® accurately characterized fruit shape elongation as had been recorded in previous studies. Although elongated shapes were measured accurately, the calculations used were unable to conclusively analyze ovoid or pear-shaped fruit. Study 2 evaluated the inheritance of leaf shape (lobing) in several populations of *V. rotundifolia* crosses within the University of Arkansas fruit breeding program. Based on previous studies, it was hypothesized that leaf lobing was a dominant trait. Two populations expected to demonstrate a 3:1, lobed:standard, phenotypic ratio accepted the hypothesis, while only two of the six expected to demonstrate a 1:1, lobed:standard, phenotypic ratio accepted the hypothesis. Previous studies suggest the unexpected ratios observed may be attributed to a lethal allele combination, where homozygous dominant progeny are not viable, or modifier genes impacting leaf shape of the seedlings. Further evaluation of these and other populations in addition to molecular analysis would be helpful in characterizing inheritance of leaf lobing in muscadine hybrids.

### The Petty Residence: A Landscape Design Based on Principles of Sustainability

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The demographic shift of the earth's population from rural to urban emphasizes the need for sustainable landscape designs that maximize energy efficiency, diversity, and wildlife. The Petty Residence, a project completed in Horticulture 461, Problems in Landscape Design, at Clemson University, illustrates the process of sustainable landscape design. The site encompasses 25 acres, including a floodplain and river. Site problems include compacted soil, erosion, invasive plant material, and storm water drainage. Results included a design intended to address these problems and restore the site's ecology. Examples include: 1) designing with the existing topography, 2) designing for low maintenance, 3) incorporating a diverse pallet of native plants, 4) specifying plant material at appropriate container sizes, 5) locating plants for maximum energy efficiency, 6) incorporating microgeneration ideas, 7) providing essential elements for wildlife 8) reclaiming storm water, 9) selecting plants to suit cultural conditions, and 10) utilizing permeable hardscape materials. Project methodology included research, case studies, site analysis, program development, preliminary plans, and a master plan with detail drawings, plant list, plan view, and section drawings.

## Norman F. Childers MS Graduate Student Paper Competition

### Determination of *Quercus* Series *Virentes* Heredity in Texas

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Populations of *Quercus virginiana* Small and *Q. fusiformis* Small in Texas are not reproductively isolated but interact throughout much of

the state. This creates the opportunity for interspecific hybridization leading to phenotypically and genotypically diverse *Quercus* series *Virentes* populations. A putative population of *Quercus* series *Virentes* located just south of Justiceberg, TX was identified and examined. One magnificent individual from this population was selected and was determined to possess unique phenotypic traits allowing it to thrive in a more environmentally demanding location. These attributes include higher tolerance to drought, high pH, and cold temperatures. To characterize the phylogeny of this specimen with other native oak population in Texas, a genetic analysis was conducted using 70 simple sequence repeats (SSRs) to examine genetic diversity. Forty-eight *Quercus* accessions were sampled from locations predominantly recognized as *Q. virginiana*, *Q. fusiformis*, or a hybrid swarm of both species. Genetic analysis suggests geography may be relevant to population trends. Four genetic clusters represent populations in different terrestrial regions of Texas. The specimen located in the Justiceberg, TX population and a second individual located in Elmen-dorf, TX appear to be relic populations of *Quercus* series *Virentes*. The physical age, traits, and genetic analysis indicated both specimens are genetically older than many *Virentes* populations in Texas.

### Evaluation of Sixteen Accessions of Sunn Hemp (*Crotalaria juncea*) for Seed Production Potential in Florida

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Sunn hemp is a tropical legume that is commonly produced for fiber, but is also used as a cover crop, green manure, and fodder. Sunn hemp provides soil stability, weed and nematode suppression, and biomass and nitrogen accumulation. Adoption of sunn hemp as a cover crop in the U.S. has been limited because seed is expensive and the supply is unpredictable. Commercially available cultivars, such as 'Tropic Sun' have a short-day flowering response and are unable to consistently set seed in the continental U.S. Therefore, seed is imported from Hawaii, South Africa, and Brazil where conditions that favor seed set occur. Development of a cultivar of sunn hemp that can produce seed in the continental U.S. would provide growers with a lucrative alternative seed crop resulting in improved seed availability and thus utilization of sunn hemp as a cover crop. This experiment evaluated 16 accessions of sunn hemp, provided by the USDA-ARS (Griffin, GA). The study was conducted in 2008 and 2009 at Rosie's Organic Farm in Gainesville, FL. The experimental design was a split plot with planting dates (May, June, and July) assigned to the main plots, which were arranged in a randomized complete block design with four replications. The 16 accessions were randomly assigned to the sub-plots. Vegetative and reproductive data were collected. Vegetative data (height, number primary branches, number of leaves, shoot dry weight, and leaf area) separated the accessions into two "groups." One group of accessions appears to exhibit a short-day flowering response, with tall growth habits, late branching and flowering, and little to no seed production. The other group of accessions appears to have a day-neutral flowering response, with early branching and flowering, and viable seed production. Of the seed-producing accessions, PI 314239 and PI 322377 produced the most seed. Although the seed-producing group demonstrates promise for commercial seed production in Florida, these accessions tend to have lower shoot biomass production than the short-day accessions, making them less desirable as a cover crop. Additional work is planned to select an accession for foundation seed development and to breed a day-neutral variety that retains the desirable cover crop characteristics of commercially available short-day sunn hemp varieties.

### Efficient Asexual Propagation of *Lindera glauca* (Siebold & Zucc.) Blume and *Lindera aggregata* (Sims) Kosterm.

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*Lindera glauca* and *Lindera aggregata* (Grayblue spicebush and Spicebush), in the family Lauraceae, are large shrubs to small trees reaching maximum heights of 15-20 ft. Both species are native to China

and have excellent landscape potential. *Lindera glauca* exhibits attractive fall color while *Lindera aggregata* is evergreen. Both species produce round black fleshy drupes in the fall which are consumed by various birds. Both species perform well in USDA hardness zones 6-8. Asexual propagation by stem cuttings has proven difficult in many Lauraceae including *Lindera* sp. often limiting cultivar development and widespread landscape use. Experiments were conducted to examine the effect of auxin and time of propagation for efficient cutting propagation of *L. glauca* and *L. aggregata*. These terminal cuttings were collected from plants at the Stephen F. Austin Mast Arboretum on 12 May 2009 (softwood), 11 June 2009 (softwood), and 6 Aug. 2009 (semi-hardwood). Treatments for both species included a control (no hormone), 0.3%, 0.5%, 0.8% K-IBA solution. *L. glauca* experiment included a fifth treatment with Hormodin-3 talc powder. Cuttings were rooted under intermittent mist in a heated greenhouse with bottom heat (about 21 °C). Cuttings were evaluated after 65 days for root number and total root length. Statistical analysis was performed using a two-way ANOVA with binary response. Results were significant at the 0.05 level. Talc powder treatment did not improve rooting percentage at any growth stage, averaging 22%. Rooting percentage and root numbers for *Lindera glauca* were highest in the August trial, independent of treatment. *Lindera aggregata* rooting percentage was highest with 0.5% K-IBA with no time/treatment interaction. There was no significant time difference shown. Rooting percentages ranged from 65% to 95%, independent of time.

### Screening Ornamental Peppers (*Capsicum* spp.) for High Temperature Tolerance using In Vitro Pollen Germination, Pollen Tube Length and Cell Membrane Thermostability

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Temperature affects both reproductive potential, aesthetic and commercial value of ornamental peppers. The influence of temperatures from 10 to 45 °C at 5 °C intervals was studied on in vitro pollen germination (PG) and pollen tube length (PTL) on artificial pollen media in 12 ornamental pepper cultivars. In addition, relative injury was estimated using leaf cell membrane thermostability tests. From the modified bilinear temperature-pollen germination and tube length response functions, cardinal temperatures ( $T_{min}$ ,  $T_{opt}$ , and  $T_{max}$ ) for PG and PTL, maximum PG and PTL were estimated. Cultivars varied significantly for PG and PTL. Maximum PG and PTL varied from 50.6% to 92.4% and 405 to 1140  $\mu$ m with a mean of 77.5% and 869  $\mu$ m, respectively, among the cultivars. The mean values for cardinal temperatures were 11.8, 26.9, and 41.2 °C for PG and 12.0, 28.2, and 41 °C for PTL for  $T_{min}$ ,  $T_{opt}$ , and  $T_{max}$ , respectively. Cumulative temperature response indices (CTRI) were estimated by summing the individual response indices estimated from the pollen and relative injury parameters. Using the CTRI, cultivars were classified as sensitive (Black Pearl, Red Missile and Salsa Yellow), intermediate (Calico, Explosive Ember, Purple Flash, Sangria and Variegata) and tolerant (Chilly Chilli, Medusa, Thai Hot and Treasures Red) to high temperature. Significant, but weak, linear correlation ( $R^2 = 0.54$ ) between CTRI (pollen) and relative injury indicates that screening based on pollen based parameters is an accurate measurement for thermotolerance. The identified thermotolerant cultivars are potential candidates in breeding programs to develop new pepper genotypes for high temperature environments and selecting cultivars for a niche environment.

### Yield and Quality Characteristics of Selected Blueberry (*V. ashei*) Cultivars

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Eleven rabbiteye blueberry cultivars were evaluated with regards to yield and fruit quality characteristics at the North Alabama Horticulture Research Center, Cullman, in 2009. Data for mean fruit size, soluble

solids content, total fruit acidity, pH, skin color, percent berries with wet stem scar, and total yield per bush were recorded to determine fruit quality characteristics of selected well-established and newly released rabbiteye blueberry varieties including 'Alapaha', 'Baldwin', 'Brightwell', 'Climax', 'Ira', 'Montgomery', 'Onslow', 'Powderblue', 'Premier', 'Tifblue', and 'Yadkin'. Our first year results demonstrated 'Alapaha' was the earliest ripening cultivar with first ripened berry harvested on 16 June. 'Alapaha' was found to produce the smallest berries (0.95 g) with the highest sugar content (15.38%) in our study. 'Onslow', 'Yadkin', 'Baldwin', and 'Powderblue' matured late in the season. Their first harvest occurred on 3 June. 'Ira' was the highest cropping cultivar (3.4 kg per bush), while 'Baldwin' had the lowest crop in the season (1.0 kg per bush). 'Premier' had the largest berry diameter of 16 mm and 'Baldwin' had the heaviest berry (1.4 g) in the 2009 season.

### Using GIS Technology to Evaluate Transportation of Ornamental Crops in Georgia

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In the agricultural industry, the importance of transportation costs is considerably heightened as fuel and labor costs rise. Logistic cooperation is an important strategic alternative to reduce transportation costs and increase efficiencies. Georgia's ornamental industry is characterized by producers that share clients, routes, and origins; however, each producer has an independent transportation system. This paper analyzes a case study to determine if a transportation alliance through a horizontal cooperation and routing junction among ornamental producers in Georgia would reduce shipping costs, increase distribution efficiencies, and reduce carbon dioxide emissions. Routing and cost analysis were conducted followed by a sensitivity analysis for each constraint. Results showed that with the GIS ArcLogistics 9.3 software, transportation alliances in the ornamental industry are profitable in terms of transport efficiencies and internal and external costs. Total cost savings ranged from 1% to 13.2%, total miles driven savings from 1.1% to 13.6%, total number of trucks savings from 2.5% to 10%, driving hour's savings from 1% to 18.4%, and CO<sub>2</sub> emission savings from 1.2% to 8.4%.

## Warren S. Barham PhD Graduate Student Paper Competition

### Polyploids in *Lantana camara*: Possible Origins, Uses for Breeding, and Association with Invasiveness

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*Lantana camara* is a versatile landscape plant commonly used in the southern U.S. Commercial varieties are available in a wide array of colors and growth forms. Other horticultural value includes high flowering intensities and low water use. These desirable characteristics have attracted breeders' attention and several hundred named varieties have been released into the commercial market. Over time this species has naturalized in the southern U.S. and several other areas of the world. In Florida, naturalized *L. camara* populations also pose a threat to displace native species as well as cross-pollinate with the native *Lantana depressa*. Genetic approaches are being developed to reduce or eliminate the invasive potential of this species. Recent studies have revealed that many lantana varieties produce unreduced female gametes. This interesting phenomenon seems to suggest multiple pathways for the origin of polyploids in this species and potential roles in the evolution of its invasive behaviors. This trait may also allow for manipulation of the genetic resources available for variety development and understanding of the effects of polyploidization on plant physiology.

### Genetic Diversity of Natural *Coreopsis leavenworthii* Populations and Gene Flow from *Coreopsis tinctoria*

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Interest in commercial production and large scale planting of *Coreopsis* seeds in Florida has been increasing in recent years. Two closely related species, *C. leavenworthii* and *C. tinctoria*, are of particular interest. The objectives of this study were to determine the genetic diversity of *C. leavenworthii* in its natural populations from southern, central, and northern Florida and to assess the potential of pollen-mediated gene flow from *C. tinctoria* to *C. leavenworthii*. Both phenotypic and molecular marker analyses indicated a considerable amount of genetic diversity and an obvious differentiation in the natural populations of *C. leavenworthii*. Clustering of natural *C. leavenworthii* populations was mostly according to their seed source origins. This differentiation pattern suggests a possible existence of regional ecotypes within Florida and a need to zone Florida in seed planting for better preservation of the genetic diversity of this nearly endemic, narrowly distributed species. Morphological differences between *C. leavenworthii* and *C. tinctoria* were observed on leaf petioles, flowers, and seeds. Inheritance studies showed that the presence of maroon spots on *C. tinctoria* flowers is dominantly inherited, and this spotting can serve as an easy and reliable morphological marker for detecting and quantifying potential gene flow from *C. tinctoria* to *C. leavenworthii*. When *C. leavenworthii* pollen trap plots were planted 5, 10, 25, 50, 100, 150, 200, 250, and 300 ft from *C. tinctoria* plots in the field for two seasons, interspecific hybrids resulting from gene flow were observed in plots 5 to 200 ft and 5 to 50 ft from *C. tinctoria* in the first and second seasons, respectively. In both seasons, the percentage of interspecific plants decreased as the planting distance increased. These results indicate that the two species need to be separated by at least 200 ft to prevent potential cross-pollination.

### Establishing an *Agrobacterium*-mediated Transformation System for Western Shipper Cantaloupe and Honeydew Melons (*Cucumis melo*)

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Genetic transformation is a useful procedure to incorporate novel genes within and across plant species. Sexual incompatibility and interspecific barriers to traditional plant breeding can therefore be circumvented. Melon transformation protocols have been reported in the past 20 years. However, the transformation efficiency varies among different varieties/cultivars, ranging from 0 to 12.5% (Nuñez-Palenius et al., 2006, 2008). So far most successful transgenic melons have utilized French and Asian germplasm lines, which are unacceptable in the U.S. market. The western shipper melon is the most popular and consumed muskmelon in the United States. Therefore, our research focus was on an *Agrobacterium*-mediated transformation system using our elite western shipper melon line, 'F39', and high-quality honeydew line, '150'. Six different media compositions were examined to improve melon shoot regeneration. Our study then proceeded to establish a successful *Agrobacterium*-mediated transformation protocol based on the highest regeneration system. This will lead to a successful transformation with genes of interest in melon fruits in order to improve fruit quality traits.

### Determining the Effect of Ethylene on Internal Black Marbling Expression in Sweetpotato.

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Field trials were conducted in 2008 and 2009 to determine the role of ethylene produced by ethephon and flooding in the expression of internal black marbling in sweetpotato storage roots. The experiment

was a factorial design with 3 cultivars x 3 ethephon rates x 2 irrigation regimes. The 3 sweetpotato cultivars were 'Beauregard', 'Carolina Ruby', and 'Covington'. Ethephon at 3 rates (0, 0.8, and 1.1 kg/ha) was applied to the crop canopy 14 days before harvest. The entire experiment received ambient rainfall and half was irrigated with an additional 20 to 31 cm 14 days before harvest. At harvest, 150 number 1 grade storage roots were collected from each treatment, then cured, and stored for cutting to evaluate for internal black marbling. Evaluations were completed 9, 30, 60, 90, 120, and 150 days after harvest (DAH). For evaluation, 5 cm of the growing end of the root were cut crosswise into 0.3-cm segments. Intensity of black marbling was rated on a scale of 0 (no symptoms) to 9 (entire segment with symptoms). Incidence was the percentage of roots that showed symptoms. The lowest intensity and incidence for all treatments was at 9 DAH. Intensity and incidence peaked and plateaued at 60 DAH. Cultivars differed in intensity of internal black marbling. Among cultivars, 'Beauregard' had the lowest intensity and incidence (0 to 2.2 and 3% to 12% at 60 DAH) and 'Covington' had the greatest (3.2 to 4.4 and 20% to 74% at 60 DAH). The two rates of ethephon were different from the nontreated. At 60 DAH, 'Covington' treated with 0.8 and 1.1 kg/ha had an intensity of 4.3 and 4.4, respectively, and incidence of 74%. The nontreated 'Covington' had an intensity of 2.4 and incidence of 26.5%. Additional irrigation had no effect on the intensity and incidence of internal black marbling. However, the irrigated plots were 2 to 4% less than the nonirrigated treatment for intensity and incidence. At 60 DAH for the nontreated 'Covington', intensity and incidence were 2.4 and 26.5% for the nonirrigated and 2.1 and 13.5% for the irrigated plots. Ethylene created from ethephon has a negative effect on the black marbling of roots in certain sweetpotato cultivars. However, flooding the roots prior to harvest had no negative effect on the intensity and incidence of black marbling expression of sweetpotato roots. The ethephon may cause higher concentrations of ethylene than the flooding treatment. During periods of heavy rainfall during sweetpotato harvest, growers do not risk increased black marbling in their sweetpotato storage roots. Ethephon should not be applied to 'Carolina Ruby' or 'Covington'; however, 'Beauregard' is tolerant to ethephon application.

### Effects of Submersion and Salt Rates on Two *Taxodium* Genotypes

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*Taxodium distichum* (L.) Rich. var. *distichum* (Baldcypress, BC) and (*Taxodium* X 'Nanjing Beauty', NB) were subjected to chronic exposure of four rates of salt solution (0, 51, 102, and 153 mol·m<sup>-3</sup>) in a container submersion study. NB is a controlled cross developed in the Nanjing Botanical Garden, Nanjing, China, between baldcypress and the Montezuma cypress, *Taxodium distichum* var. *mexicanum* (Carriere Gordon), selected for growth rate, lack of knees, salt/alkalinity tolerance and a tendency to be evergreen in mild climates. A split block design was utilized with 2 genotypes, 4 salinity treatments, 3 blocks, and 8 plants per genotype. Beginning 24 July 2009, the plants were submerged in salt solution in baby swimming pools for 6 weeks. A 1-5 foliage "browning" scale indicated that BC was quickest to show salt damage symptoms and exhibited foliage browning at the low, medium and high salt rates, while NB produced salt damage symptoms only at the medium and high salt rates. At 1, 2, 4, and 6 weeks, two plants per genotype were selected at random from each pool and cut into 3 parts (leaves, trunk, and roots) for elemental content analysis. In this chronic salt rate study, BC and NB differed in response to increasing salt rates. Total Na concentration in BC leaves, trunks and roots was significantly higher than in NB plant parts. Total Na in BC leaves, trunks and roots increased with increasing salt rates. However, NB total Na peaked at the low rate, and then declined at the medium and high rates. In both BC and NB, the pattern of Na partitioning was the same, highest in the leaves, followed by roots, and the lowest concentrations were found in the trunk. NB appears to have the ability to regulate Na uptake, while BC did not. There was no significant salt rate effect on K, Ca, Mg, S, and P in BC. There was no significant salt

rate effect on Ca, Mg, S, and P in NB. K values decreased significantly in NB with increasing salt rates. The NA/K ratio in the two genotypes significantly increased as salt rates increased. Based on salt damage symptoms and the capacity for excluding Na, the salt tolerance of NB is evident and this clone should be suitable in sites with salt and alkalinity issues normally deleterious to baldcypress, particularly those genotypes derived from the eastern end of the range.

## Education Section

### History and Analysis of the Environmental Education Program at SFA Gardens

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SFA Gardens comprise 68 acres of on-campus property and includes the 10-acre SFA Mast Arboretum, 8-acre Ruby M. Mize Azalea Garden, and 42-acre Pineywoods Native Plant Center. From 1985 to 2000, many K-12 groups have visited SFA Gardens but programming can best be characterized as simple walk-and-talk tours. In 2000, a Texas Forest Service Urban Partnership grant allowed the creation of an Educational Coordinator position. From 2000-2010, K-12 numbers have risen from 5000 to over 10,000 children per year. Funding agencies include the Kellogg Foundation, Texas Forest Service, Texas Parks and Wildlife, U.S. Fish and Wildlife, U.S. Environmental Protection Agency, George and Fay Young Foundation, Meadows Foundation, and T.L.L. Temple Foundation with total funding over \$500,000 since 2000. Educational programs include Arboretum Adventures, Trees Are Terrific, GardenQuest, Go Wild, Go Native Field Day, School Gardening, Pineywoods Day Camp, Children's Special Activities, Wild About Wetlands, and the capstone program for SFA Gardens, Bugs, Bees, Butterflies and Blossoms (BBBB). The latter is a 4-day April event that has been in place since 2000 and involves over 2500 children, 16 "stations" at the SFA Mast Arboretum with no more than 22 children per station, 128 elementary school teachers, over 300 parents, 10 SFA Gardens volunteers, eight beekeepers, 100 SFA Elementary Education majors, five Texas Forest Service employees, four SFA professors, and the SFA Gardens Education Coordinator. A key ingredient to the continuing success of BBBB, has been the inclusion of 100 senior-level elementary education majors trained in a science teaching methods course to use Project Learning Tree methodology to teach one less for the BBBB event. Pre- and post-testing of both elementary education majors and children indicated significant differences between the Treatment Group pre-test mean scores (48.7) and their post-test mean scores (65.0), and no significant differences were found in the post-test scores of the Treatment Group by gender or race. Students scoring below the mean on the pre-test were able to significantly close the gap between their scores and the higher scoring students on the post-test. This supports other research indicating the benefits of field investigations for lower scoring students.

### Horticulture Summer Seminar: A Tool for Increasing Horticulture Awareness in High School Students

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The MSU Horticulture Summer Seminar was started 40 years ago in 1969. It was developed by the Garden Clubs of Mississippi, Inc. in cooperation with the Horticulture Department at Mississippi State University. The program is designed to bring 20 to 30 Mississippi high school students between 15 and 17 years old to campus each summer to learn about horticulture. As a primary sponsor of the Horticulture Summer Seminar, the Garden Clubs of Mississippi, Inc. helps advertise the program while the individual garden clubs identify interested students and raise or donate money to sponsor a student or help support the program. Other sponsors include Mississippi State University, nurseries, garden centers, and schools in the state. The program is a 3-day event during the second week of June. Sponsorship

in 2009 was \$175/student. Attending students stay three nights in the campus dorms and are provided with a prepaid meal card for the dining hall or student union food court to cover most of their meals. Sponsorship fees are also used to help cover program activity supplies and cost of student counselors. The program begins with a welcome picnic the first night. Over the next 2 days, students participate in classroom activities on plant propagation, greenhouse management, plant identification, indoor plants, floral design, sports turf management, and landscape architecture/design. They also tour a local vegetable farm and orchard and complete a campus landscape project. The seminar ends with a general knowledge exam testing the students on topics learned during the seminar. The seminar ends with an awards luncheon where parents and special guests are invited. Each participant is presented a participation certificate and awards are presented for highest scoring individual on the exam and most congenial seminar participant. A group photograph is taken and the students sent home with a new understanding of horticulture. This event is used as a recruiting event for the horticulture program at Mississippi State University. Several past seminar attendees have gone on to become students in the horticulture program.

### **Horticulture Career and Professional Development: A Seminar Course to Talk about the “Real World”**

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Employer and alumni surveys suggested changes to the horticulture undergraduate curriculum to prepare students for careers. Changes that have been made include increasing communication skills, exposure to business courses, and inclusion of a required internship experience. An additional change to the curriculum was development of a “Career and Professional Development” course, now a core course and prerequisite for the internship experience. The objectives of the course are that students should be able to: 1) list skills and characters needed for horticulture (and related) jobs, set professional and personal goals, and discuss behaviors appropriate to the work place; 2) identify internships and career positions of interest, prepare professional portfolios for applying for internships and career positions, and present themselves in interviews for positions; 3) explain the purpose and procedures of horticulture internships; 4) find resources useful in preparing for and having internship and career employment; and 5) discuss expectations of employers and the workplace of professional horticulturists. Students accomplish those objectives with presentations and assignments on skills assessments, personality assessment, job search skills, resume and portfolio preparation, interview skills, professional communications, branding, diversity training, personal finance, creating business plans, and objective and goal setting. Additionally, speakers from horticulture and allied businesses speak to the class. Reviews of the class from students and alums indicate that although not a horticulture technology class, it has benefit in preparing students.

## **Extension Section**

### **Increasingly Blurred State Boundaries in Small Fruit Crop Extension and How the Southern Region Small Fruit Consortium (SRSFC) is helping from a State Specialist’s Perspective**

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Simply open almost any small fruit meeting brochure in the Mid-South, such as the 3rd Annual Virginia Berry Production and Marketing Conference, slated for 11 Mar. 2010, at Virginia State University, and you will likely see that most of the speakers on the program are members of a regional small fruit consortium that is dedicated to pooling its resources and expertise to support the development of small fruit industries throughout the region. Everybody gains a lot from taking this regional approach. A strawberry plasticulture specialist like myself can really focus on the research and extension education needs of strawberry plasticulture growers and agents throughout the six member states in the consortium (NC, SC, VA, TN, GA, AR). My original position in the

Department of Horticultural Science at NC State in 1980 was designed to serve strawberry, bunch grape, muscadine, blackberry, and raspberry growers at only the state level. Since 1998, when NC State, Clemson and University of Georgia first joined forces, regionalization has allowed me to personally focus on the development of high quality research and educational programs for the benefit of strawberry plasticulture growers and agents in all of the member states. Similarly, my counterparts at other universities in Southern Region Small Fruit Consortium (SRSFC) are now able to take advantage of this special regional arrangement to develop truly substantive research, breeding and extension programs in blueberries, cane berries, muscadine and hybrid and vinifera grapes. The University of Tennessee joined SRSFC in 2002, Virginia Tech joined in 2005 University of Arkansas joined in 2007. Currently, with 6 universities in the SRSFC, we have access to a remarkable pool of entomologists, plant pathologists and weed scientists, who work with the crop production specialists like myself to produce high quality IPM guides for each of the small fruit crops. These IPM guides are completely updated on an annual basis are then posted to a public website ([www.smallfruits.org](http://www.smallfruits.org)) for the benefit of growers and agents throughout the Southern Region. Our hope is that one day the other eight states that encompass the Southern Region will also become official members of the consortium (TX, LA, OK, MS, AL, FL, WV, KY).

