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J.B. Edmond Undergraduate Student Paper Competition

Evaluating Hard Pinch Timing of *Dendranthema morifolium* on Lateral Shoot Branching and Flowering Response

Stephen Blanchette, Patrick N. Williams, and Kris-Ann E. Kaiser, Department of Agricultural Sciences, Murray State University, Murray, KY 42071-3345

Murray State University has a small horticultural program and with that labor must be utilized as efficiently as possible. Each year the program grows approximately 2800 hardy garden chrysanthemums and follows recommended cultural scheduling and practice of pinching 7 to 10 days after planting. To reduce labor costs, a treatment of pinching at planting time was incorporated. Four Yoder cultivars of *Dendranthema morifolium* were used: 'Bethany', 'Foxy Marjorie', 'Marjorie', and 'Okra'. All cultivars were in the late-season extender category and either medium or tall in height. Rooted cuttings were planted in Mycorise Pro-Mix substrate in an 8-inch bulb pan on 8 June 2007. A total of 240 rooted cuttings were planted for each cultivar, 120 for control and 120 for treatment. The plants were then placed in randomly assign blocks of 40 plants. Two measurements were used to assess plants' reaction to control and treatment pinch timing: area index ($h w^1 w^2$) and flower bud count. Final measurements were taken 16–19 Sept. 2007. Flower bud count was assessed by randomly selecting five plants per block and photographing the plant. Photographs were imported into Microsoft® Paint and counted. 'Marjorie' was the only cultivar with a significantly larger area index for the control at $P \leq 0.001$. There were no significant differences in flower bud count. Results from this initial research project will influence future production practices at Murray State University for growing chrysanthemums.

Designing a Memorial Garden for the Riley Child Development Center Emphasizing Education

Susannah Horton* and Mary T. Haque, Department of Horticulture, Clemson University, Clemson, SC 29634-0375

The Riley Child Development Center is a busy 4K early learning center whose primary purpose is to prepare at-risk children for kindergarten. The school opened in 2005 and has had little development with respect to outdoor spaces. The Riley Center staff, children, and parents along with Clemson University students and faculty worked together on a project to design a memorial garden while keeping an emphasis on education. The design methodology used was as follows: research, site analysis and inventory, program development, design, and implementation. The final design solution included four storybook gardens, an outdoor classroom for learning, a vegetable garden for hands-on experience to fulfill educational needs, a labyrinth, a memorial statue, and a gazebo for the memorial portion of the garden. Project goals included education about child abuse, hands-on horticultural education through gardening, environmental stewardship, and providing spaces for learning in an outdoor setting.

Norman F. Childers MS Graduate Student Paper Competition

Harvest Index of 'Rocky' Cucumber Plants (*Cucumis sativus* L.) Grown in 2000 ppm CO₂ Is Not Different from 'Rocky' Cucumber Grown in 400 ppm CO₂

Leah Crosby*, Ellen Peffley, and Cynthia McKenney, Department of Plant and Soil Science, Texas Tech University, Lubbock, TX 79409-2122

Cucumber is a diverse crop ranging in growth habit, pollination requirements, flower production, fruit type, and preparation methods. Greenhouse trials were conducted at Texas Tech University to screen cucumber cultivars for parthenocarp, gynoeceious, compact vines, and fruit load. Candidate cultivars screened were 'Alibi', 'Amour', 'Cucumber Bush', 'Diva', 'Genuine', 'H-19 Little Leaf', 'Marketmore 76', 'Rocky', 'Socrates', and 'Tyria'. Of these, 'Rocky' was chosen for environmental growth chamber trials because it is a gynoeceious, parthenocarpic pickler type and consistently yields fruit throughout the growing season. Plants were grown hydroponically in environmental growth chambers at 16 hours light/8 hours dark, 24 °C/20 °C, 75%/99% relative humidity, ~650 $\mu\text{mol}/\text{m}^2$, and ambient (400 ppm) or elevated (2000 ppm) CO₂. Data collected were leaf area, fruit weight, plant weight, and harvest index. Fruit of marketable size were harvested weekly. Leaf area was measured by removing leaves from the 10th and 20th nodes and running leaves through a LI-3100 area meter. At the termination of the experiment plants were harvested and weighed. Data were analyzed using the Mann-Whitney *t* test ($P = 0.05$). Leaf area and total fruit weight of plants grown in 400 ppm CO₂ was significantly different than those grown in 2000 ppm CO₂. Mean weight of plants grown in 400 ppm CO₂ (327 g) was significantly different than mean weight of plants grown in 2000 ppm CO₂ (654 g). Harvest indices of plants grown in 400 ppm CO₂ were not significantly different than plants grown in 2000 ppm CO₂.