### **Formation of an eXtension Grape Community of Practice**

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In 2009, through an idea started by the Extension and Outreach Committee of the National Grape and Wine Initiative (NGWI), a proposal to establish a national grape community of practice (GCoP) through eXtension was funded by the USDA-CSREES (now NIFA) Specialty Crops Research Initiative program. The project was strongly supported by large industry companies, state grower groups, and the Missouri Wine and Grape Board. The long term goals of the GCoP are to fulfill the eXtension requirements for becoming a Community of Practice and act as the outreach component of research projects nationwide. All members are expected to actively participate in roles that are significant to the creation of a grape community of practice, including participation and leadership on committees. The full national membership of the GCoP will participate in outreach activities to communicate to local clientele about the resources available from the GCoP through eXtension. Ultimately, the GCoP will strive to be the “one stop shop” for viticulture information on a national level with linkages to state-specific websites and expertise. These linkages will be accomplished through use of frequently asked questions (FAQs), ask an expert (AaE), and creation of new content for eXtension. The use of wikis and social networking will also play a role in the development of the GCoP. Future advances may include integration of enology information, expanded interactive learning modules, and exploration of a national viticulture certificate program.

### **Rainwater Harvesting: Evaluation of Knowledge Gains and Behavioral Changes**

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The “Logic Model” was implemented at a series of Extension Rainwater Harvesting Workshops with more than 120 homeowners

participating. The objectives were to inform and train homeowners about basic storm water issues and how harvesting rainwater could save money and improve water quality. The “Logic Model” approach was used to measure outputs and outcomes using both workshop and post (4 months) workshop surveys. Immediately after the workshop, 84% of the participants said they were very or extremely likely to install a rain barrel or rain tank to harvest water from their homes’ roofs. A similar number said they planned to store the water for use on their landscape or vegetable garden as a replacement for municipal water use. The survey took a snapshot of the participant’s level of understanding in 11 major areas. We rated understanding on a scale from 1 to 5, and the average pre-workshop score was 2.8 while the average post-workshop score was 4.4 or a 63% increase in their level of understanding. Four months after the workshop, a follow-up survey was conducted to determine what the participants had done and what they planned to do in the future. One hundred surveys were sent out, and we received 40 responses. Forty percent had already installed a rain harvest device; 32% were still researching but planned to install a device in the future; and another 20% had the system designed but not installed. We asked participants who had not installed rain harvest devices why they had not, and the two greatest reasons were the rainy summer (35%) or a lack of time (20%). However when asked if they planned to install a system before Summer 2010, the response was 95% positive.

### **Development of the “All about Blueberries” eXtension Community of Practice (CoP) SCRI Proposal**

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The process of preparing and submitting an eXtension SCRI proposal was presented in a “how-to” type format. To begin, the concept of [www.extension.org](http://www.extension.org) was presented. A Community of Practice is a team of experts developing content focused on a specific topic area. Experts that develop content are land grant university specialists/researchers, and approved individuals. There are currently more than 50 CoPs. The presentation began with a discussion about grant-writing training opportunities. The importance of the rule “read the RFA and follow the RFA instructions” was emphasized. Proposal writing will require at least 50% more time than you anticipate, so budget your work accordingly. If possible, begin to assemble your research/extension team before the RFA is released so that you can move quickly to write a proposal. Communicate with eXtension staff often during the planning process. Meet early and often with your team of investigators—we used e-mail, web conferencing and phone conferences to prepare the proposal package. Establish deadlines for key pieces of the proposal to make sure all pieces will be built before the final submission deadline. Be sure to keep your sponsored programs office in the loop so that you don’t have any surprises that may delay submission. Build a trans/intra-disciplinary multi-state team of eXperts. Establish a clearly defined leadership structure and timelines to accomplish the tasks/goals of your proposed work. Diagrams are a nice way to illustrate these structures. Obtain stakeholder support for your efforts in the form of signed letters. Create an advisory board of appropriate stakeholders from each state participating in the project. The final step is to prepare the budget. This way the budget will accurately reflect the use of time and staff resources to accomplish the proposed work. Submit your proposal on-time and early, if possible. Communication with sponsored programs during the proposal prepara-

tion process should ensure that staff members are available to take the proposal through the final submission steps.

### **Programmatic Teams for State Extension Professionals: Experiences Since 2006 at Clemson University**

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Over the last 20 years or so, like many other land-grant universities in the U.S., Clemson University has seen a precipitous drop in the number of county extension agents. South Carolina has 46 counties. In 1990 as a reference point, every county had an administrative director. The total number of county agents and directors was 253. The current number is at an all-time low of 114 people. In an attempt to reduce administrative costs, we went from a high of 46 county directors to zero. This latter change was due to the development of seven programmatic teams in 2006. My Horticulture Program Team is the largest state extension team with 36 members. All county extension agents in the state were assigned to a primary team based on their assignment/job description. Under this team concept, agents are expected to work together to develop multicounty/regional revenue-generating programs. Agents with commercial responsibilities are strongly encouraged to work with state specialists on funded research projects and to present research findings at meetings. The Hort. team has three sub-teams (Consumer/Home Hort., Commercial Fruit/Veg., and Commercial Nursery/Landscape). Sub-teams work together to plan, develop and deliver programs and develop new programmatic content. Notable successes from team efforts include a national award winning website ([www.clemson.edu/extension/hgic](http://www.clemson.edu/extension/hgic)), an on-line Master Gardener reporting system, regional pesticide training school, regional turfgrass IPM program for homeowners, etc. Program generated revenue for 2009 was nearly \$180,000 and funded, applied research projects was nearly \$270,000. Overall, the team concept has been well accepted by county staff. They particularly appreciate having annual evaluation by a content expert in their field. With fewer agents, more are taking on regional responsibilities and developing considerable content expertise. Sharing of expertise and resources has helped to strengthen morale and facilitate programmatic excellence.

### **Peach Germplasm Evaluation Program at Clemson University: An Overview**

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Peach is the “signature summer fruit” of South Carolina with an industry comprising 17,000 acres and an estimated value of \$50 million per year. More than 95% of the fruit is destined for the fresh market. Of this, approximately 80% is shipped up the east coast to chain store markets. The balance is sold locally at retail stands and farmer’s markets. We have an 18-week harvest season (early May through mid-September). Since 2000, we have been evaluating diverse peach and nectarine germplasm for adaptability and suitability for South Carolina growers. Our program combines testing both at the university research farm along with on-farm grower trials in the primary peach production regions. Cooperation with breeders and commercial nurseries across the country has allowed us to test more than 350 different cultivars and advanced selections. This includes yellow and white-fleshed cultivars, sub-acid types, pantao’s (flat peaches), etc. Prior to recommending a new peach or nectarine, we require 5 years of consistent performance. In all trials, new material is compared side-by-side with accepted industry standards. As fruit become ripe, representative samples are harvested and subject to evaluation. Criteria includes taste, set (% of full crop), shape, pubescence, % of red surface, attractiveness, stone adherence to flesh, flesh browning, average size, flesh firmness and soluble solids concentration (brix). A standardized digital photograph is taken at the time of evaluation and all data is immediately uploaded to an on-line database. The database is linked to the Clemson University peach website (<http://www.clemson.edu/hort/Peach/index.php?p=73>). All evaluation data from all sites and years is grouped by ripening season.

The website has powerful features including the ability to search any or multiple fields in the database. Further, it is possible to do side-by-side comparisons. Popular and well-attended annual grower field days (typically late July) allow regional growers to come and see (and taste) up to 40 different cultivars that ripen over a one-week period.

#### **Preliminary Findings from the Alabama Insect Pest Survey using Pheromone Traps**

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Early detection of insect pests is critical to the prevention of yield losses. The use of insect pheromone traps for early pest detection is very low (15%) among farmers in Alabama based on surveys conducted in 2009. In order to demonstrate the usefulness of pheromone traps to farmers and promote the adoption of pest monitoring systems, a team of 12 Extension personnel from the Alabama Cooperative Extension Service initiated a comprehensive entomological survey in 2009 using traps on commercial farms. Fourteen counties in Alabama were selected by the project participants as observation sites (vegetable and peanut fields) to monitor 14 key insect pest species. Data generated from the bi-monthly trap catches (i.e., a measure of population pressure x activity) were converted into information and continuously transmitted to farmers via "Insect Advisories" posted online, news articles, IPM hotline (1-800-4460375), and a detailed project website; this multi-channel, synchronized and rapid communication system is called IPM Communication Resource (or IPM-CORE). A preliminary analyses of weather data from five sites and trap catches with Pearsonian Correlation and t-test ( $P = 0.10$ ) indicated trap catches to be significantly correlated with rain days (i.e., number of days rainfall exceeded 0.1 inch) for fall armyworm (98% variance explained), beet armyworm (79%), and corn rootworm (69%). Average air temperature was significantly correlated to the trap catches for fall armyworm (88%), corn earworm (62%) and tobacco budworm (86%). Multiple years of data from this trapping project could assist in the development of site-specific insect forecasting systems for farmers.

#### **The Green Industries: A Horticulture Course to Improve Professionalism**

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In 2005 the UF Miami-Dade County Extension horticulture faculty developed an 8-week "Certificate Course in Horticulture" due to public demand for a basic horticulture classes. This lecture series was aimed at an audience of landscape professionals, parks department and garden center employees. The course was expanded in 2006 and 2007 to 11 weeks to meet the needs of the participants. The goal of the program was to increase knowledge in basic horticultural practices such as plant selection and installation, pruning, irrigation, fertilization, landscape maintenance, and pest management. Due to space constraints, we limited each course to 60 participants. Each session lasted 3 hours, including hands-on activities. From 2005–2007 and 2009, the total enrollment was 257. Eighty-six percent of the participants passed a comprehensive final exam with an average score of 88.9%. Program evaluations were given during the final class. Results were: 91.6% were very satisfied or satisfied with the course, 98% said they learned something, and 90% said they would make at least one practice change. To document these practice changes, we conducted a 6-month follow-up survey of 40 participants. From what they learned in the course, 75% said they had increased their ability to communicate horticultural information more effectively with their customers and supervisors, 92% selected site appropriate plants, 96% planted correctly, and 21% received a promotion. In 2008, we were invited to teach a revised version of this course in Spanish in Costa Rica.

## **Floriculture, Ornamentals, and Turf Section**

#### **Effect of Three Pruning Techniques on Flowering of Natchez Crapemyrtle (*L. indica* x *L. fauriei* 'Natchez')**

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On 16 Feb. 2009, three replicates within an established, in-ground block of 'Natchez' crapemyrtles were pruned according to three pruning techniques: selective thinning ( $\approx 25\%$  canopy removal), pollarding ( $\approx 50\%$  canopy removal), or severe pruning (cutting all shoots to within 10-inches of ground level,  $\approx 95\%$  canopy removal). Three additional plants remained unpruned and served as the control. All plants were mulched with pine straw, fertilized uniformly, and irrigated with drip irrigation. At the onset of flowering, panicles having 50% or more of their florets open were harvested. The panicles were counted and weighed (fresh weight). Harvest began on 26 June 2009 and was repeated at 2-week intervals through 9 Sept. 2009, for a total of six harvest dates. Average weight per panicle was calculated from the data collected. Pollarding and severe pruning delayed flowering approximately 2 weeks compared to selective thinning or no pruning. The unpruned plants produced significantly more panicles than any of the pruned plants, and the panicles had the highest fresh weight when averaged across harvest dates. Selective thinning resulted in the highest average weight/panicle at five of the six harvest dates. 'Natchez' is a late-flowering cultivar and commonly produces a heavy seed set after flowering. Without pruning, energy is funneled to seed formation, and the plant seldom flowers again, or it flowers sparsely. By removing the panicles after their peak color and before seed set, repeat flowering was induced for 12 weeks. This practice, although labor intensive, may be warranted on plants in high-visibility landscapes.

#### **Growth Retardant Effects on Herbaceous Perennials Grown under Night Interrupted Lighting Outdoors in the Southern United States**

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A study was conducted in 2002 and 2003 to determine if growth retardants could be used to suppress stem elongation of 'Moonbeam' coreopsis (*Coreopsis verticillata* 'Moonbeam') and 'Goldsturm' coneflower (*Rudbeckia fulgida* 'Goldsturm') when grown outdoors under nursery conditions in the southern U.S. without negating the benefits of earlier flowering from night-interrupted lighting (NIL). NIL accelerated flowering of both cultivars without adversely affecting plant quality. However, plants grown under NIL generally were taller than plants grown under NP. When several PGRs [Cutless, B-Nine, B-Nine/Cycocel, Bonzi (2002 only), and Sumagic (2003 only)] were applied to plants under NIL, results varied with PGR type and concentration and year. Height of 'Moonbeam' coreopsis was effectively suppressed by 5000 or 7500 ppm B-Nine + 1500 ppm Cycocel in both years of the study and with 40 or 60 ppm Sumagic in the one year it was tested. Higher concentrations of Cutless and B-Nine suppressed height growth in one of two years, while Bonzi was ineffective in the one year it was tested. None of the PGR types or concentrations suppressed height growth of 'Goldsturm' coneflower to the level of the natural photoperiod (NP) control in 2002. However, in 2003 when an additional application of Cutless and B-Nine were made, and Bonzi was replaced with Sumagic, applications of Cutless, B-Nine, B-Nine/Cycocel, and Sumagic all resulted in heights similar to or less than that of plants under NP with minimal effects on time to flower or flower and flower bud counts.

#### **Taxodium Genotype Performance at SFA Gardens**

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There are three primary *Taxodium* genotypes native to the southern USA and Mexico: *Taxodium distichum* (L.) Rich. var. *distichum* (Baldcypress, BC), *Taxodium distichum* var. *imbricarium* (Nutt.) Croom (Pond Cypress, PC), and *Taxodium distichum* var. *mexicanum* (Carriere Gordon) (Montezuma Cypress, MC). SFA Gardens includes over 136 *Taxodium* genotypes and cultivars in the accession database, some as single plants and others as multiples. Since 2001, SFA Gardens has collaborated with the *Taxodium* improvement program of Professor Yin Yunlong at the Nanjing Botanical Garden (NBG), Nanjing, China. Six accessions from that program are currently under evaluation at SFA Gardens and in other locations across the south under trialing agreements with cooperators. BC x MC crosses exhibit salt and alkalinity tolerance, a fast growth rate, persistent foliage into the winter, early budbreak in the spring, and do not form knees. Young clones have been easy to root: cuttings collected from upright vigorous growth in June–August, slight wound, 5000 PPM K-IBA 5-second dip, and placed under intermittent mist. Roots generally occur in 8 to 12 weeks. T302, a BC x MC cross, was introduced in 2002 and named ‘Nanjing Beauty’ (NB) in 2004. In 2006, a genotype evaluation study was initiated along LaNana creek in the SFA Mast Arboretum. Trees were not irrigated. Four-foot (1.2 m) circles around each tree were kept mulched and weed free. A randomized block design was utilized with 17 genotypes, two plants per genotype, with three blocks for a total of 102 plants in this study. Genotypes from across the southern US included selections from Krauss in Louisiana, Rockwood in Florida, and NB from Yunlong in China. After 3 years, considerable variation is evident in tree height, form, diameter at breast height (dbh), and foliage retention. In another field trial, drip irrigated T27 (3/4 MC, 1/4 BC) from NBG planted as 4-ft (1.2 m) trees in Mar. 2008, averaged 14 ft (4.3m) 14 Dec. 2009 after only two growing seasons. There appears to be great opportunity for selecting superior *Taxodium* phenotypes adapted to specific site requirements.

### Evaluation of Two Perennials (*Agastache* ‘Red Fortune’ and *Penstemon digitalis* ‘Huskers Red’) in Low-Input Nursery Production Systems

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Pot-in-pot (PiP) production systems coupled with drip irrigation have shown to be effective in maximizing output, while minimizing inputs (water and fertilizer) in large container production. However, there is little published research examining small container PiP production. With PiP production as a possible risk management tool for weather extremes, this experiment was designed to evaluate how PiP production compares with above ground container production in a minimal input nursery production system. Two perennials, *Penstemon digitalis* ‘Husker’s Red’ and *Agastache* ‘Red Fortune’, were used in the experiment. The species were grown in 2 gallon containers in both production systems and subjected to low, mid, and high levels of nutrients and irrigation. The high levels of nutrients and water were low by industry standards creating a stressed environment for the plants. The data collected at intervals during the growing season included: plant width (in two perpendicular directions), height, health rating, flowering, and mortality. Both species exhibited lower mortality and higher growth indices in the PiP system in comparison to the above-ground container production. Increasing nutrient levels also increased survivability and growth. The varying irrigation regimes did not significantly affect survivability or growth of these two species.

### Cutting Propagation of Two Perennial Species in Whole Pine Tree Substrates

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Wood-based materials, such as processed whole pine trees (WPT), have been identified as possible substitutions or replacements for peat moss (P) and pine bark (PB) in container substrates. Although wood-based substrates can be successfully used for crop production, limited information exists for stem cutting propagation in such substrates. We evaluated WPT as a rooting substrate for two perennial species. Four substrates [WPT, WPT:P (1:1), PB, and PB:P (1:1)] were used to evaluate root development of *Evolvulus glomeratus* ‘Blue Daze’ and *Persicaria microcephala* ‘Red Dragon’ cuttings. Each substrate was amended per cubic meter with 2.96 kg dolomitic limestone and 2.37 kg Harrell’s 16-2.6-10 Plus (5 month formulation). Containers (250 ml) were filled with substrate, completely randomized, and placed under mist for saturation. Three-node, subterminal cuttings of *Evolvulus* received a basal quick-dip in a 1000 ppm IBA solution and were stuck in late Apr. 2009. Single-node, subterminal cuttings of *Persicaria* were stuck in early May 2009. Data was collected at 66 days after sticking (DAS) cuttings and 33 DAS for *Evolvulus* and *Persicaria*, respectively. On average, *Evolvulus* cuttings in WPT had the least total root length, total root volume, and total shoot length while cuttings in PB:P had the greatest values for these variables. Cuttings of *Persicaria* had the greatest total root length and total shoot length in PB:P, although the greatest total root volume occurred in WPT:P. The addition of peat resulted in greater root and shoot development compared with WPT and PB alone. A correlation between substrate chemical properties and root/shoot development was not established. An analysis of substrate physical properties will be conducted for treatment comparisons. We demonstrated that two perennial crops could be propagated in a WPT substrate, although further research is necessary to identify optimal WPT substrate physical properties.

### Alternate Media Substrate for Poinsettia Production

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Alternative nursery medium blends are necessary due to the reduction of available pine bark. The objective of this experiment was to establish possible media blends for seasonal crops. Media blends of 5/8-inch screened pine bark (PB 5/8 inch), 3/8-inch screened pine bark (PB 3/8 inch), fine screened (<#25 sieve) pine bark (FPB), rice hull ash (RHA), peat moss (P) and a blend of pine bark, peat, and perlite (control) were used. Lime (8 lbs/ cubic yard) and Micromax<sup>®</sup> (1.5 lbs/cubic yard) were incorporated into each respective mix. A commercial soluble poinsettia fertilizer was used daily at the rate of 200 ppm N. Media combinations produced commercially acceptable poinsettias. Media combinations including 3:1 PB 3/8 inch:P, 3:1 PB 3/8 inch:RHA, 3:1 PB 5/8 inch:FPB, 3:1 PB 5/8 inch:P, 3:1 PB 5/8 inch:RHA, 3:1:1 PB 3/8 inch:RHA:FPB, 2:1:1 PB 3/8 inch:RHA:FPB increased stem count compared to the control media. Growth index of plants grown in media 3:1 PB 5/8 inch:RHA, 3:1:1 PB 3/8 inch:RHA:FPB 3:1:1 PB 5/8 inch:RHA:FPB, 2:1:1 PB 3/8 inch:RHA:FPB were significantly greater than the control medium. All media components evaluated can serve as a nursery medium.

### Calcium and Magnesium Fertilizer Sources for Ericaceous Nursery Crops

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Calcium and Mg are essential plant elements that are often deficient in plant tissue growing in high pH nursery medium. The objective of this experiment was to determine the optimum source and rate of Ca and Mg when lime is omitted or reduced in a growing medium. Calcium sources included dolomitic lime (DL)(21% Ca, 10 % Mg), gypsum (21% Ca) at 0, 4, and 8 lbs /cubic yard, and Mg sources included coated Epsom salt 9-month release, coated Epsom salt 12-month release, Keiserite, and Epsom salt at 0, 4, and 8 lbs/cubic yard. Ca and Mg sources and rates resulted in significant growth differences in azalea and gardenia. There was no significant growth difference between Ca and Mg source or rate

for ligustrum plants at 6 months. This was expected due to the wide range of pH adaptability of ligustrum. Future analysis including biomass accumulation, plant tissue and leachate analysis will give us more insight into the reason for growth differences.

### Initial Evaluation of Griffith Buck Roses under Louisiana Growing Conditions

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A landscape evaluation of 77 Griffith Buck rose cultivars is being conducted at the LSU AgCenter's Burden Center, Baton Rouge, LA. Seventeen cultivars were planted in 2007 as part of the national Earth-Kind (EK) rose evaluation. An addition 30 cultivars were planted for evaluation in Spring 2008 and another 30 cultivars were planted for evaluation in Fall 2009. The planting is established in full sun. Soil type is an Oliver silt loam. Plants are lightly pruned to control size. Plants are mulched with pine straw and fertilized annually in the spring with a 3-month slow-release fertilizer at the rate of 2 lbs N/1000 ft<sup>2</sup> bed area. Irrigation is only applied when soil moisture conditions reach critical drought stress levels. The most sold Griffith Buck roses are Amiga Mia, April Moon, Carefree Beauty, Country Dancer, Distant Drums, Freckles, Pipe Dreams, Polonaise, Quietness and Winter Sunset. Initial blackspot observations on the Griffith Buck roses in the national EK evaluation showed Carefree Beauty, Princess Verona and Prairie Princess being slightly susceptible, Polonaise, Prairie Breeze, Prairie Harvest, Square Dancer, Winter Sunset, Amiga Mia, April Moon, Barn Dance, Country Dancer, Earth Song and Folksinger being moderately susceptible, and Pearlie Mae, Quietness and Summer Wind being highly susceptible. Good landscape performers based on very initial observations of flowering and visual quality are April Moon, Dorcas, Music Maker, Piccolo Pete, Prairie Squire, Bright Melody, Kathy's Find, Aunt Honey, Countryman and Do-Si-Do.

## Fruit Section

### Survey of Dehydrin Genes in Peach Germplasm

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Abiotic stresses, such as low temperature and drought, present significant problems to fruit production. Dehydrins are known to be involved in plant protection responses to these stimuli. Previous research in peach [*Prunus persica* (L.) Batsch.] has revealed the existence and seasonal expression of three dehydrin genes. Recent analysis of the peach genome sequence has revealed the existence of two additional dehydrin genes, PpDhn4 & 5. Expression studies revealed that PpDhn1&3 are the primary cold-responsive and PpDhn 2 & 4 are the primary drought-responsive dehydrins in peach. In addition, PpDhn4 appears to be short day (SD) photoperiod-sensitive at 25 °C. PpDhn5 responds to cold primarily under SD photoperiods and is not responsive to drought. A survey of peach germplasm for variation in coding regions and promoters of the known peach dehydrins revealed that PpDhn1, 2, 4 & 5 promoter sequences are conserved while PpDhn3 is not. Furthermore, PpDhn4 is also conserved between peach and plum (*Prunus munsoniana*) while PpDhn1, 2 & 5 exhibit different variants in peach and plum. Further work on comparison of the seasonal expression of these dehydrins in bark tissue and flowers exposed to frost will give more insight into their behavior and function.

### Brushy (Woody) Weed Control in Blueberries

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Woody weed species including Chinese tallow (*Triadica sabifera*), American persimmon (*Diospyros virginiana*), and White barked maple

(*Acer leucoderma*) are often problematic in blueberry fields where they compete for sunlight, moisture and nutrients, and interfere with normal production practices and harvesting. Once these become established in blueberry fields, typically growers typically cut them near or at the base of the trunk, but secondary buds beneath the cut develop and brushy new often growth ensues. A study was conducted in a rabbiteye blueberry field near Poplarville, MS in 2008 and 2009 to determine the efficacy of painting labeled blueberry herbicides onto the cut and cambium tissue of freshly cut trunks of the three tree species. 25% v/v solutions of Roundup Ultra<sup>®</sup> (glyphosate) and Velpar<sup>®</sup> 2L (hexazinone) and distilled water effectively prevented regrowth of Chinese tallow and American persimmon (> 90% control) but only Velpar effectively prevented regrowth of White barked maple. Remedy<sup>®</sup> 4EC (triclopyr) was less effective than either roundup or Velpar in controlling these species. No herbicide injury resulting from leaching of any of the treatments was detected in blueberries adjacent to treated woody weeds.

### Cultural Problems Facing the Blueberry Industry in Arkansas

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Blueberry production in Arkansas is declining although the state's climate allows for production of the three commercial types [southern highbush (*Vaccinium* spp.), northern highbush (*Vaccinium corymbosum* L.), (*V. Ashei* Reade)]. Growers are also facing cultural problems such as general plant and yield declines. These problems are extensive and widespread throughout the industry. We conducted a survey of the industry to attempt to determine cause or causes of the problems facing the industry. We selected fourteen blueberry farms located throughout the state. The three types of blueberries were represented in the survey. Results indicate that Mummyberry (*Monilinia vaccinii-corymbosi* Reade), a disease not previously reported in Arkansas, was found in several plantings. Blueberry mosaic and Red Ring Spot virus were found in several plantings. Insect traps indicated no Blueberry maggot (*Rhagoletis mendax* Curran). Foliar analysis indicated that most of the plantings have serious nutritional deficiencies in the minor elements (B, Cu, Fe, and Zn). Based on these results, changes to pest and fertilizer management recommendations will be made. If adopted, these changes should improve plant health and yields.

### Impacts of Temperature on Node Formation and Bloom Date of Primocane-fruiting Blackberry Genotype APF-52 under High Tunnel and Ambient Conditions and Multiple Mowing Treatments

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Temperature-based plant growth unit (PGU) models are used to predict bloom and harvest of many perennial fruit crops. This study was implemented to determine whether PGU models developed for floricanes-fruiting blackberries were more accurate in primocane-fruiting (PF) blackberry than the simpler method of counting days after cane emergence. A secondary objective of the study was to determine whether nodes are an effective measure of development toward flowering. Plantings of PF genotype APF-52 under high tunnels and ambient conditions were observed in 2008 and 2009. In 2008, three harvest delay treatments were applied: 1) mowing on 15 May; 2) mowing on 15 May and again on 10 June; and 3) mowing on 15 May, 10 June, and 2 July. Because the 2008 treatments that were mowed multiple times appeared to have negative effects on growth, 2009 treatments were modified to be mowed only once per treatment. In 2009, three different treatments were applied: 1) a control with no harvest delay treatment; 2) mowing on 15 May; and 3) mowing on 10 June. Nodes were counted weekly and bloom dates were observed. Temperatures were logged every half hour under high tunnels and ambient conditions to calculate PGUs. Different models were compared by comparing coefficients of variation. Results indicated

that none of the temperature-based models were more effective than counting days. Mowing treatments did affect total time or PGU accumulation at bloom. There was a significant correlation between total PGU accumulation and total, but the correlation was weak ( $R^2 > 0.29$ ).

### Physiological Differences of Cool, Warm, and Hot Climate Grapevine Varieties on the Texas High Plains

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Throughout growing seasons in western Texas, grapevines are subjected to climatic extremes. Therefore, to assist growers in selecting adapted varieties, evaluations must be conducted under the climatic conditions found in the region. This research evaluated gas exchange of *Vitis vinifera* cool climate (Pinot noir), warm climate (Cabernet Sauvignon and Merlot), and hot climate varieties (Grenache and Mourvedre) grafted to 110R rootstocks and subjected to variable leaf temperatures. The vineyard is arranged in a randomized complete block design with four blocks and five vines of each variety within each block. On 15 dates during the 2009 growing season mid-day photosynthetic rate, stomatal conductance, transpiration, and leaf-to-air vapor pressure deficit were measured with a LI-COR 6400 on two leaves from three vines within each block. Measurements were made at leaf temperatures of 24, 27, 32, 34, 37, and 40 °C. Inside the leaf chamber light levels were maintained near 2000 PAR. Over the range of leaf temperatures, our data suggest there were few differences in gas exchange rates between each variety. Despite increased leaf temperatures, each species was able to maintain gas exchange rates at levels that would likely maintain sufficient growth. Because this is a young vineyard, additional research (gas exchange, fruit quality, shoot growth) through upcoming growing seasons will give further insight to adaptability of these varieties to the west Texas climate.

### Prospects for Midas as an Alternative to Methyl Bromide in North Carolina

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At NC State University we have been investigating various iodomethane formulations and rates since the year 2000 in strawberry plasticulture and strawberry nursery applications. This fumigant is now registered for commercial strawberry use in North Carolina and 47 other states. In this 2008-2009 study at Central Crops Research Station in Clayton, NC (USDA hardiness Zone 7b, lat. 35°7'N, long. 78°5'E), we investigated the performance of Midas 50:50 (4 rates) compared to Midas 98:2 (5 rates), we also included 2 fumigant treatments with methyl bromide 50:50 for comparison to Midas. A VIF barrier film (Pliant Blockade) was used to increase the efficacy of fumigant. The treatments were shank applied with a Symmetry Unit, and this allowed us to achieve very accurate calibrations of Midas 98:2. The broadcast rates for Midas 98:2 were 67, 78, 90, 100 and 112 kg·ha<sup>-1</sup> (34, 39, 45 and 50 kg·ha<sup>-1</sup> in-the-bed, respectively). The broadcast rates of Midas 50:50 were 134, 157, and 180 kg·ha<sup>-1</sup>. Methyl bromide /chloropicrin was evaluated at 196 and 267 kg·ha<sup>-1</sup> broadcast. Total and marketable yields were significantly greater for fumigated soil than the untreated control treatments. The marketable yield for non-fumigated untreated control was only 20,018 kg·ha<sup>-1</sup> compared to the highest yielding treatment in the study, Midas 50:50 at the rate of 112 kg·ha<sup>-1</sup> that produced a marketable yield of 26,196 kg·ha<sup>-1</sup>; followed by Midas 98:2 at 78 kg·ha<sup>-1</sup> (25,668 kg·ha<sup>-1</sup>). Methyl bromide/chloropicrin treatments had significantly lower marketable yields for the 196 and 267 kg·ha<sup>-1</sup> broadcast rates of 22,127 and 21,813 kg·ha<sup>-1</sup>, respectively. Arysta Life Science North America, LLC, is still working through the registration process in California and is expecting to hear from California regulatory bodies by the end of Feb. 2010.

### Pruning Primocane-fruited Blackberries to Delay Fruiting

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Production of autumn-bearing primocane blackberries in warm regions is limited by high temperatures during bloom and early fruit development which occur in late summer. Preliminary studies have indicated the potential for delaying bloom and fruit harvest from late summer into the autumn when temperatures may be more favorable. Previous work indicates that pruning primocane blackberries can be used for synchronization of harvest at specific times and may increase harvest compared to unpruned plants. A study was established to test the effects of time of pruning on harvest of primocane blackberries. Plants of Prime-Ark®45 were planted in Apr. 2008 in plots 2.5 m in length with five plants per plot. The trial was managed organically and woodchip mulch was used to control competitive vegetation. Treatments were begun in 2009 as follows: 1) mow to the ground 15 May; 2) mow to the ground 15 June; 3) mow to the ground 15 July; 4) mow 15 May plus soft tip; 5) mow 15 June plus soft tip; 6) mow 15 July plus soft tip. The soft tipping removed approximately 5-10 cm tissue at 30 days after the mowing treatment. As fruit matured, they were harvested twice weekly. At each harvest a 25-berry count weight was measured to estimate average berry size. Additionally, the insect pest rednecked cane borers [*Agrilus ruficollis* (F.)] galls in canes were counted. Delaying pruning delayed first and median harvest, but there was no effect of tipping on harvest date with the exception of the 15-July plus tip treatment compared to mowing alone. The time of pruning did not affect the number of days between mowing treatment and first harvest but delaying pruning compressed harvest and reduced the days between first and median harvest. However, delaying pruning significantly reduced harvest and the July pruning treatment only produced 22% of the yield as the May pruning treatment. Tipping after mowing did not affect yield compared to mowing only. Pruning did not significantly affect berry size although later pruning treatments tended to have slightly larger fruit. Delaying pruning significantly reduced the number of galls formed from rednecked cane borers.

### Mechanical Flower Thinning of Peach Trees Trained to a Quad-V System

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Removing flowers or immature fruit from peach trees is a standard but expensive cultural practice. Mechanization of this annual task would lessen the concerns associated with both the availability and the increasing cost of hand labor. This study was part of a larger trial to evaluate the mechanization of tree fruit cultural practices. Initial goals were to improve mechanized thinning by addressing tree architecture to enhance effectiveness and to test mechanical thinners to determine optimum timing, string or cord configurations, spindle RPMs and tractor speed to mechanically thin peach flowers and fruitlets. The Darwin PT 250 was used for flower thinning in three South Carolina orchards in Mar. 2009. All orchards were thinned but only one had harvest data due to hail losses. Treatments were different spindle speeds (175, 180, 200, 220 RPMs) of the Darwin plus a hand-thinned control. Each Darwin treatment had the same arrangement (2 sets or plates of cords opposite each other) and number of plates (2 x 6 sections) and cords (18/plate). The Darwin PT 250 with one configuration of cords and a narrow range of tractor (1.2 and 1.8 mph) and spindle speeds effectively thinned off 26% to 68% of the flowers; and therefore, could be adjusted to thin within the 35% to 45% range, the targeted goal for increasing fruit size. Though upper scaffolds were usually overthinned and lower scaffolds underthinned, changes in the cord number and placement should more evenly distribute the thinning throughout the canopy. Running the spindle between 175 to 200 RPMs worked best. Increasing the RPMs to 220 overthinned. Time to hand thin green fruits was reduced in the Darwin treatments by 23% to 28%. Though compromised by hail damage, the Darwin treatments did increase the number of large size fruit in the harvested orchard.

## Effect of Irrigation on Fruit Production and Quality of Rabbiteye Blueberry

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A study to evaluate the effect of three different irrigation methods on vegetative growth, yield and fruit quality of two early season rabbiteye blueberry varieties was conducted during 2008 and 2009 growing seasons. The experimental plot was set up on a blueberry farm located in the Wiregrass area of Alabama on high pH sandy loam soils. Irrigation treatments consisted of grower-installed drip tape with in-line emitters, drip tape with plug-in emitters, and micro-jet sprinklers. Treatments were applied to 2-year-old Austin and Climax cultivars. Sulfuric acid was injected through the system to neutralize water alkalinity. Data were recorded to determine plant vegetative growth. During the second season yield per bush and fruit quality characteristics were also evaluated. A significant cultivar by treatment interaction was found to affect the blueberry vegetative growth as demonstrated by the plant growth index and the leaf area measurements. In both experimental years Climax bushes had significantly greater vegetative growth compared to Austin blueberry and the micro-jet treatment produced the least plant growth when compared with the drip emitter treatments. A significant cultivar by treatment interaction affected the yield response. Plug-in emitter treatment applied on Climax cultivar provided the greatest yield per plant. Austin was found to produce significantly larger berries than Climax, 2.1 g and 1.2 g, respectively. The plug-in emitter treatment resulted in the highest fruit soluble solid content of 12.9%.

## The Effects of Girdling and Benefit® Application on Fruit Growth of New Kiwifruit Cultivars

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Trunk and/or stem girdling, and the natural plant extract Benefit® are commonly used in commercial kiwifruit production for the purpose of increasing fruit size. The goal of this on-going research is to determine the effectiveness of these practices on *Actinidia chinensis* 'Golden Dragon' and *A. chinensis* 'Golden Sunshine'. The effects of fruit size on fruit quality characteristics are also being evaluated. The experiment is arranged as a randomized complete-block design with four replications (vines) per treatment. Treatments were initiated 21 days after fruit set and included Benefit® application, trunk girdling, Benefit® plus trunk girdling, and a control group. Preliminary results indicated that Benefit® application increased the yield and marketable fruit number for 'Golden Sunshine'. Possible effects on fruit size may have been masked due to a high variability in fruit number. Greater attention to consistent fruit thinning practices should reduce the variation and allow for more conclusive results. Fruit quality appeared to be affected by fruit size. Interestingly, the smaller 'Golden Dragon' fruit tended to have a higher amount of soluble solids (SS) and a greater SS:titratable acidity ratio. Bigger fruit tended to have higher dry matter content for both 'Golden Dragon' and 'Golden Sunshine'.

## Using High Tunnels and Day-neutrals for Seven Months of Continuous Strawberry Fruiting in the Upper Mountains of North Carolina

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From the early 1960s through the 1970s, North Carolina developed the largest strawberry industry in the Mid-South (its peak was about 1000 ha), that was entirely based on U-pick or customer harvest of matted row. Starting in the early 1980s, NC State University researchers in the Department of Horticultural Science began to actively investigate an annual hill plastic mulch growing system that involved fall planting (as opposed to spring planting for matted row), of short day cultivars, including 'Chandler'. With cultivars adapted to the "plasticulture

system," growers can harvest for 5-7 weeks in the plasticulture system compared to 3 weeks for traditional matted row cultivars like 'Atlas' and 'Apollo'. Since the early 2000s NC State has been evaluating the potential of summer and early fall production of day-neutrals in the southern Appalachians. At the Upper Mountain Research Station in Laurel Springs (36.4N, 81.28W, 914 m elevation and USDA hardiness zone 6a), the newer California day-neutral 'Albion' has achieved average yields of 857 g/plant (2007), and there would appear to be excellent potential for high quality 'Albion' production from late June until early October with floating row covers for frost protection in the early fall. Thus, it is possible for this region of the state to produce strawberries continuously in the field from mid-May through early October by utilizing short day varieties for the spring season (1 1/2 months) and day-neutrals in the summer and early fall (4 months). By adding high tunnels, it may be possible to extend the fall season crop by another month through mid-November. Due to the extremely harsh winter conditions in the Upper Mountains, the high tunnels must be de-skinned in early December and the dormant crop can then be protected with medium weight row covers through late February. In early Mar. 2010, we plan to re-apply the tunnel's clear plastic cover to "force" the crop for harvest in mid-April, or 1 month earlier than the normal spring crop (mid-May). Thus, the high tunnels may have the potential to add another 2 months to the current 5-month outdoor plasticulture production system in this region for a total of 7 months of continuous strawberry fruiting.

## Postharvest Section

### Blueberry Fruit Development and Splitting

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A problem facing blueberry growers in the southeastern United States is rain-related fruit splitting. Splitting refers to a break in the skin and/or pulp of the berry, prevalent in some cultivars, that occurs after a period of drought followed by intense rain. We hypothesize that blueberry cultivars which have a higher percent of apoplast to symplast, in ripening berries, will have an increased probability of splitting. We predict that a high percent of apoplast will result in abundant intercellular spaces filled with amorphous carbohydrate. These spaces reduce cell:cell mechanical strength of the tissue and hydrophilic carbohydrates that fill them can increase fruit turgor pressure. We evaluated the cultivars 'Premier' (split-resistant), 'Tifblue' (split-susceptible), and 'Montgomery' (split-resistant but with firmness measurements consistent with split-susceptible cultivars). Blueberry fruit samples were prepared for paraffin sectioning and compound light microscopic examination. A digital picture library was created, images were edited to analyze the apoplast and symplast, and the percent apoplast was established. Preliminary evidence supports our hypothesis. Split-susceptible 'Tifblue' averaged 32.3% apoplast at the attachment end of the fruit and 16.5% at the floral end compared with split-resistant 'Premier' which exhibited percent apoplast varying from 17.4% at the attachment end of the fruit to 24.0% at the floral end and Montgomery which varied from 16.3% at the attachment end to 24.6% at the floral end. Qualitative analysis of laboratory-induced berry splitting supported field observations. Berries were submerged in distilled water and monitored for the occurrence of splitting. 'Premier' and 'Montgomery' could not be induced to split, but 'Tifblue' split readily. Sections through the split of 'Tifblue' indicate that the fissure occurs along a weak line in the apoplast with cells lining the fissure remaining intact.

### Tracking Water Absorption in Split-susceptible Blueberries

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Rain related fruit splitting in blueberries has been a problem for commercial blueberry growers in the southeastern US. The presence of split berries can cause an entire batch of berries to be rejected. Rejection of

batches can be devastating to the growers and their income. Previous studies have shown that when rainwater is prevented from reaching the fruit directly, splitting still occurred indicating that some splitting is caused by water uptake by the roots alone, moving into the fruit via the vascular tissue of the berry. What is not known is if the cells within the berry are rupturing, or if the linkages between the cell walls are being compromised. The purpose of this study is to monitor the uptake of water into the berry to determine where the water is settling. A highly splitting susceptible 'Pearl River' pentaploid blueberry was selected for this evaluation. Whole, intact berries were immersed in acridine orange stain for 1, 3, or 6 hours to monitor water uptake and location. Berries were hand sectioned, viewed and photographed with an Olympus BX60 microscope system equipped with fluorescence filters. Berry sections show dye absorption only into the berry vascular tissue occurring after 1 hour. After 3 hours the dye is found in tissue immediately surrounding the vascular bundles, and after 6 hours the dye is found in the cell walls throughout the berry. Water/dye is not found near the surface of the berry indicating that the water is being absorbed through the epidermis of the berry. Therefore, water absorption by blueberries occurs mainly through the vascular system of the berry and moves into the cell walls or the areas around the cell walls.

**Developing a Protocol for Postharvest Raspberry Evaluation**  
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Raspberries have an abbreviated shelf life, as they must be picked close to full ripeness and so have soft fruit, rapid darkening, and high rates of respiration and water loss. Problems with shelf life are further aggravated in areas where field heat loads are high, such as the southeastern U.S. Several selections have been developed in North Carolina that have tolerance to extended exposure to high soil and air temperatures. A system was designed to evaluate these selections and cultivars for postharvest quality that can be adapted by other production sites and breeders. Berries were harvested into 1/2-pint clamshells and transferred immediately to 5 °C cooling (refrigerated truck and cold room). Berries were rated for color prior to storage, weighed, placed in masters covered with FDA grade plastic (to maintain high humidity) and held for 4 to 6 days at 5 °C. When fruit started to show visible decay, boxes were weighed and fruit still in the clamshells rated for overall color and shrivel where 1 = good/none to 3 = severe/unmarketable. Each berry was removed from the clamshell and judged to be firm or soft by holding between thumb and finger. Those showing juice leakage were rated as leaky and those showing visible mold rated as decayed. An overall score was developed to encompass leak, decay, and soft: Overall = 100 – sum of percent decayed, leaky, soft. Using this system, we found that 'Nantahala' and 'NC344' retained lighter color after storage, while 'Autumn Britten', 'Joan J', and 'Heritage' were too dark. 'Himbo Top' disintegrated during storage; this variety was developed in a much colder climate and indicates that environment of origin may influence postharvest performance in warm growing regions. 'Latham' was found to be a good starting point as a marker of postharvest performance for comparison with new selections. It had good berry size, slightly firm fruit, and color scores of 2-3 after storage. 'Heritage' was too small and 'Mandarin' too crumbly to be effective cultivars for quality markers.

### **Response of the Ascorbate-glutathione Cycle to Storage Temperature in Carambola Fruit**

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The generation of reactive oxygen species (ROS) is considered to be a primary event under a variety of stress conditions. It has been generally accepted that reactive oxygen produced under stress is a detrimental factor, which causes lipid peroxidation, enzyme inactivation, and oxidative damage to DNA, before visible symptoms. To control the level of ROS and to protect cells under stress conditions, plant tissues

contain several enzymes that scavenge ROS. The ascorbate-glutathione cycle, also called Halliwell-Asada pathway plays an important role in scavenging ROS and in continual production of antioxidants. Carambola fruit harvested at the half-yellow to yellow stage were stored at 2, 5, 10, 15 and 20 °C for 21 days then transferred to 20 °C for 7 days. Fruit stored at 5 °C lost ripening capacity even after transfer to 20 °C. Fruit stored at 2 and 10 °C did not ripen during 21 days storage, but ripened after transfer to 20 °C. However, these fruit rapidly lost water and exhibited browning discoloration. At 15 °C fruit ripened unevenly, possibly due to variability of harvest maturity. Fruit ripening either commenced at harvest time and continued during storage, or the fruit remained unripe. Fruit stored at 20 °C ripened normally, but rapidly lost quality due to ethanol accumulation and softening. Activities of superoxide dismutase (SOD), ascorbate peroxidase (APX), and catalase (CAT), enzymes directly related to ROS scavenging increased during storage at 20 °C, but had lowest values at 5 °C. Activities of dehydroascorbate reductase (DHAR), monodehydroascorbate reductase (MDHAR) and glutathione reductase (GR), enzymes, related to continual ascorbate oxidation and reduction, increased in fruit stored at 5 °C. The results indicate that at 5 °C, fruit have low capacity to scavenge SOD, which caused damage to the fruit and disturbed the ripening process. Nevertheless, storing carambola at 5 °C results in extended appearance life and therefore commercial acceptability, although may result in poor flavor quality due to chilling injury.

**Evaluation of the Antimicrobial Capacity and Phenolics of Extracts from Different Sections of Various Muscadine Cultivars**  
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Muscadine (*Vitis rotundifolia* Michx.) grapes are rich in phenolics and other bioactive compounds. These compounds possess antioxidant properties and also antimicrobial properties. The objectives of this research were to determine which cultivars and what parts of the grape (concentrating on skin and seeds, the richest in antioxidants) were higher in phenolics acids and had higher antimicrobial activity. Moreover, antimicrobial activity was compared to phenolics and other properties (skin color, etc.) to evaluate any relationship. Hot water-soluble muscadine extracts from freeze-dried skin, pulp and seed sections of selected muscadine cultivars were prepared. Phenolic and polar compounds of each of the extracts were determined by HPLC. A cocktail of three stains of *Escherichia coli* O157:H7 was used to discern the antimicrobial capacity of each sample by the disc diffusion assay. For the skin part, the samples from some varieties (such as 'Nesbit'—bronze, 'Southland'—purple) had strong ( $P < 0.05$ ) antimicrobial activities, resulting in an initial count of approximately 5 log cfu/mL of the cocktail to nondetectable levels ( $<1$  log cfu/mL). However, regardless of other factors, the samples from some other varieties (like 'Coward'—purple and 'Sweet Jenny'—bronze) had no ( $P > 0.05$ ) antimicrobial capacity ( $<1.00$  log CFU/mL reduction). The concentrations of main active organic compounds were different among cultivars, correlating to results in the antimicrobial tests. Tartaric acid concentration in skins, for example, was 9645.2 ppm ('Nesbit'), which also showed a high log reduction of 4.92, and was low in 'Sweet Jenny' (3764.2 ppm), which showed no antimicrobial activity. Similar results were seen with the seed sections. These results showed that muscadine cultivars differ in total phenolics, that these correlated well with their antimicrobial capacity, and that any section of the muscadine cultivar can be used to compare antimicrobial and antioxidant/phenolics capacity between cultivars.

### **A Study on Aromatic Profiles of *Thymus hyemalis* and Spanish *T. vulgaris* Essential Oils at Five Physiological Stages**

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Shrubs of clonal selections of *Thymus hyemalis* L. and Spanish *T. vulgaris* subsp. *vulgaris* were harvested at five phenological stages during the plant growing cycle: vegetative (VEG), floral (FL), floral-fructification (FL-FR), fructification (FR), and passed fructification (FR-pas). The volatile profile of the essential oil samples was determined by capillary gas chromatography coupled with an olfactometry detector (GC-O) and two trained panelists evaluating samples in triplicate runs. Sample aromatic profiles were also evaluated by a 10-member panel using the free-choice profiling (FCP) method in which panelists are allowed to use their own vocabulary. Peak intensities obtained by GC-O were analyzed using ANOVA and by principal components analysis (PCA). Sensory data were analyzed by the general Procrustes analysis (GPA). *T. hyemalis* and *T. vulgaris* had 36 and 28 aroma-active compounds, respectively, perceived in a consensus by the two GC-O panelists. For *T. hyemalis*, the VEG stage was characterized by high green/menthol peak intensity due to gamma-terpinene. The FL stage also had high intensity for green/menthol (gamma-terpinene), raspberry ( $\beta$ -ionone), as well as unknown peak with fresh/herbal aroma. One unknown compound with spice/anise aroma was perceived in FL-FR and absent in other stages. The FR and FR-pas stages had high intensity for many peaks, including  $\beta$ -myrcene (engine oil), thymol (herbal/menthol) and spicy (eugenol). The FCP analysis revealed that the FL stage was well differentiated from other stages, with a dominant of medicinal, cedar, earthy/musty aromas. The FR-pass stage was also distinct from FL by honey and engine oil notes. *T. vulgaris* differed from *T. hyemalis* by the presence of terpenyl acetate (spice/herbal) and the absence of p-cymene (engine oil), thymol (herbal/woody) and carvacrol (herbal/thyme). Eucalyptol (menthol) and eugenol (spice/clove) were also higher in *T. vulgaris*. As a result, the essential oil of *T. hyemalis* was perceived with more negative notes (engine oil, earthy/musty, pencil) than *T. vulgaris*, which had floral, herbal, spices, and menthol descriptors.

#### **Toward a Facile Method to Remove Ascorbate Interference in the Folin-Ciocalteu Assay of "Total Phenolic Content"**

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The long-established Folin-Ciocalteu (F-C) assay for total phenolics can have limitations due to interference by ascorbic acid (AsA). For common fruit juices this interference can easily exceed the magnitude of the total phenolic signal itself. Approaches to eliminating the AsA interference are briefly discussed, with particular attention to the use of ascorbate oxidase (AO). AOs isolated from cucurbitaceae and from fungi were tested. Both oxidized AsA, although we found the fungal AO has a broader pH range and wider temperature tolerance and functionality. We found that dehydroascorbic acid (DHA), the AO catalyzed product of AsA with oxygen, also acts as an F-C reductant giving an apparent molar strength of 10 to 20% of the parent AsA. Thus AO alone will likely not completely solve the problem of AsA interference in F-C assays. One promising approach to eliminating the DHA is discussed. Any such approach must remove most or all of the DHA while giving products that are not themselves F-C reductants. Further, it must not substantially alter or damage the phenolics present.

#### **Reduced O<sub>2</sub> and Elevated CO<sub>2</sub> Tolerance Limits of Fresh-cut 'Kent' Mango During Retail Display**

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Exposure to unfavorable temperatures encountered during retail display may induce the development of injurious atmospheres inside improperly designed packages of fresh-cut products, compromising their quality and safety. The objective of this study was to determine the optimal

reduced O<sub>2</sub> and/or elevated CO<sub>2</sub> concentrations suitable for fresh-cut 'Kent' mango handling at an elevated temperature (15 °C), as unfortunately is frequently encountered during retail display of fresh-cut products. Overall sensory quality, respiration rates (RR), firmness, composition, and aroma volatiles were measured. Atmospheres of 0 or 2.5 kPa O<sub>2</sub> with no CO<sub>2</sub> modification were found to partly inhibit the symptoms responsible for shelf life reduction (i.e. browning, water-soaking, off-flavor, and spoilage). However, a completely anaerobic atmosphere is not recommended since it may result in tissue damage during longer exposure periods. When reduced O<sub>2</sub> atmosphere (2.5 kPa) was compared with reduced O<sub>2</sub> plus elevated CO<sub>2</sub> (10 or 20 kPa CO<sub>2</sub>) atmospheres and an air control, the 2.5 kPa O<sub>2</sub> plus 10 kPa CO<sub>2</sub> atmosphere was found to best maintain fresh-cut 'Kent' mango quality. In contrast, an atmosphere of 2.5 kPa O<sub>2</sub> plus 20 kPa CO<sub>2</sub> had no beneficial effect. Higher levels of fermentative aroma volatiles (i.e., acetaldehydes and ethanol) occurred in slices held in reduced O<sub>2</sub> atmospheres compared with air, but no objectionable aroma was detected subjectively. The RR was not significantly affected during storage by the reduced O<sub>2</sub> levels compared to holding in air. These results provide valid information that can be used as a starting point for the development of a modified atmosphere packaging system that will be capable of maintaining the overall quality of fresh-cut mango slices when exposed to elevated temperatures.

#### **Sanitization Treatments of Blueberries for the Frozen/Processing Market**

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Fresh blueberries are packed without washing; however, those for the frozen and other processing markets are usually washed prior to packing. Washing is usually done by dipping the berries in a water bath or by spraying water on them. This step can result in an increase in microbial load and contamination if not properly done. However, it can also be used to reduce the microbial load of blueberries, especially mold and yeasts. The purpose of this study was to compare the effectiveness of selected postharvest sanitation treatments on microbial load of blueberries prepared for the processing market. Fresh rabbiteye (*Vaccinium ashei*) blueberries were dipped in water along with an oxidizing agent (Boxyl<sup>®</sup>) at different temperatures and, concentration and contact times. The response surface method (RSM) was used to evaluate the effect of temperature (60 - 90°C), contact time (10-30s), and Boxyl<sup>®</sup> concentration (0 to 0.1%) on aerobic (APC) and yeast and mold (YMC) reduction, wax/bloom removal, and color removal on the surface of blueberries. Addition of Boxyl<sup>®</sup> to water had the least effect on microbial reduction, while affecting quality. Contact time had a minimal effect on microbial reduction. However, solution (water) temperature was the only effective ( $P < 0.05$ ) factor affecting microbial reduction and product quality. The ridge analysis of the response surface indicated that maximum APC and YMC microbial reduction increases with an increase in temperature; whereas wax/bloom and color removal decreased as temperature decreased. Water temperatures above 80 °C resulted in adverse effects on berry quality. It was found that holding berries in water at 75 °C for 20s resulted in a reduction of 3.56 to 1.78 log<sub>10</sub> cfu/g APC; and 4.58 to 1.60 log<sub>10</sub> cfu/g YMC. Furthermore, this treatment showed no detrimental effect on the berries as determined by sensory results. Thus, using hot water at 75 °C is an alternative to adding chemicals for reduction of microbial load in blueberries.