Evaluating Seashore Paspalum Seed Germination and Enhancement, Erosion Abatement, and Potential Use as a Vegetative Landfarm Cap

Dexter Paul Fontenot, Louisiana State University, LSU AgCenter, 137 J.C. Miller Hall, Baton Rouge, LA 70803

Four temperatures were tested to determine the optimum temperature for seed germination of *Paspalum vaginatum* 'Seaspray' seed. Results indicated that *P. vaginatum* germination percentage was greatest at 30 °C. Three seed enhancement treatments were applied to *P. vaginatum* seed to determine improvements in germination percentage and MTG of the seed. Potassium nitrate, GA, and soaking seed in distilled water yielded greater germination percentages than the dry control. Seeds subjected to enhancement treatments had significantly faster MTG rates than the dry control seeds. Seeds also had higher germination percentage with exposure to light when compared to seeds that germinated in conditions not exposed to light. MTG was not significantly different.

Above-grade Planting with Organic Matter Improves Post-transplant Root and Shoot Growth and Physiology of Two Native Shrub Species

Julie L. Guckenberger* and Amy N. Wright, 101 Funchess Hall, Department of Horticulture, Auburn University, Auburn, AL 36849

Wright et al. (2007) had success transplanting container-grown woody shrubs using a modified version of the above-grade planting technique typically used for trees: the root ball was left above grade, but rather than the remaining soil, a shallow layer of 100% pine bark was applied to the top of the exposed root ball and a thick layer of pine bark was applied around the root ball, tapering from the root ball down to the surrounding soil grade to 30.5 cm (12 inches) from the stem. To further investigate this modified technique, 24 plants each of *Morella cerifera* (L.) Small (syn. *Myrica cerifera* L.) (wax myrtle) [11.3 L (3 gal)] and *Kalmia latifolia* L. (mountain laurel) [19 L (5 gal)] obtained at the same time were planted on 30 Oct. 2006 (fall planting) and 12 Apr. 2007 (spring planting) in six rows in a shade house in Auburn, AL. At planting in fall and spring, plants of each species were randomly assigned one of four treatments. Three of the four treatments utilized the modified above-grade planting technique described above using either pine bark (PB), peat (P), or cotton gin compost (CGC). In the fourth treatment, plants were planted at grade with no organic matter (NOM) using only the native field soil (Marvyn sandy loam). Net photosynthesis (net Ps) and stem water potential (ψ_{stem}) were measured 15–23 Aug. 2007 for shrubs of each species planted in the fall and spring before and after irrigation. Plants were harvested 18 Sept. 2007. Generally, for both species at harvest, shrubs planted in the fall had higher shoot dry weight (SDW) and root ball diameter (RBD) than when planted in spring. Plants also typically had higher RBD when planted in PB or P. *Myrica cerifera* had higher net Ps than *K. latifolia*, and both species had higher net Ps after irrigation than before. Differences in net Ps before and after irrigation were more pronounced for shrubs planted in the spring than in the fall. Highest net Ps and ψ_{stem} were generally observed for shrubs in PB and P. For easy-to-transplant species (such as *M. cerifera*) and especially for difficult-to-transplant species like *K. latifolia*, fall planting utilizing this modified above-grade planting technique with PB or P may reduce post-transplant stress, improve post-transplant root growth, and speed establishment.

Woody Ornamental Plant Response to Simulated Glyphosate Drift

D.R. Mack and E.W. Bush, Louisiana State University AgCenter, 137 J.C. Miller Hall, Baton Rouge, LA 70803

Field research was conducted during Summer 2007 to evaluate the response of azalea (*Lagerstroemia indica* L.) and crape myrtle (*Rhododendron* spp.) to simulated drift rates representing 0%, 5%, 10%, 100% of the usage rates of 1120 g·ha⁻¹ a.i. glyphosate. Drift occurs when herbicide moves into a non-targeted area. When this happens, adjacent crops and landscapes sometimes experience damage to desired plant material. Two sequential post-emergent applications were made to 'Dwarf Tradition', 'Orange Fashion', and 'Pink Ruffles' azaleas and 'Catawba', 'Sioux', and 'Tonto' crape myrtles. Azalea and crape myrtle injury occurred in most treatments with differences between treatments. Plant injury significantly increased with 5%, 10%, and 100% of the recommended usage rates of glyphosate. Higher rates produced commercially unacceptable plants (6.4 and below). Visually, flower bud abortion occurred with crape myrtles by 7 DAT typically recovering by 28 DAT. 'Sioux' and 'Pink Ruffles' varieties proved more susceptible to glyphosate applications than the other cultivars. 'Tonto' was least susceptible to glyphosate treatments compared to 'Dwarf Tradition' which was the most susceptible. 'Catawba' recovered faster than the other cultivars. By 35 DAT, all plants showed signs of recovery, indicated by unaffected new growth. A second application of glyphosate was applied with similar results. After the second application of glyphosate, plants declined as expected, but recovered as before 35 DAT.