#### **Effect of Laser Labeling on the Survival of *Salmonella* spp. on Tomato Surfaces during Postharvest Storage**

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Laser labeling produce is an alternative to adhesive labels. The system consists of using a low-energy carbon dioxide laser-beam to generate pinhole depressions forming alphanumeric characters to

etch information onto produce. This ruptured epidermis may increase the risk of foodborne pathogen infiltration and growth. The objectives of this study were to evaluate the impact of laser labeling and different postharvest treatments on the fate of *Salmonella* on tomatoes. Mature green, round tomatoes were labeled using a maximum energy level of 0.678 W per character at 35  $\mu$ s with a duty cycle range of 25%, spot inoculated with a five-strain cocktail of Rifampicin-resistant *Salmonella*, and swabbed with commercial tomato wax. Five different sequences of laser label, inoculum, and wax application were evaluated. Samples were stored for up to 28 days at 4, 12, or 25 °C. Bacteria were enumerated following a rub-shake-rub of tomatoes on tryptic soy agar supplemented with Rifampicin for recovery of *Salmonella*. The effect of each scenario on bacterial populations was determined using ANOVA. There were no significant differences ( $P < 0.05$ ) between populations of *Salmonella* on laser-labeled and unlabeled tomatoes stored at 4, 12, or 25 °C over the experiment. *Salmonella* held at 4 °C decreased  $\approx 2$  log cfu/tomato over 28 days, while those held at 12 and 25 °C for 28 and 14 days, respectively, remained stable. Laser labeling tomatoes does not adversely affect the tomato surface with respect to pathogen survival and offers industry a permanent, safe alternative to traditional adhesive labeling.

## Vegetable Crops Section

### Utilization of Grafted Tomato Seedlings for Open Field Production

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Two tomato rootstocks (RST-04-105 and RST-04-106) resistant to bacterial wilt (*Ralstonia solanacearum* L.) were used in combination with a single tomato scion (BHN 602) to evaluate the performance of grafted seedlings in open field production. A self-grafted entry was included to ensure that the grafting process did not impact bacterial wilt resistance or fruit yield. Bacterial wilt incidence in the trial area was low overall and was not seen in ungrafted tomato seedlings. The self-graft as well as the grafted entries had low incidence of bacterial wilt infection; however, there were no significant differences in bacterial wilt incidence between entries. Other trials performed with similar rootstocks showed significant reduction in bacterial wilt incidence compared to un-grafted susceptible cultivars. Rootstock had a significant effect on total marketable yield with 'BHN 602' grafted onto 'RST-04-106' yielding greater than all other combinations. There were no significant differences in yield between other combinations. These data show that grafting holds promise for increasing the disease resistance in tomato cultivars as well as increasing the overall productivity of tomato cultivars.

### Fresh Market Tomato Irrigation Management on Sandy Loam Soils

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Irrigation management of fresh market tomatoes in the mid-Atlantic may impact nutrient losses from production systems. The objective of this study is to define an irrigation regime using evapotranspiration (ET) data for plastic-mulched tomatoes grown on sandy loam soils in the mid-Atlantic. Four irrigation regimes based on ET (0.5, 1.0, 1.5, and 2.0 ET) were implemented to determine irrigation management effect on petiole nitrate concentrations, normalized difference vegetative index (NDVI) readings and marketable yield. A fifth treatment was triggered by a tensiometer wired into the irrigation system that kept the soil at or below 40 kPa at the 12-inch

depth. Petiole sap nitrate tests and NDVI readings were collected when fruit averaged 2 inches in diameter. Regression analysis at  $P = 0.05$  was used to develop relationships between irrigation regimes, marketable yield, NDVI and petiole sap nitrate. A best fit regression line of  $y = 4E-07x^2 - 0.0005x + 1.04$  ( $R^2 = 0.247$ ) was found when NDVI was plotted against petiole sap nitrate concentrations. Lower NDVI readings may be due to more fruit on the plant, which have a lighter green color than plant vegetation, which is more prominent with low fruit loads and/or excessive vegetative growth. Total marketable yields indicated that the 0.5 ET irrigation rate produced more pounds of fruit (73,600 lb) per acre than the other treatments. Lower yields from higher irrigation rates may be due to nutrients leaching beyond the root zone of the plant. Over the growing season, the tensiometer treatment used similar gallons of water as the 1.0 ET treatment (5,953 and 6,245 gal/acre/d, respectively) and produced similar yields (59,520 and 53,509 lb/acre, respectively). Overall, preliminary data suggests that triggering irrigation with a tensiometer at 12 inches is similar to 1.0 ET but offers lower yields compared to the 0.5 ET irrigation regime.

### Position of the Wetted Front under Drip-irrigated Tomatoes Grown on a Sandy Soil

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Keeping water and nutrients in the root zone of vegetable crops is a main goal of nutrient Best Management Practices. How deep irrigation water moves through the soil profile depends on the volume of water applied and how much water is taken up by the plant. It is possible that reducing drip irrigation system operating pressure (OP) may result in slower vertical water movement because of 1) greater lateral water movement and 2) lower water application rate. Without a crop, water moved in a deep sandy soil at about 1 inch for every 10 gal/100 ft of water applied, implying that in a 60-day crop cycle, the wetted soil depth would be 288 inches (at 4.8 inches per day). In this study, tomato plants were grown for two seasons using plasticulture. Replicated ( $n = 4$ ) treatments were OP (6 and 12 psi) (41 and 82 kPa) and two irrigation rates of 100% and 75% UF-IFAS recommended rates. A blue dye was injected on 7 and 21 DAT and the soil was dug on 57 and 84 DAT in 2008 and 2009, respectively. The depth of water front was significantly affected by OP ( $P = 0.01$ ) with maximum wetted depths of 52 and 63 inches at 6 psi, and 64 and 67 inches at 12 psi, respectively, for 2008 and 2009. Irrigation rate did not have any significant effect on the depth of water front. While reducing OP significantly reduced the downwards movement of water in the soil, it was not sufficient to keep the irrigated water from moving beyond the crop root zone on a sandy soil.

### Quality and Yield of Hybrid and Heirloom Tomatoes Grown for the Early Market Using Season Extension Structures

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Production in high tunnels offers the potential to improve crop yield and quality, while also extending the growing season. In 2009, a field trial was conducted with three hybrid ('Fletcher', 'Primo Red', and 'BHN 589') and three heirloom ('Cherokee Purple', 'Valencia', and 'Arkansas Traveler') tomato (*Solanum lycopersicum*) varieties to compare production inside high tunnels versus outside. Tomatoes were transplanted into the field and tunnels on 27 Mar., 17 Apr., and 8 May. The plots were managed organically and no pesticides were used in the study. Tomatoes were harvested twice a week for 7 weeks starting 24 June for the March-planted tomatoes. Yield, disease incidence, and fruit quality data were collected. Tomatoes grown inside the tunnels had a significantly lower incidence of early blight than those grown outside. Tomato varieties 'Fletcher' and 'Primo Red' grown inside the tunnels outyielded the same varieties grown in the field. Hybrid tomato plants grown both inside and outside the tunnels had greater yields than

heirloom plants. The earlier plantings (March and April) tended to have higher yield than the May planting. All tomato varieties grown in high tunnels had higher soluble solids values than those grown outside. 'Arkansas Traveler', 'Fletcher', and 'Primo Red' fruit grown inside the tunnels had significantly greater red color (higher absorbance values) than the same varieties grown outside. Lycopene values were significantly higher in 'Cherokee Purple', 'Fletcher', and 'Primo Red' fruit grown inside the tunnels versus outside. High tunnels were found not only to increase yield and decrease disease incidence in tomato, but also to increase fruit sugar content, red color, and lycopene content.

### Effects of Shoot Pruning on Bacterial Spot Infestation on Tomato Cultivars

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Two field trials were conducted to determine the effect of pruning on the incidence of bacterial spot (*Xanthomonas perforans*) and on growth and marketable yields of tomato (*Solanum lycopersicum*). Seedlings of 'Tygress' and 'Security 28' tomato were planted in fumigated beds and submitted to no pruning, light pruning (2 stems left), and heavy pruning (1 stem left) at 3 weeks after transplanting. Plots were left either to natural bacterial spot infestation or inoculated with  $1 \times 10^6$  cfu/mL. The results indicated that the three factors (cultivar, bacterial spot inoculation, and pruning) were not significant for plant height at 6 weeks. There was significant effect of each of the individual factors on total marketable fruit weight, but none of the interactions were significant. 'Security 28' and non-inoculated plants had higher total marketable fruit weight than plots planted with 'Tygress' and inoculated plants, respectively. There was no difference between plots with lightly pruned plants and nonpruned plots, whereas heavy pruning reduced yields by 11% in comparison with no pruning.

### Earth-Kind Tomato Production

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An experiment was conducted in 2009 to evaluate the principles of 'Earth-Kind' rose gardening to a variety of tomato cultivars. The objective of Earth-Kind landscaping is to combine the best of organic and traditional gardening and landscaping principles to create a horticultural system based on real world effectiveness and environmental responsibility. Earth-Kind landscaping encourages landscape water conservation, reduction of fertilizer and pesticide use, landscaping for energy conservation, and reduction of wastes. Six commercial tomato cultivars were grown with 50 lb N preplant fertilizer, one application each of organic and synthetic pesticides as the only inputs. A similar experiment was conducted with standard commercial fertility and pest control. Both experiments were watered regularly according to standard local requirements. Results indicate that most tomato cultivars in the Earth-Kind plot yielded as well as if not better than the commercial plot. There were no differences in disease or insect pressure between the two experiments. This experiment will be repeated in 2010 to calculate the cost of production of the two systems.

### Height Control in Three Pepper Varieties Using Exogenous Abscisic Acid (ABA) Applications

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A greenhouse experiment was conducted to determine height control induced by exogenous application of abscisic acid (ABA) of transplanted pepper varieties. Three varieties of peppers were used in these studies, bell pepper (*Capsicum annuum* L. cv. Aristotle), Jalapeño (*Capsicum annuum* L. cv. Grande) and banana pepper (*Capsicum annuum* L. cv. Pageant). Seeds (Siegers Seeds, Holland, MI) were planted in the greenhouse on 23 July 2009. Jiffy-Pots® (Hummert International, Earth City, MO) were used for planting and were filled with peat moss Canadian Growing Mix 2 (Conrad Fafard

Inc., Agawam, MA). Total pot size was calculated at 473 cc, with a desired drench application rate of 10% of the total pot volume. A drench application rate of 50 cc with the concentration of 250 ppm was used for these treatments. Treatments of 10 different weekly application were single application at week 1 (cotyledon stage), week 2 (cotyledon stage plus 1 week), week 3 (cotyledon stage plus 2 weeks), and week 4 (cotyledon stage plus 3 weeks); double application were made at Week 1 + 2, Week 2 + 3, and Week 3 + 4; and multiple application treatments received ABA at Week 1 + 2 + 3, Week 2 + 3 + 4, and week 1 + 2 + 3 + 4. ABA was obtained from VBC-30101 (10% ABA) (Valent USA, Walnut Creek, CA). Early single dose application (week 1) tend to be more effective at controlling height than single dose applied later (week 2, 3, and 4). Early multiple applications of ABA to seedling bell peppers were effective in reducing transplant height compared to single application. Aristotle continues to show significant effects even after 6 weeks whereas intermediate effects on Pageant fade away in the second week and there is no effect on Grande. In summary, early multiple applications at week 1 (cotyledon stage) should be integrated to keep the plant short. Future studies in this area will include measuring the effect of these treatments when transplants are carried to the field for yield studies.

### Cultivation and Nutraceutical Content of Virginia-grown Edamame

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A variety trial was conducted to determine suitable commercial cultivars of edamame (*Glycine max*) for cultivation in Virginia. The edamame cultivars BeSweet 292, BeSweet 2015, BeSweet 2001, Midori Giant, and Sunrise were grown in Painter, VA, during 2008 and 2009. In the laboratory, lipids, protein, antioxidant capacity, and isoflavones were measured. There were no significant interactions between yield and percent marketable pods and year; therefore data for 2008 and 2009 were combined. 'Midori Giant' and 'BeSweet 292' yielded significantly more than 'BeSweet 2015'. 'Sunrise' produced significantly more marketable pods than 'BeSweet 2001'. There were significant differences in average seed size across cultivars in both years. Cultivar lipid content followed the same patterns in both years, with 2009 having lower overall content than 2008. Protein contents were similar in 2008 and 2009. 'BeSweet 2001' had significantly higher protein content than 'BeSweet 292' in 2008. In 2009 'Sunrise' had significantly higher protein content than all cultivars except 'BeSweet2015'. 'BeSweet 2015' and 'BeSweet 2001' had high radical scavenging ability both years and 'Midori Giant' had the lowest scavenging ability both years. In 2008, there were no significant differences in the ORAC assay. 'BeSweet 292' had significantly more reducing activity than 'Sunrise' in 2009. There were significant differences in cultivar isoflavone concentration. Of all isoflavones, malonyl genistin had the highest concentration in the beans and genistein was not found.

### Control of Spring Weed Populations in Mustard (*Brassica juncea*) Utilizing Preemergence Herbicides

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The objective of this study was to screen several herbicides for potential use in brassica greens production in Oklahoma. Treatments included six different compounds (trifluralin, chlorthal, thiobencarb, ethofumesate, clomazone, prodiamine) alone and in combination for a total of six treatments and an untreated control. All treatments were applied preemergence to the crop except for trifluralin, which was applied as a pre-plant incorporated treatment. Treatment ratings were recorded for phytotoxicity and crop emergence on 2 June 2009, phytotoxicity and efficacy on 17 June 2009. The rating scale used was

a 0 to 100 scale where 0 represents no visible crop damage, weed control or plant stand and 100 represents 100% of the crop or weed species being dead or non-existent or 100% of crop being emerged. Data recorded at harvest included overall plot yields. No differences were observed for crop emergence on 2 June 2009 with emergence ranging from 78% to 97% at that time. Crop injury was highest on 2 June 2009 and 17 June 2009 for clomazone at 0.5 lbs ai/acre. Crop injury on 2 June 2009 ranged from 0 for the untreated control to 60% injury for the clomazone treatment. On 17 June 2009 crop injury ranged between 0 to 33%. Clomazone and ethofumesate had crop injury ratings of 33% and 30%, respectively. Control of Palmer amaranth (*Amaranthus palmeri* S. Wats) on 17 June 2009 ranged from 0 for the untreated control to 100% for trifluralin + chlorthal at 6 lbs ai/acre. Other treatments ranged between 75% to 99% control. Trifluralin + chlorthal at 4 lbs ai/acre, thiobencarb, ethofumesate, clomazone, and prodiamine had efficacy ratings of 99%, 86%, 75%, 94%, 99%, respectively, on 17 June 2009. Yields did not vary significantly on 2 July 2009.

### Breeding Disease-resistant Pumpkins for Georgia

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Pumpkins are an important commodity throughout the United States for fall production. Although pumpkins for processing are produced primarily in the upper Midwest, pumpkins for the fall are produced throughout the United States. Georgia, with less than 500 acres of pumpkin production in 2008, is limited in its pumpkin production because of the high incidence of aphid-transmitted viruses. We have been working for several years on developing pumpkins with higher virus resistance. To this end we have introduced 'Orange Bulldog' (*Cucurbita maxima*), a small to medium size pumpkin that is positioned for the roadside marketer and pick-your-own operation. A plant variety protection certificate was applied for in 2008 and is still pending. The USDA's Plant Variety Protection office has requested additional information. The breeding program continues to move forward with additional goals of developing larger pumpkins of uniform size and color. A variety trial was conducted this past fall that included 34 advanced lines and 10 commercial varieties. The advanced lines averaged yields of 19,129 lbs/acre compared to 9,691 lbs/acre for the commercial entries. In addition, entries were evaluated for variability on a 1-9 scale with 1-highly uniform and 9-highly variable. The commercial entries averaged 2.8 for variability, which is not surprising since they are all F<sub>1</sub> hybrids. Several advanced lines averaged below 5. Future plans include controlled crosses in the greenhouse, additional phenotypic selections, and variety trial evaluations.

### Three-year Study Examining Storability of Sweet Onions Using Various Harvest Methods and Cultivars at Vidalia, Georgia

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Onions were grown in three successive years (1997-1999) on the Bland Farm at Reidsville, GA. Two cultivars were used each year with three different methods of harvesting: harvest by hand, machine harvest without toppler, and machine harvest with toppler. The purpose was to determine if type of handling affected storability (shelf life) of the cured onions (100 °F with forced air flow for 48 hours). Cured onions were placed in 25-lb air flow boxes in an air-conditioned facility at 71 °F. Every 2 weeks beginning with the initial storage time the onions were counted and weighed. Beginning with the first 2-week measurement time, bad onions were removed, weighed, and discarded; while the good onions were counted and weighed, and stored until the next weighing time. This procedure was done until no onions remained. Onions generally did well for 4-6 weeks, and they were down to less than 20% left by week 20. A few onions lasted until 30 weeks. Sweet onions are softer than northern hard onions. They also have lower pungency levels than hard onions. This makes sweet onions more susceptible to diseases like *Botrytis* that invade the onion and rots the onion from the center.

### Snap Bean Nitrogen Management in the Mid-Atlantic

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Over 5,400 acres of snap beans (*Phaseolus vulgaris*) are grown in Virginia per year within the environmentally sensitive Chesapeake Bay watershed. The objective of this study was to pinpoint correct nitrogen (N) rates and application methods for fertilizer sources containing varying amounts of ammonium, nitrate, or other N forms. The experiment was arranged as a factorial arrangement of 3 N rates (40, 80, and 120 lbs N/acre) x 3 N application methods [100% pre-plant incorporated (PPI), 50% at-planting band + 50% side-dress at mid-flower (SDM), and 50% PPI + 50% SDM] x 5 N sources [liquid urea-ammonium nitrate (UAN, 30% N), calcium nitrate (CN, 17% N), ammonium nitrate (AN, 34% N), ammonium sulfate nitrate (ASN, 26% N), and urea + dicyandiamide nitrification inhibitor (UDCD, 46% N)] plus a 0-N control on a Bojac sandy loam. The study was repeated as a spring and fall planting. In no case was an interaction significant at  $P = 0.10$  and only main effects will be discussed. For the spring crop, we suspect that record rain events leached N fertilizer below the root zone as no source had significantly higher yields than the 0-N control, except UDCD (4477 vs. 5639 lbs/acre, respectively). Preplant incorporated (100%) had lower yields than the 0-N control as nodulation was impacted by having fertilizer N available initially but yield suffered as N was lost from the system (3505 vs. 4477 lbs/acre, respectively). The banded at-planting and SDM yield (5122 lbs/acre) was similar to the 0-N control and higher than PPI treatments. Fall treatments suggest that all N sources had statistically similar yields and were higher than the 0-N control (6703 vs. 4296 lbs/acre, respectively). A quadratic relationship indicated that 80 lbs N/acre was optimum for maximum yields (7200 lbs/acre). In conclusion, N source did not matter and producers should be encouraged to use the cheapest N source, in banded split N applications, at 80 lbs N/acre for maximum yield on sandy loam soils in the mid-Atlantic.

### Rootstock Selection Affects Grafted Melons by Impacting Yield and Fruit Quality

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The goal of this study was to determine the effect of grafted melons on fruit internal quality and overall marketable yields. Grafted plants were evaluated in the field, both spring of 2009, at the Coastal Research and Education Center of Clemson University located in Charleston South Carolina. Rootstocks used were: Dinero (wild melon hybrid), Storg Tosa (inter-specific squash hybrid), and Kazako (inter-specific squash hybrid). The scion material consisted of cultivars: Athena, Aphrodite, Strike, and Grand Slam (all cantaloupe hybrids). All plots were 40 ft long, 2 ft between plants, with 9 ft between rows, replicated five times, transplanted 15 Apr. Fruit was harvested for a period of 4 weeks beginning 22 June. Fruit were harvested at full slip (Monday, Wednesday, and Friday) and categorized as marketable if they weighed above 4 lb. Fruit were graded according to the U.S. Department of Agriculture (USDA) grading standards for all melon fruit. Rootstocks effected total fruit number, total fruit weight and average fruit size. However, the rootstocks chosen greatly affected the cultivars performance. The rootstock Kazako significantly increased earliness, larger fruit size, and total fruit number and weight. The rootstock Strong Tosa significantly increased earliness and total fruit number and weight but did not affect fruit size, Rootstock Dinero significantly delayed harvest over the non grafted control and had no affect on fruit size, and overall fruit number and weight. Cultivars reacted differently to grafting by affecting overall yields and individual fruit size. Internal fruit quality (soluble solids, firmness, and cavity size) was not influenced by grafting.

### Evaluation of Reflex in Watermelon, Squash, and Pepper

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Reflex (fomesafen) is a preplant, preemergence, or postemergence herbicide by Syngenta used for control of broadleaves, grasses, and

sedges. An experiment was conducted in 2009 at Texas A&M Horticulture Farm to evaluate preemergence and postemergence treatments of Reflex on pepper, squash, and watermelon. The pepper experiment consisted of Reflex 16, 20, 24, 32, and 48 fl. oz/A applied alone and 16 and 24 fl. oz/acre applied in combination with Dual Magnum (s-metolachlor) 16 fl. oz/acre. The Reflex alone treatments were similarly applied in the squash and watermelon experiments. However, Reflex was additionally applied at 24, 32, and 48 fl. oz/acre postemergence at 2 weeks after transplanting. There was no observed visual injury to all crops at all Reflex rates and all times of applications. There were no statistical differences among all treatments of Reflex applied alone or in combination with Dual Magnum. Only two treatments were statistically higher than the untreated control, namely Reflex 48 fl. oz/A and Reflex 24 plus Dual Magnum. Squash yields were highest with the three highest Reflex rates of 24, 32, and 48 fl. oz/acre. Similar rates of Reflex applied postemergence were lower and not statistically different from the untreated control. Similar trends were observed in the watermelon experiment with Reflex 32 and 48 fl. oz/acre statistically higher than all other treatments applied pre-transplant or postemergence. Reduced squash and watermelon yields were due to severe weed pressure. Reflex appears to be safe to these vegetable crops with no observed yield reduction even with minor leaf burn following postemergence application.

### Developing Cantaloupe Lines with Resistance to Multiple Vine Decline Pathogen

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Vine decline of western shipper cantaloupe melons is incited by a complex of soilborne fungal pathogens in southern Texas and other warm regions worldwide. Melon cultivars resistant to three races of Fusarium wilt have been developed at Texas A&M University, AgriLife Research at Weslaco and deployed since the late 1960s. However, the most serious vine decline pathogens for most southern Texas production regions are currently *Monosporascus cannonballus* and *Didymella bryoniae*, causing root rot and gummy stem blight, respectively. The melon breeding program at TAMU has devoted extensive resources to screening germplasm, verifying resistance and developing novel breeding lines with improved quality during the past 12 years. We have identified resistance to *Monosporascus* root rot after screening nearly 1000 melon accessions and cultivars from around the world, utilizing both infested field plots and controlled inoculation. The most resistant PI lines: 140632, 165449, 124104, 212210, 20488, and 20598 have been used as parents to cross with more than 30 elite western shipper lines or F1 cultivars. A recurrent selection program has been conducted to create resistant cantaloupe lines. Additionally, backcrossing up to 5 times has been conducted, followed by selfing and selection for resistance at each generation, to introgress the quantitative resistance to root rot and vine decline. Currently, lines with excellent resistance and good quality fruit are being tested as parents for F1 hybrid cultivar development. The same approach has been utilized for development of gummy stem blight resistant lines. The resistance does not follow a simple inheritance model as has been proposed, but within more than a dozen families, demonstrates the continuous phenotypic expression of a quantitative trait. Combining three different resistance sources has provided the best results following controlled inoculations in both field and greenhouse plots. Extremely virulent isolates of the fungus have been identified from growers' fields, and maintained at Weslaco. Families have been developed to combine the resistance genes for both diseases and test hybrids are currently being generated for commercial trials in Texas.

### Efforts to Improve Sulfur Nutrition in Sandy Soils

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Soil testing can provide useful information on the amount of plant-available S present in the soil. Currently, there remains to be no reliable correlation between soil extractable S and plant yield potential under field conditions. In Florida, current recommendations for S applications are based upon deficiency diagnosis within plant tissues. Positive yield responses to S applications have been found in tomato (*Solanum lycopersicum*). Therefore, finding a soil test that may help determine if S applications are necessary before crop planting would be highly useful. In addition, for tomato and other vegetable crops, a recommended universal soil test that includes S determination is lacking. Therefore, the objectives of this study were to 1) compare ICP-OES, turbidity, and LECO-S methods over selected soil samples; and 2) compare these soil S and SO<sub>4</sub>-S methods to total S in plant tissues. Fifty-two paired soil and tomato leaf samples were collected on 16 May 2007 for total S and SO<sub>4</sub>-S determination. Soil extracting solutions used were Mehlich-3, de-ionized water, and 0.025 M KCl in conjunction with ICP-OES and turbidimeter. Dry samples of soil and tomato leaf were used for the LECO. Plant leaf samples were digested using 30% H<sub>2</sub>O<sub>2</sub> and HNO<sub>3</sub> for ICP-OES. Data were analyzed using linear regression models and comparing against an ideal linear regression line with a slope of 1 and an intercept of 0. All relationships between various soil extraction solutions and plant tissue S were found to be variable. Only four had significant linear regression models. Low R<sup>2</sup> values (less than 0.70) were found for all significant relationships between soil SO<sub>4</sub>-S, total soil S, and plant tissue S. Therefore, it is suggested that current Florida recommendations of S using plant tissue testing and application of 28 to 37 kg-ha<sup>-1</sup> S when S deficiency is diagnosed continued to be utilized.

### Soil Persistence of Dimethyl Disulfide Fumigant due to Application Rate, Chemical Formulation, and Plastic Mulch Type

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Field studies were conducted to determine the effect of totally impermeable film (TIF) on dimethyl disulfide (DMDS) and dimethyl disulfide plus chloropicrin (DMDS:Pic 79:21) retention, and yellow nutsedge (*Cyperus esculentus* L.) control. Two separate experiments were conducted in the summer of 2009. These experiments compared multiple rates and formulations of DMDS under TIF and VIF (virtually impermeable film). In addition several herbicides were tested for yellow nutsedge control. The treatments for the first experiment were an untreated control, a high rate of DMDS:Pic (60 GPA) under VIF, various rates (30, 40, 50 GPA) of DMDS:Pic under TIF, and pure DMDS (43 GPA) under TIF. All DMDS treatments were shank applied for the first experiment. In the second experiment all DMDS treatments were emulsifiable concentrate (EC) formulations applied through two drip tapes, except where noted. Treatments for the second experiment included an untreated control, a preplant application of napropamide, a pre plant application of fomesafen followed by a postemergent application of halosulfuron, DMDS:Pic (50 GPA) shank applied under VIF, DMDS:Pic (50 GPA) under TIF, and DMDS:Pic (60 GPA) by itself or with a pre plant application of napropamide under VIF. VOC (volatile organic compound) readings were taken daily at the bed surface utilizing 4 inches of headspace using a Minirae 3000. TIF retained DMDS:Pic at higher levels than VIF for longer periods of time. Shank applied DMDS:Pic at a rate of 50 GPA required 30 days to dissipate. Pure DMDS dissipated more quickly than DMDS:Pic at similar rates. Under TIF, low rates of DMDS dissipated faster than high rates. All fumigants and pre plant applications of fomesafen followed by halosulfuron post emergence controlled yellow nutsedge better than the untreated control and pre plant applications of napropamide. The use of 50 GPA DMDS:Pic applied as an EC under TIF controlled

nutsedge as well as 60 GPA DMDS:Pic applied as an EC under VIF and 50 GPA DMDS:Pic shank applied under VIF. The use of TIF appears to maintain fumigant efficacy while using reduced application rates. It is unclear how much rates can be reduced at this point but the future use of TIF mulch may have broad implications for buffer zones as well as personal protective equipment associated with fumigation.

### Relative Abundance of Weeds in Organic, Reduced-till Broccoli Production Utilizing Living Mulches

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Utilization of reduced-tillage and living mulches offers potential benefits for weed management in organic systems. In early season vegetable production, living mulches can provide a sustainable alternative to cultivation and tillage. However, the successful use of living mulches has been limited due to inadequate suppression of weeds or competition with the main crop. Experiments were conducted with 'Belstar' broccoli in Knoxville, TN in Spring 2009 to determine the effect of tillage (main plots: conventional tillage and strip-tillage) and living mulch [subplots: annual ryegrass (*Lolium multiflorum*), red clover (*Trifolium pretense*) and bare ground] on weed suppression. Weed stem counts were collected from a 0.25-m<sup>2</sup> sample over an 8-week interval. Relative abundance values were calculated for each species. Relative abundance is a measurement used to rank species, according to their overall occurrence relative to all other species observed. Values varied by weed species, indicating each species was uniquely impacted by the treatment combinations. Tillage effects were significant for grass species only [crabgrass (*Digitaria sanguinalis*) and bermudagrass (*Cynodon dactylon*)], while living mulches only affected carpetweed (*Mollugo verticillata*). Treatment interaction affected 3 of 17 weed species observed [crabgrass, carpetweed, and spurge (*Euphorbia maculata*)], with no clear trends observed. Crop stand was evaluated using the linear transect method. Data indicated poor establishment of red clover, with no difference observed between red clover and bare ground controls. Results were consistent across tillage treatments. Establishment of ryegrass differed between tillage treatments, with significantly greater cover offered in tilled than strip-tilled plots. Results suggest that reduced-tillage and living mulches can reduce the relative abundance of specific weed species, but may not decrease weed pressure for all species present in a cropping system. Furthermore, some living mulches may be better suited than others for use in reduced-tillage situations.

### Effects of High Tunnels on Strawberry Growth, Yield, and Postharvest Quality in Florida

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Two studies were conducted to compare the effects of high tunnel and open-field production on the growth, fruit earliness and yield of strawberry cultivars and to evaluate postharvest quality of strawberries. Six treatments resulted from the combination of three strawberry cultivars and two production systems. The production systems were high tunnels and open fields, while the tested cultivars were 'Strawberry Festival', 'Winter Dawn', and 'Florida Elyana'. Production systems and cultivars significantly affected strawberry early and total yields, but the interaction between both factors was not significant. Early yields increased by up to 54% inside the high tunnels in comparison with those from the open fields. Strawberry total marketable yields maximized inside the high tunnels in comparison with the open fields, with up to 63% fruit weight increments. Among the cultivars, 'Strawberry Festival' produced the highest early and total marketable yields, followed by 'Winter Dawn' and 'Florida Elyana'. These findings indicated that the protective environment improved strawberry fruit earliness and total yield under Florida conditions. Fruit yields after freezing, storability, and soluble solid contents were also increased inside the high tunnels. These results showed that planting

strawberry cultivars under high tunnels has a major influence on the growth and development of strawberry. Several environmental factors likely influenced these responses: 1) high tunnels protected the flowers and small fruit against the effects of hard freezes; 2) flowers and fruit were not exposed to sprinkler irrigation damage during freezing events; and 3) high tunnels protected fruit against rainfall. Although a detailed economic analysis is needed, the use of high tunnels in Florida for strawberry production might benefit growers by improving earliness and providing a competitive edge in the market, as well as reducing the use of sprinkler irrigation for freeze protection, hence reducing fruit damage and fuel or electricity costs, and reducing the incidence of foliar and fruit diseases.

### Influence of Irrigation Programs on Strawberry Cultivars

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A field trial was conducted to determine the effects of irrigation programs on the yields of 'Strawberry Festival' and 'FL-99-117' strawberry (*Fragaria xananassa*) cultivars. The irrigation programs consisted of six combinations of water volumes and frequencies of irrigation. The water volumes were 7, 14, and 21 acre-inch/acre per season, and the frequencies were one and two cycles per day. There was no significant effect of the irrigation programs on 'FL-99-117' growth and early and total yields, whereas 'Strawberry Festival' yields were influenced by the watering programs. For early yields (first 10 harvests), there were no differences among treatments, regardless of water volume or frequency of irrigation. Total yields were influenced by water volumes when two irrigation cycles per day were used, increasing from 10.8 to 13.2 ton/acre with 7 and 14 acre-inch/acre per season. There were no significant changes in total yields when one irrigation cycle per day was used, averaging about 12.2 ton/acre. It appears the crop could be irrigated with 7 acre-inch/acre per season during the first 8 weeks without significantly reducing early yields.

### Effects of Planting Density and Apical Removal on the Performance of *Crotalaria juncea* for Horticultural Systems

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The cover crop *Crotalaria juncea* was planted to determine the effect of planting density and apical cutting on weed suppression and biomass production. The experiment was conducted in Apr. 2009 at the University of Puerto Rico Agricultural Experimental Station in Lajas, Puerto Rico. A South African accession of *C. juncea* was planted at 3 densities (10, 25, and 40 lb/acre) and with 4 apical cutting treatments (no cut, cut at 3, 4, and 5 weeks after planting), for a total of 12 treatments. For apical cutting, 1-2 inches were cut from the principal apex of each plant. Plots were 20 ft x 6 ft and a randomized complete-block design with four replications was used. At 4 and 8 weeks after planting, weed samples were collected from a representative area of 1.5 ft x 1.5 ft within each plot. These were cut at soil level and categorized by grass, broad leaf, and sedge. Biomass was assessed by collecting 4 plants/plot (cut at soil level) at time of flowering and post-harvest. Dry weight was taken for all samples and an analysis of variance was conducted ( $\alpha = 0.05$ ). For both weed suppression and biomass production, there was no significant interaction found between planting density and apical cutting. At 4 weeks after planting, there were no differences amongst weed categories. Eight weeks after planting there was suppression of broad leaf weeds at a density of 40 lbs/acre, as compared to 10 lbs/acre. For biomass, on both sampling occasions biomass was significantly higher at densities of 25 and 40 lbs/acre. The dry weight of the biomass at flowering was 5354.34 and 6280.52 lbs/acre, respectively, as compared to 3086.23 lbs/acre at a density of 10 lbs/acre. Higher planting densities showed a positive effect on the suppression of broad leaf weeds and increased biomass production.

However, in terms of this experiment, planting at 40 lbs/acre showed no significant benefit over planting at 25 lbs/acre. Apical cutting treatments did not result in any significant changes or interactions.

### Effects of Irrigation Rates on Soil Moisture Content and Fruit Yield and Quality in Seedless Watermelon

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Overirrigation in watermelon is frequent due to inadequate irrigation scheduling, resulting in water waste and nutrient leaching. The objective was to evaluate the effects of irrigation rates on soil moisture content, and fruit yield and quality in watermelon. The experimental design consisted of a randomized complete block with five treatments [irrigation rates (33%, 67%, 100%, 133%, and 167% the rate of crop evapotranspiration)] and four replications. We used a seedless watermelon cultivar ('Tri-x 313' as female, and 'Ace' as the pollenizer) that is commonly grown in the southeastern U.S. The trial was conducted in Tifton (sandy loam soil) and Camilla, GA (loamy sand soil) in the spring of 2009. The mean volumetric soil moisture content at a soil depth of 10 cm increased with the irrigation rate. The average soil moisture content over the season for the irrigation rates was 8.5% (33% ET), 10.7% (67% ET), 9.3% (100% ET), 13.1% (133% ET), and 13.6% (ET). Fruit yields and average fruit weight were not significantly affected by irrigation rate; however, they tended to be lowest at the lowest irrigation rate (33% ET). The concentration of fruit soluble solids slightly decreased with increasing rates of irrigation. The results suggest that there is potential to reduce the current rates of watermelon irrigation and thus increase the water use efficiency without significantly affecting fruit marketable yields and quality. Fruit yield and quality of watermelon plants irrigated with 67% ET were similar to those of plants irrigated at higher irrigation rates. Acknowledgements: We thank the U.S. National Watermelon Association for kindly supporting this research project.

## Vegetable Crops Section—Cowpea

### Virus Survey of Commercial Cowpea Fields in the U.S. and Evaluation of the Core of the USDA Cowpea Germplasm Collection for Resistance to Tomato spotted wilt virus

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Cowpea (*Vigna unguiculata*) is an important vegetable crop in the southern United States. Cowpea plants are susceptible to over 20 viruses and many of them are seed-borne. A survey was carried out to evaluate the current virus status in commercial cowpea fields in five states (MO, NM, SC, TN, and TX). A total of 211 leaf samples were collected and used to test by enzyme-linked immunosorbent assay (ELISA) for the presence of 14 viruses. The following eight viruses were identified in the commercial fields: *Alfalfa mosaic virus* (AMV), *Cucumber mosaic virus* (CMV), *Cowpea aphid-borne mosaic virus* (CABMV), *Cowpea chlorotic mottle virus* (CCMV), *Southern bean mosaic virus* (SBMV), *Tobacco mosaic virus* (TMV), *Tobacco ringspot virus* (TRSV), and *Tomato spotted wilt virus* (TSWV). The survey results confirmed the presence of TSWV on cowpea in the U.S.; in addition to confirming the original report from New Mexico, TSWV was also found in Tennessee and Missouri. The incidence of CMV infection was high, especially in South Carolina, where all plants sampled were infected. However, incidence of viral infection in commercial cowpea fields by other viruses was low (1% to 4%). Probably due to the wide use of certified seeds in recent years, *Blackeye cowpea mosaic virus* was even not detected. The core of the USDA cowpea germplasm collection (677 accessions) was evaluated for TSWV resistance using a tomato strain of TSWV. The TSWV infections were restricted to the inoculated tissues (cotyledon or leaf);

newly developed leaves on the inoculated plants did not exhibit TSWV symptoms. Future effort in screening should focus on using the cowpea-infecting strain of TSWV.

### An Overview of the Current Status of Southernpea Breeding Programs in the United States

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American horticulturists use the term southernpea when referring to any type of cowpea being grown as a vegetable crop. Several types of southernpeas, e.g., pinkeye peas, blackeye peas, crowder peas, cream peas and snap peas, have a long history of use in the southern United States. An extensive industry exists to supply the canned and frozen peas that are marketed nationwide. The crop is also a popular home garden and market garden item in all of the southern states from Texas through the Carolinas and Virginia. Plant breeders employed by public agencies have played a major role in supporting the vitality of the industry by developing southernpea cultivars with the needed disease and pest resistance, stress tolerance, and horticultural traits. There are a number of suitable cultivars now available for most production sites. However, public support of southernpea breeding programs has been on a steady decline in recent decades. In 1970, Auburn University, the University of Arkansas, the University of Florida, the University of Georgia, Clemson University, Louisiana State University, Mississippi State University, Texas A&M University, the Virginia Truck & Ornamental Research Station, and the USDA Vegetable Laboratory in Charleston, SC, each supported a recognized southernpea breeding program. Of the 10 public breeding programs active in 1970, only three are still active today, and expected retirements of southernpea breeders might reduce the number of active programs to a single program in the near future. It is doubtful that a single southernpea breeding program can address all of the future cultivar development needs of the home garden, market garden, canning, and freezing segments of the industry.

### Comparison of Cowpea (*Vigna unguiculata*) Breeding Lines and Cultivars for Tolerance to Halosulfuron and Sulfentrazone

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A unique approach to identifying new compounds for weed control in crops is screening existing cultivars and breeding lines for tolerance to compounds labeled for other crops. There are numerous herbicides registered for weed control in soybean (*Glycine max* L.) and corn (*Zea mays* L.). Two of these compounds, halosulfuron (Sanda) and sulfentrazone (Spartan), have proven to be effective in the control of several warm-season broadleaf weeds in Oklahoma and surrounding states. Based on previous work in Arkansas, collaborative studies with University of Arkansas were completed in 2006 to determine the tolerance of advanced breeding lines (ABL) and cultivars to halosulfuron and sulfentrazone. Nine ABLs and 'Early Scarlet' were compared for tolerance to halosulfuron at 0.048 and 0.096 lb ai/acre, four ABLs and six cultivars were compared for tolerance to sulfentrazone at 0.1875 and 0.375 lb ai/acre. All treatment and non-treated plots for each ABL and cultivar in both studies received a pre application of S-metolachlor (0.75 lb ai/acre) + imazethapyr (0.063 lbs ai/acre) following planting prior to treatment application. Overall yields and visual ratings were recorded for crop injury and flowering in each study where 0 = 0% injury or flowering and 100% = complete death of the crop or complete flowering. Crop injury in both studies was  $\leq$ 15% on 10 July 2006 for all ABLs and cultivars and herbicide rates. On 25 July 2006, injury from halosulfuron was  $\leq$ 3% for all treatments and ranged between 0 to 22% for sulfentrazone treatments. Yields were highest for ABL 01-174 in the halosulfuron study and for ABL 92-551 in the sulfentrazone study. Complete reports of these studies can be found at: <http://www.hortla.okstate.edu/pdf/06vegreport.pdf>.

# Vegetable Crops

## Section—Sweetpotato

### Destructive and Useful Insects in Sweetpotato Breeding Nurseries

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Sweetpotato polycross nurseries depend on natural pollination by bees and other insects. Unpollinated flowers dehisce and do not produce seeds, thus it is important to protect natural bee populations to ensure maximum seed production. There are several other insect species that frequent sweetpotato seed nurseries that are quite destructive. Foliar feeders, such as armyworms, tortoise beetles, and the sweetpotato hornworm can cause significant damage to sweetpotato plants, but they are usually easily controlled. Of much more concern at the U.S. Vegetable Laboratory in Charleston, SC, is the potato leafhopper. These insects reach high numbers, and if not controlled they can severely stunt or kill the sweetpotato plants in a polycross nursery. They are also difficult to manage because most of the insecticides used to control them are also toxic to bees. Sprays of materials with a short residual activity should be applied in the afternoon after the sweetpotato flowers close and fewer bees are present.

### Evaluation and Selection of Sweetpotato Germplasm for Bioethanol Production

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While the US has 3% of the world's oil reserves, it consumes 25% of the total output, resulting in higher prices for imported oil. In addition, oil consumption causes air pollution, smog-filled cities, and global warming. Investment in alternative renewable forms of energy, such as from biomass other than corn could reduce the conflict between the crop as food or energy. One such crop is the sweetpotato, which is high in dry matter and starch, and the white-fleshed varieties are not generally used as food in the US. Replicated variety trials were conducted to evaluate 28 sweetpotato accessions from around the world, based on yield, percent dry matter, harvest index and latex production as potential feedstocks for bioethanol production. Results indicate that percent dry matter ranged from 22% for High Dry 055A to 41% for TU09 while storage root yield ranged from 12 for WS149 to 49.5 kg/ha for W308. Harvest index ranged from 56.8% for Hidry047-05 to 84.0% for BM8542199-05 and was positively correlated with storage root yield and negatively correlated with dry foliage yield. Seventeen accessions had little latex, nine had some, and two had abundant latex. It appears that the relationship between percent dry matter and storage root yield depended on accessions in that dry matter and root yield were inversely related among many of the accessions.

### Screening Sweetpotato Breeding Clones as a Suitable Potential Source of Feedstock for Bio-ethanol Production

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Global climate is affected by the use of fossil fuels, mainly through release of carbon and other noxious gases of combustion. One approach being explored is the use of bio-fuels from biomass, which adds little or no CO<sub>2</sub> to the atmosphere. Sweetpotato storage root carbohydrate and ethanol yield, are approximately three times that of corn and white-fleshed high dry matter clones are less likely consumed as food in the. Experiments were conducted to screen 10 sweetpotato cultivars for ethanol production based on extractable starch yields, dry matter content, amylose-amylopectin ratios and ethanol yields. Samples of sweetpotato slurry comprising a solids/liquid ratio of 0.12 were

hydrolyzed using diastatic barley malt and fermented with yeast (*Saccharomyces cerevisiae*) for 40-h at 28C. Results show that amylose/amylopectin ratio ranged from 0.24 to 0.44, dry matter from 19.6% to 35.9%, extractable starch yield from 10.9% to 25.3%, and ethanol yield from 32.4 g/L for Beauregard to 66.0 g/L for W308. There was a strong positive correlation between dry matter and starch, dry matter and ethanol yield and between starch and ethanol yield indicating for example that dry matter could be a predictor of both extractable starch and ethanol yield.

### In silico prediction and characterization of microRNAs from Sweetpotato [*Ipomoea batatas* (L.) Lam.]

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MicroRNAs (miRNAs) are a new family of small RNA molecules (21-24 nt) found in animals and plants and are involved in gene regulation through translation inhibition, mRNA cleavage, or directing chromatin modifications. Their existence in sweetpotato [*Ipomoea batatas* (L.) Lam.] is unknown. Using previously known miRNAs from *Arabidopsis*, *Solanum*, and other plant species, we carried out extensive computational analysis to mine sequences mainly coming from root, leaf and stem libraries. Root sequences are from expressed sequences tags (ESTs) from public databases (total 22,626 sequences from Genbank, Release 172.0) and the rest of sequences (415,619 sequences) are unpublished (R. Schafleitner, personal communication). We identified 116 sequences representing 27 miRNA families for sweetpotato. The potential miRNA targets identified belong to gene families with different biological functions, including the control of plant development, signal transduction, transcription, metabolism pathways, and responses to environmental stress. Nine miRNAs were selected as preliminary candidates for study. The objective is to characterize the expression and role of these candidates in sweet potato root development.

### Yield and Quality of 'Evangeline', 'Hatteras', and Other Mainstream Sweetpotato Clones in North Carolina

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Two sweetpotato clone evaluation tests were conducted with the primary objective being to compare the newly released 'Evangeline' and 'Hatteras' with other commercially produced clones grown in North Carolina. A total of eight clones were compared; 'Beauregard 94-14', 'Beauregard 94-24', 'Carolina Ruby', 'Covington', 'Evangeline', 'Hatteras', 'Jewel', and 'O'Henry'. Clone treatments were arranged in a randomized complete block design and replicated 4 times at the research station in Clinton, NC and grower site in Four Oaks, NC. Roots were harvested 123 days after planting (DAP) at the Four Oaks site and 122 DAP at Clinton. Yields of all clones averaged an 87% increase across clones at Clinton than those harvested at Four Oaks. Similarly, a 317% increase in average jumbo yields was obtained at the Clinton site in jumbo grade roots when compared across clones. Total marketable yields ranged from 24.2 to 42.7 MT/ha at Four Oaks, while yields ranged from 47.8 to 68.5 MT/ha at Clinton. 'Beauregard' B-14 and B-24, and 'Hatteras' were generally the top yielding clones of marketable roots (US No. 1, canner, and jumbo). 'Evangeline' and 'O'Henry' were typically the lower yielding clones.

### Response of 'Hatteras' Sweetpotato to Various Nitrogen Fertilizer Application Methods and Rates

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The goal of this study was to determine the response of 'Hatteras' to nitrogen (N) rate, one-time versus split application and compare it to recommended rates used for production of 'Beauregard' (67 kg/ha 10 days after planting (DAP) and 'Covington' (101 kg/ha total, 50.5 kg/ha

10 and 28 DAP). Rates applied for 'Hatteras' production treatments were 0, 34, 67, 101, and 135 kg/ha. All of the fertilizer was applied either at one time approximately 10 DAP, or as a split application (half of the total seasonal rate was applied 10 and 28 DAP respectively). A complete randomized block design with four replications was used. Two tests were planted, one in Bailey, NC, the other in Kinston, NC. Roots were separated into US No. 1, canner and jumbo roots and yield determined for each category. At the Kinston location, yields for 'Beauregard', 'Covington', and 'Hatteras' varieties were generally highest at the zero N rate. This likely indicates that the soil was rich in N. In a lighter, sandier soil in Bailey, numerically, yields were greatest at the recommended N fertilization programs for 'Beauregard' and 'Covington'. 'Hatteras' generally yielded more number one roots than the other varieties. At Kinston when N was apparently plentiful, when various N rates were applied one time to 'Hatteras', yields were similar when 0, 34, or 67 kg/ha were used. Yields were reduced when all fertilizer was applied at 101 and 135 kg/ha. At Bailey with sandy, light soils, the 135 kg/ha rate resulted in reduced yield of no. 1 'Hatteras' roots. When applications were split, this almost always resulted in better root enlargement, regardless of N rate. It is apparent that 'Hatteras' is a good N scavenger like 'Beauregard'. Yields and earliness are promoted when 67 kg/ha N is applied as a split application, with the 34 kg/ha apparently being sufficient in soils containing relatively high levels of N.

#### **Yield Response of 'Evangeline' and 'Covington' Sweetpotato to Various Potash Carriers and Rates**

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Sweetpotato tests were conducted to evaluate response of potash carrier, rate and method of application in two North Carolina studies and one Louisiana study in 2009. There were two primary potash carriers; sulfate of potash (SP, 0-0-50), potassium chloride (KCl, 0-0-60), and KMag (0-0-22) which was blended with SP or KCl. Rates of potash applied per acre were 80, 160, and 240 lb of each carrier or a blend of one-half of each carrier with K-Mag. A no potash treatment was included as the control. The fertilizer was applied two times, one-half of the treatment rate was applied pre-plant, one-half at laybe approximately 28 days after planting (DAP). A one-time treatment of the various carriers alone or in combination with K-Mag was applied pre-plant at 160 lb potash per acre. 'Covington' and 'Evangeline' varieties were grown in the North Carolina studies, while 'Beauregard' and 'Evangeline' were grown in the one Louisiana study. Many of the sweetpotatoes rotted in Louisiana with the 'Beauregard' having tremendous root loss due to excessive moisture. Thus, the results will focus on the North Carolina studies. Yield of number one and canner grade roots were greater for 'Covington' than 'Evangeline'. However, 'Evangeline' had greater jumbo yield than 'Covington' indicating that the former had roots bulk up more quickly than 'Covington'. Total marketable yield was better with 'Evangeline' than 'Covington' because the former had considerably greater quantities of jumbo roots produced. There were sporadic statistical differences between given potash treatments; however, consistent differences between treatments in the two test locations for specific treatments was not apparent. The no potash application treatment was usually one of the lowest yielding treatments; however, some high rate potash treatments (240 lb/acre) yielded similar to the no potash treatment. There were no obvious differences between potash carrier or rate. One time application or two applications at the recommended 160 lb/acre rate resulted in similar yields for each grade and for total marketable yields. From this research, which had fields that had relatively low levels of potash, it appears that application of potash played a limited role in yield enhancement. Uses of continued low levels of potash in fields over time may play a more critical role as potash levels are depleted over time. This will require more research but is an important economical consideration given the high costs of potash fertilizer.

#### **Sweetpotato Production in Israel**

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Sweetpotato is a minor export vegetable grown in two divergent production regions. Acreage and export volume, mostly to Europe, is increasing, but land for further expansion is a constraint. The industry relies exclusively on the 'Georgia Jet' variety, which produces high yields and a consistent shape; however, it does store poorly and the industry has difficulty in meeting a 12-month supply to markets.

#### **Methyl Bromide Fumigation Alternatives for Sweetpotato Hotbeds in California, Year 2**

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Alternative fumigants were evaluated in a commercial hotbed operation near Atwater, CA, using a randomized block split-plot design with three replications. Main plots consisted of six fumigation treatments: 1) untreated control; 2) MeBr + Pic 53/47% at 350 lbs/acre; 3) Pic-Chlor 60 (1,3-D + Pic) at 45 gal/acre; 4) metam sodium 40 gal/acre + 1,3-D 12 gal/acre shanked, incorporated, and rolled; 5) Pic only at 150 lbs/acre; 6) flat solarization. Split-plot treatments include two different fungicides and herbicides: Devrinol (napropamide) 4 lbs/acre; Valor (flumioxazin) 1.5 oz/acre; Botran (dichloro nitroaniline) 3.5 lbs per 14 gal per 1000 sq ft; Mertect (thiabendazole) 30 fl oz per 14 gal per 1000 sq ft; fungicide + herbicide combination; untreated control. Fumigation and solarization treatments were installed in Summer and Fall 2008; herbicide and fungicide applications were made after bedding in Mar. 2009. Plots were evaluated for weed pressure, nematodes, root rotting caused by *Pythium* fungi, and plant production. Research thus far has shown weeds to be the main pest issue sweetpotato growers must contend with in the hotbed area. As a result, the Telone + Vapam treatment has been the most effective and economical alternative to MeBr. Unfortunately, solarization has not been that effective in suppressing weed populations, probably a result of the length of time between treatment in the summer and bedding the following spring. The use of pre-plant herbicides Devrinol or Valor significantly improved weed control, especially in the Pic only, solarization, and untreated alternatives. However, Valor caused some noticeable crop phytotoxicity, with a corresponding reduction in plant production. Even with this, plant production was excellent in 2009, with 240–280 plants per 4 ft<sup>2</sup>. No crop phytotoxicity was seen as a result of the main plot fumigation treatments. A third year for this trial is planned.

#### **Sweetpotatoes as an Industrial Feedstock: An Overview of Research and Development Activities at NC State University**

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Sweetpotatoes have considerable potential as a feedstock for the production of bio-renewables such as ethanol and plastics. Compared to many other crops, sweetpotatoes are easy to grow and can produce substantial biomass yields with minimal inputs. For example, several University and USDA-ARS studies have demonstrated that sweetpotatoes can produce bioethanol yields of 4500-6500 L/ha, in contrast to only 3000-3500 L/ha for corn. From a production standpoint, farmers in the southeastern United States currently grow 74% of the countries sweetpotato tonnage, and there is well-developed research and extension support for the industry. This makes the region well placed to rapidly adopt sweetpotatoes as a bio-renewable feedstock. This is in contrast to other potential biomass crops. There is also a precedent for the development of a commercial industrial sweetpotato industry, in the form of existing industries in China and Japan. In 2008, with start-up funding from the Biofuels Center of North Carolina, a 3-year project was established at NC State University to pursue the development of an industrial sweetpotato production

system. The aim of this project is to address the major hurdles to utilizing sweetpotatoes as an industrial feedstock. Our areas of research include: breeding high-yielding and high-starch sweetpotato clones; evaluating if it is feasible to produce sweetpotatoes using cut seed piece planting technology; and developing mechanical harvesting and inexpensive storage. This talk will provide an overview of the current project and a summary of the project outcomes to date.

#### **Potential Products for Use in Sweetpotato Production**

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In 2009, research studies were initiated to evaluate various plant nutrient and soil amendment products marketed to the sweetpotato industry. These studies were located at the Pontotoc Ridge-Flatwoods Branch Experiment Station, Pontotoc, MS, and the Sweetpotato Research Station, Chase, LA. Treatments included, a Standard fertilizer program (soil test recommended NPK), Hydra-Hume 60lb/ac, Asset sprayed on slip-ends prior to planting (1 qt/acre rate), BM-86 15 DAT (3 pt/acre rate), BM-86 15 and 30 DAT (3 pt/acre rate), BM-86 30 and 45 DAT (3 pt/acre rate), Hydra Hume 60 lb pre + BM-86 15 and 30 DAT (3 pt/acre rate), Hydra Hume 60lb pre + Asset on slip-ends (1qt/ac rate), Hydra Hume 60lb pre + Asset on slip-ends + BM-86 15 and 30 DAT (1 qt/acre rate), (3 pt/acre rate). Pontotoc results, US No. 1 yield ranged from 218 to 585 boxes/ac for the Standard and Asset on slip-ends, respectively. Yield with Asset on slip-ends was greater than seven other treatments. Percentage of US No. 1 yield was highest for Hydra-Hume + BM-86 at 15 and 30 DAT (75.3%), and lowest for the Standard (62.2%). Total marketable yield ranged from 357 to 818 boxes/acre for the Standard and Asset on slip-ends, respectively. Chase results, US No. 1 yield ranged from 357 to 549 boxes/acre for Hydra Hume 60 lb + Asset on slip-ends and Hydra-Hume +BM-86 at 15 and 30 DAT, respectively. Total marketable yield ranged from 834 to 1140 boxes/acre for Hydra-Hume 60 lb/acre and Asset on slip-ends, respectively. The best treatments across locations for US No. 1 yield were Asset applied to slip-ends and Hydra-Hume applied alone or partnered with BM-86. Total marketable yield was the highest with Asset applied to slip-ends at both locations.

#### **Physiological Differences of Sweetpotato Varieties Subjected to Water Stress**

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Soil-plant-water relationships were investigated on sweetpotato varieties to determine traits that can be associated with drought tolerance. Potted plants, 4 weeks old, were subjected to water stress for 1 to 3 days until wilting under greenhouse conditions (18 to 32 °C). The effect on stomatal conductance that influences leaf transpiration and photosynthesis was measured and associated with volumetric soil moisture and plant water status (water potential). Leaf moisture content was determined also. Results indicate that as soil moisture is depleted, plant water status decreases. Stomatal conductance was reduced also and stomata closure was reached -9 to -13 Bar depending on the variety. At this level, transpiration was minimized and photosynthesis was shut down. 'Evangeline' closed the stomata at -9 Bar and was the most resistant variety to wilting. In contrast, 'Jewel' and 'Covington' were the most sensitive to wilting and stomatal conductance was stopped at -13 Bar. Although wilting resistance and stomatal conductance response to water stress may appear to be a drought tolerance trait in sweetpotato, it is still unclear how stomatal closure at higher or lower plant water status would affect storage root initiation.

#### **Differences in Growth and Storage Root Initiation among Sweetpotato Varieties Subjected to Water Stress**

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In a field study under a rain shelter (high tunnel), seven sweetpotato varieties ('Beauregard' B-14 and B63, 'Covington', 'Evangeline', 'Hatteras', 'Centennial', and 'Jewel') were evaluated on their capacity to initiate storage roots and sustain growth under water stress. Varieties were planted and drip-irrigated for 30 min. Three growing periods [1 to 33 days after planting (DAP), 34 to 63 DAP, and 64 to 95 DAP] were established for drought/irrigation treatments. Treatments consisted in irrigation in the first and second period, irrigation in the first or second period only, and no irrigation. Samples from each cultivar at the end of each period were evaluated for growth and storage root initiation/set. Vegetative growth (biomass) was reduced (50% to 80%) in all varieties subjected to water stress in the first period. Storage root set and yield after the second and third period were also reduced with water stress except in 'Hatteras', which had similar storage root set under water stress as with irrigation. All varieties were able to recover from the first drought period when irrigated in the second period, but not to the extent of plants irrigated in both periods.

#### **The Bayesian Choice: Toward a Decision-theoretic Approach of Determining Irrigation Frequency and Amount in Sweetpotato Production**

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Decision-theoretic techniques explicitly define management of uncertainty and tradeoffs. These techniques are based on probability theory and assist in making decisions based on maximizing expected utility. We describe the development of a prototype phenology-based, data-driven Bayesian belief network (BN) model that represents the causal relationships of agroclimatic variables on the U.S. #1 storage root count and yield. Subsequently, we will illustrate how to extend this prototype BN model into a fully functional irrigation decision support system through the addition of utility and decision nodes. The model will be used to simulate various agroclimatic scenarios and expected hypothetical utility values associated with each decision state.

#### **Togari's Experiments in Sweetpotatoes: Evidence Ignored, Forgotten, or Overlooked?**

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Current sweetpotato literature frequently associates Togari's work with anatomical studies. Yet, anatomical data only represented approximately 30% of his report. The remainder of the report showed tables and figures that documented apparent relationships between storage root initiation and external variables such as transplant quality, light, soil moisture, temperature, and fertilizer. Many of these variables continue to be the subject of research and some of Togari's findings could be used to further elucidate cause and effect relationships and create opportunities for follow up studies. Yet, almost 90% of current published reports that document relationships between some of these variables and storage root yield do not include references to Togari's work. Possible reasons for this apparent oversight will be presented.

#### **Evaluation of Selected Insecticides for Management of Sugarcane Beetle in Sweetpotato**

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The sugarcane beetle, (*Euethola humilis rugiceps* Burmeister) is a sporadic but significant insect pest affecting sweetpotato in Louisiana and Mississippi. Adult sugarcane beetles feed on sweetpotato roots late during the production season. Sugarcane beetles move into sweetpotato fields during August and September after preplant and layby soil insecticide applications have been applied. Sugarcane beetle feeding

damage compromises the aesthetic quality of sweetpotato roots, often leaving them unsuitable for market. Producers currently rely on traditional labeled soil insecticides and planting date recommendations to manage this insect in commercial fields. More information is needed on monitoring techniques and chemical control options for this insect. Several insecticides currently labeled for use on sweetpotato in Louisiana and Mississippi along with Belay 2.13 SC (clothianidin) were evaluated in 2009 for their efficacy against sugarcane beetle. All pre-plant insecticide treatments were applied the day preceding transplanting. Sweet potato transplants were planted at a rate of 1 plant/ft in plots of 4 rows (centered on 42 inches) x 30 ft on 9 July. Treatments were arranged in a RCB design and replicated four times. Preplant and layby insecticides were applied as a band along the row center to the two center rows, and the beds were disked immediately following application. At harvest, roots from the middle rows were dug and 25 roots per plot were chosen at random and evaluated for insect damage after washing. The majority of root damage in the current trial was attributed to sugarcane beetle. Total percent insect damage (all species) ranged from 13.00% to 50.00%, whereas sugarcane beetle damage ranged from 8.00% to 40.00%. Preplant applications of Belay 2.13 SC and Lorsban resulted in significantly less total soil insect damage and sugarcane beetle damage compared to the non-treated control plots. No yield differences were detected between any of the insecticide treatments in the current study.

### **Evaluating On-farm Insecticide Trials for the Invasive Grub, *Plectris aliena*, in North Carolina Sweetpotato**

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An invasive white grub, *Plectris aliena*, was first discovered in North Carolina in 2006. Since then, the insect has caused over \$3 million in losses to the sweetpotato industry in the state. Trials were conducted in 2009 in a commercial field with an existing population of *P. aliena* in Columbus County, North Carolina. Experiments were arranged in a split-plot design. Whole-plot factors (PPI or drench insecticides) were arranged in a randomized complete block with 4 reps. Whole plot treatments for trial one were: 1. Admire Pro @ 10.5 oz/a; 2. Belay 2.13 SC @ 12 oz/a; 3. Coragen 1.67 SC @ 7 oz/a (drench); 4. Cyazypyr 100 SE @ 20 oz/a (drench); 5. Balance @ 32 oz/a; 6. Untreated check. Whole plot treatments for trial two were: 1. Admire Pro @ 10.5 oz/a; 2. Belay 2.13 SC @ 12 oz/a; 3. Belay 2.13 SC @ 6 oz/a; 4. Coragen 1.67 SC @ 7 oz/a (drench); 5. Cyazypyr 100 SE @ 20 oz/a (drench); 6. Untreated check. Subplot factor (layby insecticide) was randomly assigned within each whole plot. Subplot treatments for both trials were: 1. Admire Pro @ 10.5 oz/a; 2. Belay 2.13 SC @ 12 oz/a; 3. Untreated. PPI insecticide treatments were applied on 9 and 16 June, planting dates were 17 June and 18 July, drench treatments were applied on 8 and 28 July, and layby insecticide treatments were applied on 23 July and 6 August in trial 1 and 2 respectively. All PPI treatments were broadcast over soil using a tractor-mounted sprayer delivering 15 GPA and incorporated using a field cultivator. Layby insecticides were directed to cover the entire bed and were incorporated using rolling cultivators. Soil drench treatments were applied by hand in 3oz solution per plant. Subplots not receiving layby treatments were cultivated to control for the effects of cultivation. Sweetpotato slips ('Covington') were transplanted into beds spaced 42 inches apart in both trials. Grub damage incidence ranged from 2% to 12% in trial one, and there were no statistical differences or interactions between whole plot or sub-plot treatments. White grub damage was higher (31%) in the untreated check than in all other treatments ( $P = 0.0007$ ) in trial two; there were no other statistical differences for trial two. Insecticide treatment alone is unlikely to provide acceptable control of *Plectris aliena*, and an integrated management program is being developed.

### **KIH-485: New Herbicide for Future Weed Management in Sweetpotato**

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KIH-485 is a new herbicide that is being developed by Kumiai Chemical Co. KIH-485's mode of action is like that of a seedling

growth inhibitor similar to metolachlor. Early indications have shown it being an effective chemical for preemergence grass control and for the control of several broadleaf weed species. The goal of this trial was to determine if KIH-485 has acceptable crop tolerance, grass control, and broadleaf weed control for use in sweetpotato. The study was conducted on a Falkner silt loam (Fine-silty, siliceous, thermic Aquic Paleudalfs) in 2008 and 2009. Treatments include KIH-485 at 1.5, 2.0, 2.5, and 3.0 oz/acre applied PRE and POST transplant and flumioxazin at 2.5 oz/acre applied PRE + clomazone at 2.66 pt/acre applied POST transplant. Foliage injury was less than 4% for all treatments at 14 DAT. In 2008, all KIH-485 POST treatments controlled pigweed at least 90%, which was higher than the treatment of Valor + Command at 28 DAT. In 2009, pigweed control was 100% for all POST treatments of KIH-485 at 21 and 28 DAT. Pigweed control for PRE Treatments was at least 94% and 89% for all PRE treatments of KIH-485 at 21 and 28 DAT, respectively. Broadleaf signalgrass control in 2008, was at least 90% at 7 DAT for all POST treatments except KIH-485 at 1.5 oz/acre. At 28 DAT, grass control ranged from 73% to 90% for KIH-485 at 1.5 oz/acre and Valor + Command, respectively. Grass control in 2009, was at least 96 and 91% for all KIH-485 treatments applied POST at 21 and 28 DAT, respectively. Grass control was less than 92% and 80% for all KIH-485 PRE treatments at 21 and 28 DAT, respectively. This was lower than the treatment of Valor + Command, which controlled broadleaf signalgrass 100% and 99% at 21 and 28 DAT, respectively. In 2008, US No. 1 yield was highest with KIH-485 at 3 oz/acre applied POST rate, which was comparable to the treatment of Valor + Command. In 2009, US No. 1 and Total Marketable yields with KIH-485 applied POST were greater than with Valor + Command. Yield for all PRE treatments of KIH-485 were less than Valor + Command for US No. 1 and Total marketable grades.

### **Some Results from Simulated Flooding Studies with In Situ and Detached Storage Roots: Methods and Potential Pitfalls**

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Simulated flooding is routinely used as a method to evaluate sweetpotato response to flooding conditions. This approach typically involves simulated flooding of field-grown in situ plants or submerging detached storage roots in containers filled with water. However, there is currently a perceived lack of standardized procedures for imposing flooding treatments as well as evaluating responses. The adoption of uniform methodology will lead to a better understanding of causal variables that influence pre- and postharvest storage root response to flooding conditions. We will present representative results of simulated field and laboratory studies that were conducted in 2009 and discuss the advantages and disadvantages of each method. External variables such as temperature and duration of treatment were critical for both in situ and detached storage root studies. We were able to document plant response to in situ flooding treatments but we had no control of temperature, sunlight, and other variables. We had moderate control of external variables in detached storage roots submerged in buckets or jars but the results could not be readily extrapolated to intact plants. Subsequent studies will focus on standardizing procedures, data collection, quality of planting material, and nature of experimental unit. Such steps are needed to help guide research into reduction of flooding-related losses in sweetpotato production.

### **Product Evaluation for Reniform Nematode Suppression in Mississippi Delta Sweet Potato Production**

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The reniform nematode *Rotylenchulus reniformis* can cause significant losses in sweetpotato, (*Ipomoea batatas*) production. This has been documented across the historical sweetpotato producing areas in the United States. Mississippi delta growers have turned to sweetpotato as an alternative crop to diversify their operations. Traditionally, high populations of the reniform nematode are encountered in the sandy/silt loam delta soils that are suitable for sweetpotato production. During the

2009 growing season five products were compared for suppressing the reniform nematode in replicated sweetpotato plots. Nematode samples were taken twice during the season to assess reniform numbers from each treatment. Yield and quality of the sweetpotatoes from each treatment was recorded and analyzed.

### 2009 Evaluation of Monty's Plant Food Products to Enhance Yield for Crops Grown in the Mississippi Delta

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Research plots were planted to evaluate yield response to Monty's Plant Food foliar feed products in sweet potatoes, cotton, and soybeans grown in the Mississippi Delta. Monty's Plant Food products 8-16-8, 2-15-15, and Liquid Carbon were applied during the seasonal growth stages of each crop. A yield increase was seen in each crop treated with the Monty's foliar feed products. Sweet potato plots treated with the foliar feed applications showed an increase in US#1 potatoes and the jumbo potatoes while the US#2 potatoes were higher in the untreated plots, indicating the treated plots maturing somewhat ahead of the untreated plots. The yields in the two treatments were significantly different ( $P = 0.10$ ). Wet conditions extended the harvest of the sweet potato plots but due to cool temperatures a low percentage of rotted and jumbo potatoes were harvested. The soybean plots were harvested on a timely basis with acceptable moisture content, percent damaged, split beans, and foreign matter sample report. The treated plots showed an 11 bushel per acre increase. The yields in the two treatments were significantly different ( $P = 0.0007$ ). The cotton plots were planted very late and were treated weekly for insect populations. Plants per acre counts were high and growth regulator applications were needed to keep plant height manageable. Although overall yield was low, the treated plots showed an increase of 143 lbs of lint per acre. The yields in the two treatments were significantly different ( $P = 0.07$ ).

### Use of Poultry Litter in Mississippi Sweetpotato Production

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Sweetpotato is a valuable crop to Mississippi agriculture with an estimated value in 2008 of \$70 million. With rising nitrogen prices and an increase in the demand for organically produced sweetpotato, interest in poultry litter as a fertilizer source has increased. According to federal organic guidelines, fresh poultry litter should be applied at least 120 days prior to the harvest of the sweetpotato crop. Treatments included 1 ton litter, 1 ton litter with supplement, 2 ton litter, 2 ton litter with supplement, 1 ton composted litter, 1 ton composted litter with supplement, 2 ton composted litter, inorganic 50N-43.6P-250K, and inorganic 50N-43.6P-250K with soilSolution<sup>®</sup> at 2 oz/gal of transplant water. The 1 ton litter with supplement (555 boxes/acre) was not different from 2 ton litter (546 boxes/acre), 1 ton composted litter with supplement (488 boxes/acre) or the Standard inorganic fertilizer (458 boxes/acre). Total marketable yield ranged from 464 to 812 boxes/acre for the 1 ton composted litter and 1 ton litter with supplement, respectively. Two tons of litter was sufficient for an organic program in sweetpotato.

### Insect Population Monitoring and Damage to Sweetpotatoes

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Several sweetpotato varieties were planted in the field to compare the insect damage and yield. Sweetpotato root damage by insect feeding and the crop yield were also evaluated in field plots with 3-year history of ryegrass and by incorporating HumaSoil based soil conditioner. Insect populations were monitored in sweetpotato fields for two consecutive years by weekly sweep net sampling and biweekly counts of insects collected on two different sizes of purple sticky traps and Pherocon<sup>™</sup> AM yellow sticky traps. Four sweep net samples, each consisting of 25 sweeps were taken from each of four (2007) or three (2008) different locations from early July to late September. During early July, eight

(2007) or four (2008) replications of each purple and yellow sticky traps were installed around sweetpotato fields at different locations. Traps were checked from early August to late September. Insect samples were collected and identified. The sticky traps attracted more insect pests than those captured by sweep net sampling. Several species of click beetles (adult wireworms, mostly *Conoderus vespertinus*), *Cerotoma trifurcata*, *Lygus lineolaris*, *Diabrotica undecimpunctata*, tortoise beetles and flea beetles were collected in purple/yellow sticky traps or sweep net samples. Consistent numbers of different insect species were collected in both purple and yellow traps than in sweep net samples. Sweep net sampling collected all insect species except *C. trifurcata*, whereas click beetles and flea beetles were mostly collected during July and August. A 25-ft row of sweetpotatoes from each replication was harvested to evaluate insect damage and marketable yield. Overall, mean insect damage was not significantly different ( $P < 0.001$ ) between control and test plots with the history of ryegrass or incorporated with soil conditioner. But mean weight of marketable sweetpotatoes significantly differed under different growing conditions. Different sweetpotato varieties showed significantly different ( $P < 0.001$ ) susceptibility to insect damage. Marketable yield of sweetpotatoes also significantly differed ( $P < 0.001$ ) among varieties. Use of resistant sweetpotato varieties and an effective insect monitoring system, such as sticky traps may play a significant role in pest management of sweetpotatoes in Mississippi.

### Sensory Evaluation and Variety Trials of Tissue Culture Sweet Potato (*Ipomoea batatas*) in the CNMI

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Sweet potato [*Ipomoea batatas* (L.) Lam.] is one of the important subsistence food crops grown in the Northern Marianas and severely affected in recent years by the introduction of major diseases and insect pests impacting on the production. Sensory evaluations (taste testing) and field trials of new varieties successfully conducted throughout the islands of Saipan, Rota, and Tinian. Seventeen varieties of tissue culture sweet potato evaluated for the tolerance to insect pest and diseases, plant growth, tuber quality, shape, yield, taste, texture and other superior agronomic and morphological characters. Red-purple skin varieties IB 098, IB 0701, IB 0702, IB 195, and IB 083 rated excellent for taste, texture, quality of tubers, easy cooking, plant growth, and high yield. Yellow-orange and red-purple varieties with medium size tubers (3.5 inches) were preferred over the white skin and white flesh varieties. Sweet potato weevil (*Cylas formicarius elegantulus*), flea beetle, katydid, grasshopper, and rodents were the main insect pests caused damage to the crops. Bacterial stem and root rot (*Erwinia chrysanthemi*), leaf spot and stem blight (*Alternaria* spp.), scab and anthracnose (*Collectotrichum* spp.) were observed among the diseases. The introduced varieties were identified as the economically and culturally important ones that have been tested for superior characteristics in the Pacific region. Selected varieties were propagated through tissue culture and distributed to the farmers throughout the Commonwealth. Results indicated that new varieties performed well in local soil and climatic conditions of the Northern Mariana Islands. Small collections of sweet potato in the field at the Agriculture Research Station have been successfully maintained; however, land, labor, and high production costs are limiting factors.

## Vegetable Crops Section—Watermelon

### Phylogenetic Relationships among Cucurbit Species Used as Rootstocks for Grafting Watermelon

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There is an increased interest in the United States in grafting watermelon on cucurbit rootstocks to control soilborne diseases.

Several cucurbit species including *Lagenaria siceraria*, *Cucurbita* spp. and *Benincasa hispida* (wax gourds) have been used in Asia as rootstocks for watermelon. In our preliminary field experiments in Charleston, SC, the cucurbit species *Praecitrullus fistulosus* was also found to be compatible for grafting watermelon. The *P. fistulosus* has been considered a close relative of watermelon (*Citrullus lanatus* var. *lanatus*), and previously was classified as *Citrullus lanatus* var. *fistulosus* (Stocks) Duthie & J.B. Fuller. Still, different studies indicated that its taxonomic classification in relation to watermelon is incomplete. In this study, we used EST-PCR, EST-SSR and SRAP markers to assess phylogenetic relationships of *P. fistulosus* with *Citrullus* spp. (*C. lanatus* var. *lanatus*, *C. lanatus* var. *citroides*, *C. colocynthis*), *Cucumis* spp. (including *C. melo*, *C. sativus*, *C. anguria*, *C. meusei*, *C. zeyheri*), *B. hispida*, *L. siceraria* and *Cucurbita* spp. (including *C. pepo* and *C. maxima*). The phylogenetic data indicate that *P. fistulosus* is phylogenetically closer to *B. hispida* and *L. siceraria* than to *Citrullus*, *Cucumis* and *Cucurbita* species. In an additional study, phylogenetic relationships were determined among United States Plant Introduction accessions (PIs) of *L. siceraria* collected throughout the world. Two major groups of *L. siceraria* PIs were identified. The first group included *L. siceraria* PIs collected in Asia, while the second group included PIs collected in Central and South America. Several of the *L. siceraria* PIs collected in Asia are resistant to zucchini yellow mosaic virus (ZYMV), while several of the PIs collected in Central and in South America showed lower galling in response to root-knot nematodes (RKN). In field experiments in Charleston, SC, several of the *L. siceraria* PIs that are resistant to ZYMV or moderately tolerant to RKN were highly compatible for grafting watermelon, and promoted watermelon fruit quality.

#### Update on the Watermelon Vine Decline Virus and Other Whitefly-transmitted Cucurbit Viruses in Florida, and Their Effects on Watermelon

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Whitefly-transmitted *Squash vein yellowing virus* (SqVYV) was shown in the mid-2000s to cause a watermelon vine decline in southwest and west-central Florida. More recently, *Cucurbit leaf crumple virus* (CuLCrV) and *Cucurbit yellow stunting disorder virus* (CYSDV), also whitefly-transmitted, have been found in Florida watermelon. Cucurbit weeds including Balsam-apple (*Momordica charantia*), creeping cucumber (*Melothria pendula*) and smellmelon (*Cucumis melo* var. *dudaim*) can provide reservoirs for SqVYV, CuLCrV, and CYSDV. Green bean (*Phaseolus vulgaris*) also can provide a reservoir for CuLCrV. To more fully characterize the systemic wilt and rind necrosis induced by SqVYV, watermelon plants were grown under whitefly-free conditions in a greenhouse and inoculated with buffer (mock) or SqVYV at 2-week intervals. Symptoms appeared at about 2 weeks post-inoculation on all virus-inoculated plants but older plants tended to require a few more days for symptom appearance. Virus infection had significant deleterious effects on whole plant fresh and dry weight, fruit rind and flesh color, and soluble sugars compared to mock inoculated plants. However, the effects of virus infection were reduced at later inoculations.

#### Linkage Mapping of NBS-LRR Disease Resistance Gene Analogs in Watermelon

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Watermelon disease resistance gene analogs (WRGA) from 'Calhoun Gray', PI 296341, and PI 595203 were isolated using degenerate primers specific for the nucleotide binding sites (NBS) from the NBS-leucine-rich repeat (LRR) resistance gene family. Following cloning, sequencing, and analysis of these clones, we

identified 66 which contained motifs characteristic of NBS-LRR resistance genes. Using cluster analysis, eight groups of WRGA were identified and further characterized as having homology to *Drosophila* Toll and mammalian interleukin-1 receptor (TIR) and non-TIR domains. Three of these WRGA, as well as three disease-related watermelon expressed sequence tags homologs, were placed on a testcross map. Linkage mapping placed the WRGA on linkage group XIII, clustered with other resistance gene analogs. In addition, these WRGA were amplified from various genera of the Cucurbitaceae indicating that conservation of resistance gene analogs exists among cucurbits. These WRGA-STS markers may be useful in marker-assisted selection for the improvement for disease resistance in watermelon.

#### Tolerance to the Herbicide Clomazone in Watermelon Plant Introductions

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The pre-emergence herbicide clomazone (trade name: Command 3ME), is widely used in watermelon production in the US to control annual grasses and broadleaf weeds growing in between plastic beds. Exposure of young watermelon plants to clomazone can cause moderate or severe injury that is expressed as bleaching of leaves and growing tips. Even moderate injury results in delayed growth and development. Most commercial watermelon varieties are susceptible to clomazone injury. The objectives of the current study were to determine if clomazone tolerance could be identified in watermelon plant introductions (PI). We initially evaluated 123 PIs and identified several that were tolerant to clomazone. The tolerant PIs were not injured by clomazone at 1.5 mg ai/kg dry soil. Watermelon cultivars were moderately or severely injured by this concentration. Based on the initial screen; 67 PIs were selected for reevaluation. Twelve were rated <2 on a 1-10 rating scale (1=no injury, 10=plant dead). Of these, three *Citrullus lanatus* var. *citroides* PIs (PI 482324, PI500354, PI532624) were not injured. PI271773 and PI244017 (*C. lanatus* var. *citroides*) and the variety Charleston Gray were very susceptible to clomazone injury. Segregation among individual plants within PIs for reaction to clomazone was also observed. In a subsequent concentration response experiment, PI482324 and PI500354 were injured less at 3 mg a.i./kg dry soil; than PI244017 and Charleston Grey were injured more at 0.75 mg/kg. Two field experiments further confirmed the tolerance of PI500354 and PI482324 to clomazone (1.5 pt/acre, 0.5 lb a.i.) compared to the susceptible lines PI271773, PI244017, and Charleston Grey, which were significantly more injured. We have selfed (S3) the most tolerant or susceptible plants selected from these PIs in order to obtain genetically homogenous lines for future studies.

#### *Lagenaria* and *Cucurbita* Rootstocks Prevent Infection of Watermelon Scions by *Fusarium oxysporum* f. sp. *Niveum*

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Although *Fusarium oxysporum* f. sp. *niveum* is not pathogenic on cucurbit species other than watermelon, this pathogen can infect other cucurbits. Our objective was to determine if *F. oxysporum* f. sp. *niveum* was able to infect, cause wilt, and spread to the watermelon scion when six rootstocks were inoculated. The rootstocks Emphasis, Macis, and WMXP 3945 (*Lagenaria siceraria*), Shintosa Camel and Strong Tosa (*Cucurbita moschata* x *Cucurbita maxima*), and Ojakkyo (*Citrullus lanatus* var. *citroides*) were not grafted or grafted with seedless watermelon Tri-X 313 (*Citrullus lanatus* var. *lanatus*) and inoculated by dipping roots into 10<sup>6</sup> microconidia/ml of an isolate of *F. oxysporum* f. sp. *niveum* race 1 or race 2. Watermelon Tri-X 313 (susceptible to races 1 and 2) and Allsweet (resistant to race 1) were included as control cultivars. In each experiment, 20 plants of each cultivar were inoculated and 10 to 20 plants were not inoculated. Two to three weeks after inoculation, rootstock stems above the first true leaf on nongrafted plants, scion stems above the first true leaf on grafted plants, and bases of rootstock stems from all plants were disinfested and cultured on Komada's medium, which is semi-selective for *F. oxysporum*. Tri-X 313, Allsweet, Ojakkyo, and Tri-X 313 grafted onto Ojakkyo showed

symptoms in all experiments, while the other inoculated rootstocks and noninoculated plants were symptomless. Recovery of *F. oxysporum* was not significantly affected by race or grafting. *F. oxysporum* was recovered above the first true leaf from 0 to 15% of inoculated grafted or nongrafted *Lagenaria* and *Cucurbita* rootstocks, which was significantly lower than recovery above the first true leaf on grafted or nongrafted Ojakkyo (75 to 100%). Grafting Tri-X 313 onto *Lagenaria* and *Cucurbita* rootstocks significantly reduced recovery of *F. oxysporum* from the scions compared with recovery of *F. oxysporum* above the first true leaf of nongrafted Tri-X 313 ( $P < 0.0001$ ) and Allsweet ( $P < 0.07$ ).

### Yellow and Orange Flesh Watermelon Cultigen Evaluations

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Fifteen advanced lines or cultivars (cultigens), 10 yellow flesh and 5 orange flesh were evaluated for yield and quality at the Cunningham Research and Extension Center, Kinston, NC. The cultigen treatments were arranged in a randomized complete-block design, with four replications per entry. Seeds were planted 6 Apr. and transplants were set on 8 May 2008. Recommended cultural practices for watermelon were used during the season including growing the plants on black polyethylene mulch with drip irrigation. Cumulative fertilization for the growing season was 91-135-182 (N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O) kg/ha. Transplants were set in-row 0.76 m apart while distance among row centers was 3.1 m. Four harvests were made. The first was 18 July and the last on 22 Aug. Each fruit was harvested and weighed and was considered marketable when size exceeded 5.4 kg. Cumulative fruit number and mass were determined on a per hectare basis. Fruit quality characteristics measured included average fruit weight, soluble solids of the mesocarp, percentage and severity hollow heart, and firmness of the mesocarp. The highest yielding (by fruit number) yellow flesh cultigens were 'Butterball', 'PX 1811', 'SVR 1817', 'Treasure Chest', 'Triple Gold' and 'Yellow Bird', with the percentage of marketable fruit being at least 80% and greatest with 'PX 1811' and 'SVR 1817'. Production of marketable fruit tonnage was greatest with 'PX 1811' and 'SVR 1817', with these cultigens having the highest average fruit weights of 8.2 kg. 'Orchid Sweet' produced smaller-sized fruits than the other cultigens, which led to reduced marketable yields of standard-sized watermelons. 'PX 1811' and 'SVR 1817' also had the firmest flesh and least amount of hollow heart of all yellow flesh cultigens evaluated and would likely serve as an excellent shipping watermelon. Orange flesh cultigens 'Gold Strike' (diploid), triploids 'Pure Orange', 'SSX 7736' and 'SSX 7739' had similar yields, percentage brix, and flesh firmness. 'Pure Orange' had no hollow heart while the other cultigens had at least 10% hollow heart. 'New Queen', orange flesh diploid, was not an acceptable cultigen for commercial production due to the rind's propensity to split easily.

### Evaluation of Instrumental Texture Measurements of Watermelon Cultivars

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Use of sensory evaluation to describe the texture of raw fruit cultivars may be logistically challenging and resource intensive. Instrumental measurements that are rapid and relate to sensory properties may be employed instead, if there is a strong correlation between the two types of measurements. An expedient, quantitative method could have great utility when screening a wide variety of fruit cultivars. This study seeks to develop a texture measurement method that is correlated with the sensory experience using watermelons as the target crop. The textural properties of five seedless watermelon cultivars ('Amarillo', 'Petite Perfection', 'Imagination', 'RWT8225', and 'RWT8229') were assessed by sensory descriptive analysis and instrumental measurements. The instrumental methods included the standard puncture test with an 11-mm cylindrical probe and a new hollow probe of the same contact area, a 3-point bend test and a measurement of apparent juice content. Initial screening of in-

strumental measurements by ANOVA and Tukey-Kramer multiple comparison analysis revealed that the puncture test with the new hollow probe could distinguish between some watermelon cultivars and all fruit tissue types (heart, placenta and locule), while the standard puncture test using an 11-mm probe, currently used by watermelon breeders, could not distinguish cultivars or tissue types.

### Resistance of Wild Watermelon (*Citrullus lanatus* var. *citroides*) Rootstocks to Southern Root-knot Nematode

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Seedless watermelon (*Citrullus lanatus* var. *lanatus*) 'Tri-X 313' scions were grafted on ten different cucurbit rootstocks and evaluated in a field infested with southern root-knot nematode (RKN), *Meloidogyne incognita*, in Charleston, SC in 2009. The rootstocks evaluated included five wild watermelon (*Citrullus lanatus* var. *citroides*) germplasm lines (RKVL 301, RKVL 302, RKVL 303, RKVL 316, and RKVL 318), one bottle gourd (*Lagenaria siceraria* 'Emphasis'), one squash hybrid (*Cucurbita moschata* x *C. maxima* 'Strong Tosa'), one commercial watermelon rootstock (*C. lanatus* var. *citroides* 'Ojakkyo'), and three wild tinda (*Praecitrullus fistulosus*) rootstocks. Self-grafted and non-grafted 'Tri-X 313' were included as checks. RKN infection was severe in 'Emphasis' bottle gourd, 'Strong Tosa' hybrid squash, and the three wild tinda rootstocks with percentages of root system galled ranging from 86% to 100%. The five RKVL wild watermelon lines exhibited significantly lower ( $P \leq 0.05$ ) percentages of root galling (range: 9.1% to 16.2%) than non-grafted 'Tri-X 313' (40.9%), 'Emphasis', 'Strong Tosa', and the wild tinda rootstocks. RKVL 301, RKVL 303, RKVL 316, and RKVL 318 wild watermelon rootstocks had significantly greater ( $P \leq 0.05$ ) amounts of fibrous roots than all other entries. The grafted wild watermelon rootstock RKVL 318 produced significantly more ( $P \leq 0.05$ ) fruit (12 per plot) than all other entries (mean = 5.3 per plot), and it produced a heavier ( $P \leq 0.05$ ) fruit yield (29.5 lbs per plot) than all entries except self-grafted 'Tri-X 313' (21.5 lbs per plot). The results of the present study suggest that the RKVL wild watermelon rootstocks (*C. lanatus* var. *citroides*) possess durable resistance to root-knot nematodes in the field and may provide a new alternative to pre-plant soil fumigation for managing RKN in watermelon.

### Patterns of Virus Distribution in Single and Mixed Infections of Florida Watermelons

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Whitefly-transmitted Squash vein yellowing virus (SqVYV) and Cucurbit leaf crumple virus (CuLCrV), and aphid-transmitted Papaya ringspot virus type W (PRSV-W) have had serious impact on watermelon production in southwest and west-central Florida in recent years. To determine the distribution of virus within plants, 80 entire plants were collected randomly, 20 each on four different dates, from a commercial watermelon field showing symptoms of SqVYV, CuLCrV and PRSV-W and possibly CYSDV. This was followed by a smaller sampling of five plants in a different commercial planting. Tissue prints were made from cross sections of watermelon plants from the crowns through the tips at 0.6-m intervals on nylon membranes and nucleic acid hybridization assays were used for virus detection. Results showed that SqVYV, CuLCrV and PRSV-W were present in approximately 37%, 43.5% and 54%, respectively, of the 80 plants from the first field. For individual vines diagnosed with SqVYV, the distribution of SqVYV in vine tissue decreased proportionately with distance from the crown. In contrast, CuLCrV tended to be more evenly distributed throughout the plant. The distribution of PRSV-W resembled that of SqVYV. In the smaller sampling similar trends were detected;

however, CYSDV was also detected in these plants. Overall, results indicate that SqVYV, CuLCrV, and PRSV-W are distributed differently in watermelon plants, and this difference has implications for sample collection, and may affect vector acquisition and transmission of these viruses.

### Effects of the Watermelon Vine Decline Virus on Vining Cucurbit Germplasm Including Wild Cucurbits

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Squash vein yellowing virus (SqVYV) is the casual agent of watermelon vine decline in south Florida, a disease that induces foliar chlorosis, necrosis and wilt, followed by plant death. Symptoms of wilt and death induced by SqVYV in watermelon have not been observed on any other known host species, all of which are in the family Cucurbitaceae. To examine the infection phenotype across a broader range of cucurbits, 21 vining cucurbit varieties in 11 species were grown to maturity and pollinated to produce fruit. Plants were subsequently inoculated with SqVYV and rated for visual symptoms of virus infection. Most species tested showed mild or no symptoms of virus infection, however three species showed wilting in petiole and leaf blades, and necrosis along vine tissue similar to SqVYV induced decline in watermelons. Virus distribution within infected vines was determined by nucleic acid hybridization assays and RT-PCR and found to be similar in declining and non-declining cucurbits. Screening of wild cucurbit germplasm has also identified watermelon relatives including *Citrullus lanatus* var. *citroides* lines that have increased resistance to vine decline. These results show that a wider range of cucurbits suffer SqVYV induced vine decline and that resistance to the decline may be found in wild watermelon relatives.

## Poster Section

### A Bioassay to Determine Potential Phytotoxicities in Aged and Fresh WholeTree

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WholeTree (WT) is a wood fiber alternative substrate created by milling all aboveground portions of a pine tree through a hammermill using a screen size suitable for substrate material. WT is approximately 80% wood, 15% bark, and 5% needles. Previous experiments expose differences in plant response in aged and fresh WT, where plants grown in aged WT have greater growth indices, dry weights, and bloom counts than those grown in fresh WT. One cause of these differences could be an allelopathic relationship between fresh WT and the plants. A bioassay was carried out and repeated under controlled conditions to determine whether a phytotoxic relationship does exist. 100 g (dry weight) samples of aged (199 days since processing) and fresh (2 days since processing) WT were soaked in 900 mL of distilled water for 72 hours and drained to obtain full strength (FS) leachate. The FS was then mixed with the appropriate amounts of distilled water to acquire 100%, 50%, 25%, and 12.5% concentrated solutions for fresh WT and aged WT, respectively. A control treatment of distilled water made a total of nine treatments. Five New Red fire lettuce (*Lactuca sativa*) seeds were placed in between germination papers in a glass petri dish. Each petri dish counted as one replicate, with 10 replications per treatment. Five milliliters of the appropriate solution were poured over the top of the seeds, and the petri dishes were sealed and placed in a 24.5 °C incubator for 5 days. After the incubation period germination percentage and average radicle length for each replication were calculated. Data were analyzed using Proc Glimmix in SAS Version 9.1. There were no treatment differences in experiment 1 or experiment 2; this study

indicates there are no phytotoxicities in aged or fresh WT. We hypothesize differences in plant response in aged and fresh WT may instead be attributed to nutrient immobilization or leaching; however, further experimentation is required.

### Provenance Effects on Stomatal Conductance in *Quercus* Series *Virentes* across Texas

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In order to evaluate the impact of provenance on stomatal conductance, four open-pollinated *Quercus* series *Virentes* accessions from native stands or long established specimens of *Q. virginiana*, *Q. fusiformis* and their hybrids, in and around the South Texas Plains, the Post Oak Savannah, Trans-Pecos Mountains and Basins, and the Texas High Plains vegetative regions were subjected to several local studies to elucidate the stomatal conductance levels. An acute drought study was conducted to examine stomatal conductance of each *Virentes* accession. Finally, a sequential drought study was also initiated to determine the response of the selected seedlings accessions to repeated periods of drought. The results of this study indicate that provenance impacts an accession's recuperative capacity following drought exposure.

### Impact of Post-establishment Applied Organic Mulch on Gas Exchange and Growth of Landscape Tree Species

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Organic mulch is thought to provide many benefits to urban landscapes. However, little research has investigated response of established trees to organic mulch. Research objectives were to compare gas exchange and growth of established trees exposed to organic mulch placed on the soil surface surrounding the tree. Trees were planted in 2002. Data presented here includes four species: *Acer truncatum* (shantung maple), *Cercis canadensis mexicana* (Mexican redbud), *Quercus muehlenbergii* (chinquapin oak), and *Q. robur* (English oak). Trees were arranged in randomized complete blocks with three blocks with two plants of each species within each block. Within each block trees were randomly assigned a mulch treatment: no mulch, or mulch (10 cm of cypress bark mulch). Mulch was applied Fall 2008. During the 2009 growing season each tree received weekly irrigation (based on evapotranspiration and soil surface area) from emitters placed near the trunk. Soil temperature, soil water content, and soil heat flux sensors were installed below the soil surface between nursery rows (non-irrigated control), and additional sensors were placed below a mulched and a non-mulched redbud tree. Budbreak data from each tree was collected Spring 2009. Mid-day stomatal conductance was collected on several occasions from each tree. Shoot growth data was measured on selected shoots from each tree, and leaf area was measured on 100 leaves from each tree with a leaf area meter. Data were exposed to ANOVA. If treatment differences were observed, means were separated by Fisher's least significance procedure. Soil data indicated soil under mulch was cooler, had greater soil moisture, had less soil heat flux and had fewer extremes compared to soil under non-mulched trees and control soil. Influence of mulch on budbreak differed for each species. Overall gas exchange data does not indicate specific trends. For all species (except English oak) shoot growth was greatest for trees grown with mulch compared to trees grown without mulch. Except for Mexican redbud, leaf area data did not indicate specific trends. Our data suggest response of gas exchange and growth to organic mulch is species and plant structure specific. Additional research will continue to determine if organic mulch is a benefit to gas exchange and growth of established landscape tree species.

### Survey of White-tailed Deer Impacts on Ornamental Plants in Alabama

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White-tailed deer (*Odocoileus virginianus*) numbers continue to increase in the state of Alabama, and many nursery and landscape professionals commonly experience deer damage. The purpose of this survey was to determine the amount of deer damage that nursery and landscape professionals throughout Alabama experience. The surveys included 30 questions and were mailed to members of the Alabama Nursery and Landscape Association, totaling 223 professionals in the sample. Surveys were mailed 25 Sept. 2009 to the recipients in ALNLA envelopes along with a prepaid envelope for return. Participants were then given one month to complete the survey, and surveys were to be postmarked no later than 25 Oct. 2009. Data were analyzed using SPSS 17.1 (SPSS, 2008). Seventy-eight surveys were returned for a response rate of 35%. Sixty-eight percent of the total respondents from east central Alabama answered "yes" to damage problems. Similarly, in southwestern Alabama, 66% of the total respondents answered "yes" for deer damage. Based on a white-tailed deer density map provided by the Alabama Department of Wildlife and Conservation, many counties in east central and southwestern Alabama have more than 30 deer per square mile, which represent the highest populations within the state. High fencing, electric fencing, Liquid Fence<sup>®</sup>, and motion irrigation had the highest means of the 11 preventative measures listed by participants, so these four products were rated most effective by respondents. Indian hawthorn was reported to have the most damage, with 26 growers and landscapers reporting damage. Other plants that were rated high by respondents include: holly, pansy, azalea, rose, hosta, and hydrangea. Time of the year that most damage occurs was also determined. Participants reported that most damage occurs during the winter and fall months of January, February, October, November, and December. Because availability of natural foods for deer is typically lowest during this period, these results are not surprising.

### **Developing Cell Membrane Thermostability and Triphenyl Tetrazolium Chloride Cell Viability Tests for Assessing Heat Tolerance in Ivy Geraniums**

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Summer heat stress causes a reduction in plant growth and flowering in ivy geraniums. Current cultivar screening for heat-tolerance relies heavily on whole-plant methods, which are time and labor consuming. Cell Membrane Thermostability (CMT) and Triphenyl Tetrazolium Chloride (TTC) cell viability tests are alternative laboratory-based cultivar screening methods. They have been reported to be used in agricultural crops like wheat, tomato, and soybean. Compared to the whole-plant methods, CMT and TTC appear more efficient and cost saving. However, there is no report on application of CMT and TTC in ivy geraniums. Eleven ivy geranium cultivars were used for the CMT and TTC assay. Rooted cuttings were potted in 15 cm pots and grown under greenhouse conditions for 6 weeks. The plants were transferred to growth chambers at 35 °C for 24 h before conducting the CMT and TTC tests. Additional cuttings were potted in 10-cm pots for 4 weeks and then transplanted to 25-cm pots with three plants per pot and grown under outdoor conditions in Starkville, MS from 15 May to 1 Aug. 2009. Plant width and height were measured. A growth index was calculated and degree of chlorosis rated. These parameters were correlated to results from the CMT and TTC tests. When you get your abstract finished, please email me a copy and bring a copy to the meetings. Here we show that both CMT and TTC tests can represent the variance of heat tolerance in ivy geraniums. The results of both CMT and TTC tests correlated well with plant width and growth indexes. Their correlations to plant chlorosis were low. Unlike TTC, CMT strongly correlated with plant width. Our results demonstrate that CMT and TTC tests can be applied to cultivar screening for heat tolerance in ivy geraniums, providing two efficient complementary laboratory-based methods to the currently used whole-plant method for ivy geranium breeding.

### **Home Gardening Workshop Demographics of South Mississippi**

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The recent conditions of the economy have increased homeowner interest in stretching budget dollars through home vegetable gardening. Many requests for information were from homeowners having little or no previous gardening experience. To meet the increased demand for gardening information, a home vegetable gardening workshop series consisting of three workshops was offered in the spring of 2009 in Biloxi, MS. The workshop series focused on the process of the home garden from the beginning planning stages to how to preserve the harvest by freezing or canning. Presentations and hands-on demonstrations were given by Mississippi State University Extension specialists, Mississippi Agricultural & Forestry Experiment Station researchers and Master Gardeners from Harrison County. Workshop participants drove distances up to 40 miles to attend. Total participants numbered almost 400. Participants completed a questionnaire to help determine the level of gardening skills. A follow-up questionnaire is planned for Spring 2010 to determine the level of gardening participation and success in 2009.

### **Lack of Nut Production in a Potentially Sterile, Late-flowering Ornamental Tung Oil Tree (*Aleurites fordii*)**

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We recently identified an *Aleurites fordii* seedling with ornamental potential that shows late flowering, approximately 4 weeks delayed, and does not produce normal drupes, which are toxic and a nuisance to lawnmowers since they are large (5-8 cm) and heavy. The ornamental and landscape industries could benefit from a small (4-6 m), deciduous landscape tree that has no known insect or disease problems, has uniform growth habit, tolerates diverse soil conditions and drought, is readily propagated, and has a tropical flair with large, heart-shaped leaves and catalpa-like blooms. Clusters of approximately 60 flowers open before the leaves in early spring and have 5 to 7 ivory petals with pink or red throats. Flowers are monoecious and both male and female flowers are visible on the late-flowering selection. Staminate male flowers produce visible pollen but staining and microscopy measurements show a high percentage of large, heavily-stained pollen grains mixed with unstained normal-sized pollen. Genome size comparisons using a flow cytometer do not suggest ploidy differences between the late-flowering selection and other cultivars in our tung oil tree germplasm collection. Tung oil trees are not self-sterile and flowering times for normal trees and the late-flowering selection overlap slightly. However, male sterility combined with late-flowering may account for the lack of drupes. Two-way controlled crosses were made between seven bud-grafted clones of the late-flowering selection and seven random plants from the tung-oil tree germplasm collection to confirm sterility. Cold-hardiness evaluations of bud-grafted clones are under way since previous literature indicates hardiness only in USDA cold-hardiness zones 8 to 10, which would limit the ornamental potential of this tree.

### **A New Blueberry Variety for Home Gardeners**

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Many home gardeners desire more locally grown, environmentally sound products and produce. The convergence of outdoor living and eco-friendly consumer trends provides opportunity for edible

ornamentals; especially ones that offer multiple seasons of appeal and provide the consumer with garden fresh produce on their patio or outdoor living space. The southern highbush blueberry selection TH-682 was jointly released in 2008 by The University of Georgia and USDA-ARS for the home gardener market. The new variety ripens early compared to rabbiteye varieties generally available to homeowners in the Southeast through large commercial gardening outlets. TH-682 produces an abundance of attractive, light blue fruit, and berries are generally large and flavorful. The plant of TH-682 has nice ornamental appeal as well, with glamorous flowers in the spring, and notable fall coloring of leaves. The selection is estimated to have a chilling requirement of 500 to 550 hours below 45 °F, and will likely perform well in USDA hardiness zones 6a thru 9a. A patent for the new variety has been applied for under the name TH-682. However, the variety has been exclusively licensed to McCorkle Nursery, and will be sold under the trade name Blue Suede™, which will be introduced as part of their Gardener's Confidence® Collection (www.GardenersConfidence.com) in late 2010 or early 2011. Propagation rights are controlled by University of Georgia Research Foundation, Technology Commercialization Office, GSRC Boyd Bldg, Athens, Ga. 30602-7411 (www.ovpr.uga.edu/tco/).

### Effect of Growing Location on Fruit Quality of Muscadine Grape Cultivars

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'Black Beauty', 'Black Fry', 'Darlene', 'Early Fry', 'Ison', and 'Janet' fresh market and processing muscadine grape cultivars planted at two experimental sites in central Alabama were selected to assess the effect of growing location on grape yield and berry fruit quality. Mature grape vines grown at the E.V. Smith Research Center (RC), Shorter, and at the Chilton Research and Extension Center (REC), Clanton, were studied during 2008-2009 growing season. Data were recorded to determine grape harvest season, total yield per vine and fruit quality characteristics. 'Black Beauty', 'Black Fry', 'Darlene', and 'Ison' produced higher yield at the Chilton REC, while 'Early Fry' and 'Janet' were more productive at the E.V. Smith RC. 'Darlene' grape grown at the E.V. Smith location provided the largest berries, 16 g on average. All of the muscadine grape cultivars studied at the E.V. Smith site had greater berry size and higher soluble solids content when compared to the same group of cultivars grown at the Chilton location. Greater muscadine grape yield produced at the Chilton location had affected the berry fruit quality when compared to the quality of grapes grown at the E.V. Smith location.

### Evaluation of Twelve Fig Cultivars for the Gulf Coast Area

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There are only a few cultivars that are recommended for the humid Gulf south region. There are many cultivars of the common fig (*Ficus carica*) available. Several considerations need to be made when choosing a cultivar for the gulf south regions, because of very humid conditions that occur during harvest period. The cultivar must produce fruit with a closed or partially ostiole (eye) to reduce spoilage. Late summer defoliation, caused by several pathogens, limits fruit maturity in late season. Large fruit size (> 30 g) influences yield and picking time. Also, fig trees are grown as dooryard trees and in small orchards, mature tree size and architecture are important considerations. A comparison of fruit (syconium) characteristics of 12 cultivars of common type figs were made in Summer 2008 using fruit from 8-year-old trees. Fruit were evaluated for several characteristics based on marketing quality. Fruit were objectively measured for internal and external color and soluble solids. External fruit color was determined objectively by placing whole fruit from each cultivar on the eye lens of the spectrophotometer along the equator of each fruit. Fig cultivars,

along with cultivars with known degrees of susceptibility to late summer defoliation were grown in a research orchard. Field notes were recorded annually in late summer on the degree of defoliation of each tree. Symptoms caused by the two pathogens often appear at the same time creating difficulty in separating the two diseases under field conditions as to which one causes defoliation. Wide differences exist in fruit size, color and foliar diseases. Cultivars that produce fruits with closed or partially closed eyes (ostioles) have less fruit spoilage during wet weather. 'Hardy Chicago' and 'Celeste' yielded the most marketable fruit during periods of high rainfall. Several cultivars, i.e., 'LSU Purple', 'O'Rourke', and 'Champagne' have good resistance to late summer defoliation. Trees of cultivars that had upright growth habit were 'Champagne', 'Celeste', and 'Hardy Chicago'. 'Tiger', 'Magnolia', and 'San Pietro' had a weeping or prostrate growth habit. The cultivars with largest fruit size were 'San Pietro', 'Magnolia', 'Tiger', and 'Kadota'.

### Influence of Rootstocks on Physiology of Merlot Grapevines Grown on the Texas High Plains

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Within the state of Texas there are approximately 1174 ha of vineyards. Because of extreme growing conditions found on the West Texas High Plains, there is a great need for adapted varieties and rootstocks. To assist growers when selecting varieties and rootstocks adapted to the growing conditions found on the West Texas High Plains this study investigated rootstock effects on physiology of field-grown merlot grapevines. Research took place at the Texas AgriLife Research and Extension Center in Lubbock, TX. *Vitis vinifera* 'Merlot' scions grafted to four rootstocks were used: 5BB (*V. berlandieri* x *V. riparia*), 1103 (*V. berlandieri* x *V. rupestris*), 110R (*V. berlandieri* x *V. rupestris*), and 4453 [*V. riparia* x (*V. cordifolia* x *V. rupestris*)]. Vines were planted Spring 2006 in a completely randomized block design. For each rootstock and scion combination, there was a total of 25 plants. Budbreak data along with mid-day leaf water potential, stomatal conductance, leaf to air vapor pressure deficit, transpiration rate, and photosynthetic rate were measured throughout the growing season. Budbreak and daily physiological means were exposed to ANOVA. If differences were detected, means were separated by Fisher's least significance difference procedure. Stomatal conductance versus LVPD data were analyzed by regression analysis. Over the course of the growing season ANOVA indicates few differences in budbreak and physiological data. In fact, on only two dates were physiological data different between rootstocks and scion (stomatal conductance, 28 July and 6 Aug.). Linear regression also revealed stomatal response to leaf to air vapor pressure difference did not differ between rootstock and scion combinations. Despite descriptions of low to high drought resistance of tested rootstocks, our data indicates during the 2009 growing season physiological differences between merlot scions and various rootstock combinations were not present. In addition, it appears each rootstock tested may be suited to growing conditions found on the West Texas High Plains. To further assist producers on the West Texas High Plains additional physiological and production (fruit quality, pruning weights, etc.) data will be collected during the 2010 growing season.

### Postharvest Evaluation of 'Prime-Ark® 45' Primocane-fruiting Blackberry

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'Prime-Ark® 45' was tested for postharvest storage capability along with other primocane- and florican-fruiting cultivars. Berries were harvested into clamshells and stored at 5° C for 7 d. After storage the berries were evaluated for leak, firmness, decay, and reddening. Leak, firmness, and decay were used to calculate marketability. The marketability values for 'Prime-Ark® 45' were comparable to 'Apache', 'Ouachita', and 'Natchez' in 2007 and 2008. In 2009 'Prime-Ark® 45' had marketability values similar to 'Ouachita' and 'Natchez', but better than 'Apache'. The reddening measurement,

which is not used in the calculation for marketability, for 'Prime-Ark<sup>®</sup> 45' was no different from 'Apache' or 'Ouachita', but was better than 'Natchez' in 2007. In 2008 the 'Prime-Ark<sup>®</sup> 45' reddening measurement was similar to 'Natchez' and 'Ouachita', but not as good as 'Apache'. In 2009 there were no differences among all four cultivars for reddening. 'Prime-Ark<sup>®</sup> 45' is the first primocane-fruiting blackberry from the University of Arkansas with high-quality commercial and shipping capabilities.

### 'Suzible': A New Early Ripening Southern Highbush Blueberry

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A new southern highbush blueberry cultivar named 'Suzible' was released in 2009 by The University of Georgia. It is an early season cultivar with large fruit having a medium to light blue color, and a small, dry picking scar. 'Suzible' berry firmness and flavor are both good to very good. The new cultivar flowers and ripens with 'Star', although, berry size and firmness have been better than 'Star' in Georgia trials. 'Suzible' plants are vigorous, precocious and have a semi-spreading bush habit with a medium crown. Yield has been similar to or greater than 'Star' in South Georgia. Leafing has been excellent, even following mild winters. 'Suzible' has an estimated chill requirement of 400 to 450 hours (<7 °C). Propagation is easily accomplished using softwood cuttings. Plants of 'Suzible' are self-fertile, but it is recommended they be planted with other southern highbush blueberry cultivars with a similar time of bloom for cross-pollination ('Star' and 'Rebel' suggested). 'Suzible' is new, so planting on a trial basis is recommended. Propagation rights are controlled by University of Georgia Research Foundation, Technology Commercialization Office, GSRC Boyd Bldg, Athens, GA 30602-7411 ([www.ovpr.uga.edu/tco/](http://www.ovpr.uga.edu/tco/)).

### Three New Fig Cultivars for the Gulf Coast

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'Champagne', 'O'Rourke', and 'Tiger' figs (*Ficus carica* L.) were developed by the Louisiana Agricultural Experiment Station to provide good quality fruit, ripening during the traditional fig harvesting period. 'Champagne', 'O'Rourke', and 'Tiger' are the third, fourth, and fifth cultivars released, respectively, from a fig breeding program initiated in the 1950s to develop cultivars for the gulf south region. The three selections were evaluated at research stations in Louisiana. Three selections, L55-13-22, L57-11-103, and L57-13-121, were chosen for release because of superior fruiting characteristics. 'Champagne', 'O'Rourke', and 'Tiger' are selections from seedlings derived from a cross of 'Celeste' x 'C1' (a Capri fig from California). The crosses and selections were made by Dr. Ed O'Rourke. The selection L 57-11-103 was so named 'O'Rourke' to honor Professor Ed O'Rourke's service to the fruit industry. The syconium (fruit) of 'Champagne' has a slightly round distal end and tapers slightly toward the stem end with a short neck. The fruit has a partially closed eye (ostiole) on mature fruit. Internal color is gold to caramel color when soft ripe. 'Champagne' fruit ripen about the same time as 'Celeste', the first week of July in Baton Rouge, LA. The main crop fruit of 'Champagne' ripens over a 15-day period, which is comparable to 'Celeste' and 'Kadota'. 'O'Rourke' has a round distal end and tapers slightly toward the stem end with a long neck region. The fruit stalk is longer on 'O'Rourke' than that of most common fig cultivars, with an average length of 14.2 mm compared to fruit stalk on 'Celeste' of 10.4 mm. 'O'Rourke' produces fruit about 35 mm in diameter of moderate size (20 g), light brown fruit larger than fruit (14 g) from 'Celeste'. The ostiole of 'O'Rourke' is not completely closed compared to a closed eye of 'Celeste'. Internal color is gold with some red near center of fruit when soft ripe. Fruit of 'O'Rourke' ripen 5 to 7 days before 'Celeste' or about the last week of June in the Baton Rouge area. This selection has a longer than normal fruit stalk, which contributes to the characteristics of this fruit hanging down when fully ripe. This cultivar has not consistently produced

a breba crop during the 7 years of observation. The main crop of 'O'Rourke' ripens over a 15-day period, which is comparable to 'Celeste' and 'Kadota'. 'Tiger' fig produces good quality, 30 to 40 mm in diameter, and large size (50 g) brown fruit with a darker brown stripe visible on most fruit. The brown fruit of 'Tiger' have a slightly round distal end and taper slightly toward the stem end with a short neck. The fruit has a partially closed eye on mature fruit. Internal color is yellow to gold with some red near center when full ripe. Fruit ripen about 5 to 7 days after 'Celeste' or about the first week of July in the Baton Rouge area. The main crop fruit of 'Tiger' ripens over a 15-day period, which is comparable to 'Celeste'. Fruit of all currently recommended cultivars of figs will split and crack to some degree during the ripening stage when excessive moisture is present. Notations on deep radial cracks radiating from the ostiole of 'Tiger' one to three days after heavy rain events indicate that 'Tiger' has a greater tendency to have radial cracks when ripe than 'Celeste'.

### Chlorine Dioxide as a Sanitizer for Closed Loop Irrigation Systems in Bell Pepper

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Recycled irrigation water is easily contaminated with plant pathogens and algae; therefore, water must be sanitized prior to recirculation. Chlorine dioxide (ClO<sub>2</sub>), a common disinfectant used to treat municipal water and postharvest dump tanks, has been proposed as a disinfectant for recirculated irrigation systems. Little prior research has been performed to determine if this chemical is appropriate to use in irrigation on greenhouse specialty crops. The objective of this study was to determine the effects of ClO<sub>2</sub> on the vigor of bell pepper plants at different concentrations (0, 10, 20, and 40 ppm) and in two different soilless medias (perlite and pine bark). Plants were transplanted in the University of Florida Protected Agriculture Project greenhouse on 5 Nov. The ClO<sub>2</sub> application occurred 11 days after transplanting. Pepper plant height was measured weekly for 6 weeks. Leaf area, fresh mass, and dry mass of plants was measured at the end of 6 weeks. Data were analyzed using SAS (v.9.2). There was no interaction between media and ClO<sub>2</sub> concentration, therefore main effects are reported. For the concentrations examined, results indicate that increasing concentrations of ClO<sub>2</sub> in the irrigation water is negatively associated with plant height, leaf area, fresh mass and dry mass. For all parameters, peppers produced in perlite were less vigorous than peppers produced in pine bark.

### Improving Fruit Quality and Phytochemical Content through Better Nutrient Management Practices

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Consumer preference quality traits (e.g., taste, texture) of muskmelons (*Cucumis melo* L.) and many other fruits are strongly influenced by cultivar as well as soil properties such as soil type and nutrient supply capacity. Among nutrients, potassium (K) has the strongest influence on quality parameters. However, during fruit growth and maturation, soil K supply alone is seldom adequate to satisfy K requirements. The effects of soil type (sandy versus clay soil) and K fertilizer amendments on market quality and phytochemical content of muskmelon (cv. Cruiser) fruit were investigated. Experiments were established in two sites with contrasting soil types (sandy vs. clay), and starting at fruit set additional foliar fertilizer K applications were made at weekly intervals using several K salts (KCl; KNO<sub>3</sub>; potassium thiosulfate - KTS; & Potassium Metalosate, KM). Even though pre-plant soil K concentrations were high (> 300 mg/kg; especially on the clay soil), supplemental foliar K treatments resulted in generally higher tissue K concentrations. Fruits from plants grown on the heavy soil had higher K concentrations, soluble solids, sugars, and phytochemicals (ascorbic acid and β-carotene) than those from plants grown on the sandy soil. The relative responses to foliar K were greater on the sandy soil than the clay soil. There were no consistent trends among K sources except for KNO<sub>3</sub>, which tended to result in poor fruit

quality compared to control fruit especially on the sandy soil. The results demonstrate that mid- to late-season foliar K applications can improve melon fruit quality and indicate that the relative benefit of this quality improvement strategy depends on soil type.

### Hydraulic Conductance Characteristics of Rootstocks for Watermelon Grafting

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Watermelons and other cucurbits are susceptible to several root rot, vine decline, and wilt diseases that impact productivity by reducing root capacity for water and nutrient uptake. Grafting susceptible varieties on resistant rootstocks often alleviates this problem; however, graft incompatibility and poor fruit quality have frequently been reported, hence the need to identify alternative rootstocks. The goal of this study was to characterize physiological and growth differences among rootstocks from different genera in order to predict traits that may improve productivity under drought conditions. Leaf photosynthesis (Pn) stomatal conductance (gs), transpiration (E), water potentials (Ψl), root dry matter allocation, and root hydraulic conductance (Lr) characteristics of 6-week old seedlings of four hybrid squash varieties: *Cucurbita maxima* cv: 'Strong Tosa', 'RS1330', 'Shintosa Camel', and 'Tetsukabuto'; a *Lageneria siceraria* variety (cv. Pelops), and a commercial scion watermelon variety (cv 'Super Seedless 7167') were investigated. Leaf water potentials were significantly higher among the rootstock varieties than in the commercial scion variety, even though the leaf areas were significantly greater in the former. Leaf stomatal conductance (gs), transpiration (E) and photosynthesis (Pn) values followed similar trends as Ψl. Allometric relationships between roots and shoots differed between the commercial variety and rootstocks, with the former generally having lower root dry mass allocation coefficients. Among the rootstock varieties, 'RS1330' had the highest root dry mass allocation coefficients. The average Lr of rootstock varieties was significantly greater than that of the commercial variety. Although biomass allocation to roots was greatest in 'RS1330', Lr values were greatest in 'Tetsukabuto'. Differences between the rootstocks and the commercial variety are consistent with predictions of ample water supply by vigorous root systems; however, the current data also indicate differences in the capacity for water flux through root systems of the rootstocks studied.

### Investigating Flavonoid and Capsaicin Levels in Various Texas A&M Habanero (*Capsicum chinense*) Breeding Lines When Grown in Multiple Locations in Texas

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Peppers (*Capsicum* spp.) are a popular vegetable and spice, supplying a degree of "hotness" to one's palate. The source of pungency in peppers, capsaicin, is believed to be unevenly distributed in the pod and concentrated in the placental tissue of fruit. Capsaicin content is influenced by the specific variety, stage of maturity, geographic location, growing conditions, and location within fruit. Over the years, researchers at Texas A&M University have developed an array of diverse habanero breeding lines expressing various capsaicin levels. In 2008, habanero seedlings were planted at three Texas Agri-Life research locations (College Station, Uvalde, and Weslaco) in completely randomized designs. Plants were grown using commercial practices, and fully mature fruit were harvested and relocated to College Station, TX. Peppers were held at -80 °C until analysis ensued at the analytical core unit of the Vegetable and Fruit Improvement Center. 100% methanol was used to extract both flavonoids (quercetin and luteolin) and capsaicinoids (capsaicin and dehydrocapsaicin) out of fruit tissue. At the end of the preparation process, each sample was inserted into a high performance liquid chromatography (HPLC) machine to complete the analysis. A Nova-

pak C-18 4-μm isocratic column (0.5% H<sub>3</sub>PO<sub>4</sub> in water + 0.5% H<sub>3</sub>PO<sub>4</sub> in methanol, 360 nm, 1 mL/min, 20 min.) and a Nova-pak C-18 4-μm isocratic column (45% ACN in water, 220 nm, 0.8 mL/min, 20 min) were used for flavonoids and capsaicin analysis, respectively. Preliminary results are confirming observations obtained from previous studies showing variation present in fruit tissue of these phytochemicals when grown in different locations expressing a GXE interaction.

### Response of Mustard Greens to Gypsum in Sulfur Deficient Light and Heavy Textured Soils

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Low rainfall and soil organic matter contribute to low sulfate levels found in south Texas soils. In Fall 2008, a light textured (Hebbronville) soil and a heavy-textured (Raymondville) soil were supplemented with 0, 560, 1120, and 2240 kg S/ha (as gypsum) and seeded to 'Florida Broadleaf', *Brassica juncea*. After 76 days, gypsum application improved yield in plants grown in the lighter-textured soil (linearly,  $P=0.05$ ) and at the 1120 kg/ha rate in plants grown in the heavier-textured soil ( $P\leq 0.07$ ). Gypsum application rate improved plant weight (linearly) and marketable leaf area (quadratically). Sub-sampled plants grown in the heavier-textured soil had improved plant weight, marketable leaf area, and average leaf area compared to the light-textured soil. Total leaf tissue S was increased linearly to 36% of controls in the light-textured soil and quadratically to 20% of controls at the 1120 kg/ha rate in the heavy-textured soil. In the heavy soil, gypsum addition reduced leaf C:N ratio, K, P, and B levels and increased leaf N (all linearly). In the light soil, leaf K was increased and B decreased (both linearly) by added gypsum. Response of leaf chlorophyll and total carotenoid content to increasing gypsum application was cubic in the lighter textured soil and quadratic in the heavier soil with optimum responses at 560 and 1120 kg/ha, respectively. Gypsum incorporation, at the rates applied prior to seeding, improved harvest yields 7 and 9 t/ha in light and heavy-textured soils, respectively.

### Row Arrangements, Seeding Rates, and Gibberellic Acid Treatments to Improve Yield of Machine-harvested Cilantro

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Factorial combinations of two row arrangements on 1.8-m-wide beds (either 4 rows, each 30 cm apart, or 8 rows, each 15 cm apart) and two in-row seeding rates (either 48 or 96 seeds per 30 cm of row) were compared on 'Santo' cilantro (*Coriandrum sativum* L.) in five experiments at Bixby, OK. Plots were harvested once per experiment by cutting at a height of  $\approx 7$  cm with a small-plot greens harvester, and fresh weight yields were taken. Treatments minimally affected canopy height at harvest. Eight rows resulted in higher yields than four rows in 3 of 5 experiments. Main effects of seeding rate or interactions of row number and seeding rate on yield were rare. Of the four combinations tested, the 8-row arrangement sown at 48 seeds per 30 cm would be recommended. This arrangement was used in three other experiments to test effects of a single preharvest spray application of gibberellic acid (GA). Treatments were a water control and GA at either 10 or 20 g·ha<sup>-1</sup>. Treatment with GA increased bolting in a 17 Apr. planting and increased canopy height at harvest in 2 of 3 experiments. However, GA treatments did not affect yield. Treatment with GA would not be recommended for a spring cilantro crop, but should be studied further for use in a fall crop.

### Soil Changes after Four Years of Organic Vegetable Production

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In 2002, scientists at the Lane Agricultural Center in southeastern Oklahoma began a study to explore the potential for organic agricultural production. Land was certified as organic according to

the guidelines of the National Organic Program. To begin the study, soil samples were taken in 2002. Lime was added based on soil test recommendations. For 4 years, vegetable crops were grown in the summer and cover crops were grown in the winter. In most years, crimson clover and cereal rye were grown as cover crops. During the spring, the cover crops were plowed under, and four vegetable crops (tomatoes, sweet corn, southern peas, and watermelon) were planted. The vegetables were rotated within the plots each year, so that a different crop was grown in each location each year. Poultry litter was applied to the soil five times over the 4-year period. The total amount of litter applied was approximately 11.5 tons per acre, and the analysis of the litter was approximately 2% of N, P, and K. After the 4-year rotation was completed, soil samples were taken to determine soil changes that had occurred. Organic matter did not change over the length of the study. Soil pH increased. Potassium and calcium levels in the soil approximately doubled. Neither nitrogen nor magnesium changed substantially. Copper and zinc levels more than doubled. Phosphorus increased by approximately seven times. Sulfur and iron decreased, and boron increased by about 50%. In general, the use of poultry litter and cover crops for 4 years has greatly improved the nutrient status of the soil. Many of the nutrients that were formerly deficient are now at recommended levels. No nutrients are currently present at excessively high levels. However, if the former poultry litter fertilization practices are continued, we anticipate that levels of P and perhaps other nutrients could soon reach excessive levels.\

### **Yield Response of Okra to Transplanting**

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Transplanting of okra was evaluated for effects on earliness of maturity in 2008 and 2009 at Lane, OK. Okra 'Clemson spineless' was started in Speedling trays that were placed in a greenhouse for subsequent transplanting to the field. Each year, seed were sown at five dates during early to mid May to produce plants with ages ranging from 17 to 35 days when transplanted to the field. Okra was transplanted on 3 and 8 June in 2008 and 2009, respectively, and treatments of direct seeding were established the same dates (direct seeded was replanted 26 June in 2009 due to plant loss). Once okra began to set fruit, pods were harvested 2-3 times per week over an 8-week period. In 2008 the average total number of pods harvested over 8 weeks was 2.83 x 10<sup>5</sup> pods/acre and did not differ among treatments. In 2009, total yield of direct-seeded okra was 3.78 x 10<sup>5</sup> pods/acre, which was 50% of the average for transplanted okra. When analyzed by 2-week intervals, no yield differences were detected for the 6- to 8-week harvest. In both years direct seeding had lowest yields during the 2- to 4-week harvest and during the 4- to 6-week harvest in 2009. Transplanting was an effective means of increasing early season yields. Transplanting may also serve to reduce the risk of harvest delays that can result from plant loss at seeding.

### **Multiple Comparisons of Treatment Means Using the Simulation-Stepdown Method in SAS**

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Analysis of continuous data (such as plant height or root length) in response to classification treatment effects (such as different growing substrates) often requires comparison of multiple treatment means. Numerous multiple-comparison procedures (MCPs) have been developed that test null hypotheses of no difference between treatment means (pairwise comparisons), while controlling the familywise error rate (FWE; also known as the experimentwise error rate or overall Type I error rate) by providing adjusted p-values that account for the multiple, simultaneous comparisons. The Bonferroni adjustment and Tukey's (HSD) test are examples of MCPs. Fisher's LSD does not control the FWE, except in the case of Fisher's Protected LSD (when significance is indicated by an overall ANOVA *F* test and when comparing no more

than three treatment means). Without an adjustment for multiple comparisons, the FWE increases as the number of treatments increases. While MCPs control the FWE, these tests can be conservative, with the actual alpha being less than the prescribed alpha. Newer MCP methods are now available in SAS/STAT procedures that are more powerful in detecting significant differences between treatment means, while still controlling the FWE. Simulation methods (also known as resampling methods or approximate permutation tests) use the actual data to represent the distribution of the data, rather than relying on an assumed distribution (such as the normal distribution), and can provide additional power for running multiple mean comparisons. Stepdown methods can also be used along with MCPs to improve power. Stepdown procedures involve the ordering of the unadjusted p-values from smallest to largest, reducing the family size (number of remaining comparisons) for each sequential p-value, and adjusting of the p-values accordingly. The power of stepdown procedures can be enhanced by taking into account certain logical constraints among the null hypotheses. The GLIMMIX procedure of SAS includes options under the LSMEANS statement to utilize simulation, stepdown, and logical constraint methods for multiple comparisons. Sample code for a simple case is as follows: PROC GLIMMIX DATA=dataset; CLASS trt; MODEL response = trt; LSMEANS trt / ALPHA=0.05 ADJUST=SIMULATE (SEED=1) STEPDOWN (TYPE=LOGICAL) LINES; RUN;

### **Landscape Design of a Vertical Plane: The Clemson University Green Wall Project**

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The heat-island effect of urban areas is an increasing problem in many cities globally. The use of green roofs has emerged as one solution to this problem, and green walls are now beginning to provide a more visible solution. The ornamental capacity of green walls far exceeds that of green roofs; they enrich city walls; break up straight lines; and add color, texture, seasonal interest, and biodiversity while providing insulation and evaporative cooling. Growing plants on vertical surfaces isn't exactly a new concept; however, many more people are implementing green walls in today's "going green" approach to architecture. These living walls have been largely popularized and inspired by French botanist Patrick Blanc. They are not just aesthetically pleasing but are useful in meeting Leadership in Energy and Environmental Design (LEED) certification requirements and have the ability to help offset the carbon footprint. The Clemson University Green Wall project followed a landscape design methodology including research of different green wall systems and case studies, site analysis of several potential on-campus sites; site selection, preliminary design, and final master-plan. The site chosen is on the western façade of the Biosystems Research Complex near the entrance to the Clemson University greenhouse facility. This location will provide excellent opportunities for the horticulture department faculty, staff, and students to participate in the implementation and management of a green wall system. Plant selection involved choosing plant material for the site's challenging full sun western exposure, while featuring seasonal color and interest. Construction detail drawings were developed after researching green wall systems and selecting a support structure that met the engineering, irrigation, and growth requirement needs of this campus project. Results include the landscape design of a vertical plane intended to create visual excitement, energy savings, and educational and research opportunities that can serve as a model for other institutions.

### **Orchard Design Affects Satsuma Mandarin Fruit Quality, Orchard Temperature, and Light Interception**

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Freeze protection is the most challenging aspect of growing citrus commercially in Alabama. Among other strategies, growers in South Alabama use various orchard designs to protect their Satsuma mandarin orchards from freeze damage. These orchard design

strategies include planting in open fields with microsprinkler irrigation, interplanting between pine and pecan trees, and planting behind windbreaks. The effects of these orchard designs on key characteristics of Satsuma mandarin production have not been reported. Hence, the goal of this research was to evaluate the effects of different orchard designs on orchard temperature, light interception, fruit quality and yield. Five orchards were selected based on their orchard design, and four trees were randomly selected as experimental units within each orchard. For each experimental unit, a temperature data logger was placed within the canopy of the tree, outside the canopy, and in an open area outside the orchard for comparison. The orchards that were interplanted with pine trees had the greatest insulating effect on temperature when compared to the control. However, the low light interception under the pine tree canopies contributed to a reduction in fruit quality and yield. The fruit from trees under pine tree canopies were smaller and had reduced peel color. The orchards planted in the open, between (dormant) pecans trees, and behind a windbreak had the greatest light interception, which contributed to good fruit quality. However, the orchard designs with high light interception provided little protection against freezing temperatures, and microsprinkler irrigation technology may be necessary to reduce freeze damage in these orchards.

### Effects of Organic Rooting Treatments on *Vaccinium darrowii* 'Native Blue' Blueberry Cuttings

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*Vaccinium darrowii* 'Native Blue' is a low-growing compact evergreen shrub with foliage color from light pink to dark green. This cultivar reaches 3 ft at maturity, produces small semi-sweet fruit, and can be propagated by seed or cuttings. Today many organic rooting treatments are being utilized. Many reports claim honey and Salix solutions decrease rooting time. The objective of this experiment was to compare organic and inorganic rooting treatments to determine which treatment promotes root growth from tip cuttings for 'Native Blue' blueberries. On 17 July 2009 'Native Blue' tip cuttings were taken from Mill Creek Blueberry Germplasm Plots in Nacogdoches County, TX. Tip cuttings were treated by a quick 30-s dip in one of 12 rooting treatments. The treatments included an untreated control, two boiled honey solutions (1 and 2 tablespoons of honey: 473 mL of water), eight Salix solutions (20 and 40 g of Salix leaves: 0.95 L water boiled or puréed; 20 and 40 g of Salix stems: 0.95 L of water boiled or puréed), and Hormodin® 2 (IBA 0.3%). Treatments were arranged in a randomized complete-block design. Tip cuttings were stuck in 1:1 pine bark/perlite substrate ratio. The trays were placed in a mist chamber. Tip cuttings were visually checked at 14, 21, 28, 35, 42, 49, 56, and 84 days after treatment (DAT) to determine differences in root development and rooting time. In visual checks 14 to

49 DAT, 16 of 48 tip cuttings were checked. In each visual check in 56 and 84 DAT all 48 tip cuttings were checked. The data were analyzed by Repeated Measures ANOVA with Binary Response with a minimum significance level of 0.05%. When comparing all treatments and times over the 84 DAT period, treatment type did not significantly affect rooting percentages, and all treatments, including the control, indicated rooting percentages above 81%. When considering only 35 and 42 DAT, the data indicated that the rooting percentage for the Salix treatment (40 g of Salix stems: 0.95 L of water boiled) was significantly greater than the control and Hormodin® 2.

### Efficacy of Biofungicides for Control of Pythium Root Rot in Poinsettia (*Euphorbia pulcherrima* Willd. ex Klotzsch)

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Pythium stem and root rot is considered the most consistent and serious soil-borne disease problem in poinsettia (*Euphorbia pulcherrima*) production. Pythium stem and root rot is favored by cool, saturated, poorly drained soils. Resistance management is a vital component of greenhouse production of floriculture crops. A key component of resistance management is integrating biofungicides into a disease management program. The objective of this research was to evaluate the efficacy of biofungicides on controlling pythium stem and root rot. Rooted cuttings of 'Prestige Red' poinsettia were potted in 10-cm square pots on 22 Aug. 2009 and water or one of the following treatments was applied to each plant on 11 Sept.: 78 µL/L mefenoxam (SubdueMaxx), 0.97 mL/L mono- and di-potassium salts of phosphorous acid (Alude), 0.3 g/L *Trichoderma virens* strain G-41 (RootMate), 0.3 g/L *T. harzianum* Rifia strain KRL-AG2 (RootShield), and 0.3 g/L of combination of *T. virens* strain G-41 and *T. harzianum* Rifia strain KRL-AG2 (BW240). The experiment was arranged as completely randomized block design with 14 replications. On 14 Sept., plants were transplanted in 15-cm azalea pots with pythium inoculation to provide 27 cfu of pythium per gram of moist soil or plain rice. Weekly visual rating of plant health and plant growth measurements started on 21 Sept. Plants were pulled out of the pots to estimate root health visually and the shoot was harvested at medium surface to measure the final shoot dry weight on 9 Nov. Plants treated with biofungicides (Alude, RootMate, RootShield, and BW240) were not as salable as plants treated with SubdueMaxx after being inoculated with *P. aphanidermatum* or uninoculated control. Plants treated with Alude had higher visual shoot and root ratings than plants treated with the other biofungicides. Some plants with very healthy roots did not have comparable size of shoots. Biofungicide treatments longer than 72 h prior to pythium inoculation will be worth investigation for biofungicide efficacy.