Effects of Balanced Pruning and Cluster Thinning on Vigor, Yield, Fruit Composition, and Wine Phenolics of Vidal Blanc Grapevines

Patsy E. Wilson*, D.A. Archbold, and S.K. Kultural, Department of Horticulture, College of Agricultural Sciences-N 318, University of Kentucky, Lexington, KY 40546-0091

Response of vine vigor, yield components, fruit composition, wine phenolic composition, post-fermentation, and post-bottling of 'Vidal blanc' grapevines to three pruning levels of 20, 30, and 40 nodes retained for each 454 g of dormant prunings; and three cluster thinning levels of 1, 2, and 2+ clusters per shoot were measured at a commercial vineyard in the lower midwestern U.S. There was very little interaction of pruning and cluster thinning on variables measured. Vine vigor [dormant pruning weight (kg) per canopy length (m)] decreased as crop load (kg yield/kg pruning weight) increased. Increasing the severity of cluster thinning led to a 44% reduction in number of clusters harvested that translated to a 45% reduction in yield per vine. Increasing the severity of pruning resulted in a 68% increase in total wine phenolics when measured 41 days after bottling when 20 nodes were retained per 454 g of dormant prunings. Retaining one cluster per shoot, regardless of pruning severity resulted in a 65% increase in total wine phenolics when measured 41 days post-bottling. There was an interaction of balanced pruning and cluster thinning on pineapple, apple or apple/fruit aromas in wine head-space where 30 nodes and two clusters retained per shoot presented constant fruit aroma in the wine. A crop load of 8–12 (kg·kg⁻¹) corresponds to vine vigor of 0.4 kg·m⁻¹, 9–12 kg yield per vine, total soluble solids of 16.5% to 16.4%, juice pH of 3.37 to 3.34, titratable acidity of 4.75 mg·L⁻¹ to 4.69 mg·L⁻¹, and 32.96 mg·L⁻¹ to 31.14 mg·L⁻¹ of gallic acid, 26.5 mg·L⁻¹ to 34.8 mg·L⁻¹ of 3,4-dihydroxybenzoic acid, when measured 41 days post-bottling, respectively.

Warren S. Barham PhD Graduate Student Paper Competition

Phytoremediation Urban Landscape Trees

Kathryn Fontenot, Louisiana State University, LSU AgCenter, 137 J.C. Miller Hall, Baton Rouge, LA 70803

The North/South Organic Pond is a closed 1-acre impoundment on the property of Georgia-Gulf Chemical & Vinyls LLC. Although the soil was remediated in a closure in 1989, a downward gradient groundwater plume remains. Georgia-Pacific Corporation has funded a pilot phytotoxicity study to determine an optimum tree species for removal and control of the constituents of concern. Together, Professional Service Industries, Inc. and the Horticulture Department at Louisiana State University constructed a greenhouse and hydroponic system to test five tree species, *Taxodium distichum*, *Salix nigra*, *Juniperus virginiana*, *Pinus glabra*, and *Quercus nigra* for their phytoremediation capabilities. The pilot study was initiated in June 2006 and completed in Mar. 2007. Trees were subjected to six water treatments from three of the North/South Organic Pond monitoring wells. Trees were evaluated monthly for possible health affects of the constituents of concern. Monthly tree height and caliper measurements along with visual ratings were taken. Initial and final tissue (root and shoot) and soil samples were collected for analysis of potential presence and concentrations of the constituents of concern in the plants and potting media. Monthly water input and discharge samples were collected and analyzed for the constituents of concern. Results from the pilot study indicate that *T. distichum* was the optimum tree species for phytoremediation of the existing groundwater plume. *Taxodium distichum* species was the most tolerant tree species to the dilutions of the contaminated water treatments and salinity levels. Further studies will be initiated to determine phytoremediation capabilities of tree species at higher concentrations of the constituents of concern.

Photosynthetic Efficiency and Sensory Quality of *Allium fistulosum* (L.) Grown in Elevated CO₂

Amanda Broome and Ellen B. Peffley, Department of Plant and Soil Science, Texas Tech University, Lubbock, TX 79409

Allium fistulosum were grown at 400, 1200, and 2000 ppm CO₂ in environmental growth chambers. Shoots of these plants were harvested at 50-mm from media surface bi-monthly (28, 42, 56, and 70 days). Photosynthetic efficiency was determined after fluorescence ratios were measured with a pulse-amplitude-modulated fluorometer. Chlorophyll (a + b) and carotenoid content was quantified in harvested leaves. The ratio of F_v/F_m (variable fluorescence/maximum fluorescence) and chlorophyll content were analyzed using SAS 9.1 Proc GLM and Duncan's multiple range test ($P = 0.05$). Leaves from plants grown at all CO₂ levels were photosynthetically efficient. Chlorophyll content was higher in leaves from plants grown in elevated CO₂ at 28 days; however, chlorophyll content was higher in leaves from plants grown in 400 ppm CO₂ at 70 days. Carotenoid content decreased in leaves from plants grown in 2000 ppm CO₂ at 56 and 70 days. A visual sensory consumer panel (n = 25) ranked leaves from plants at each of four harvest on a scale of 1 to 6 (dislike very much to like very much). Leaves from plants grown in elevated CO₂ were ranked as most visually appealing at 28 days; leaves from plants grown in 400 ppm CO₂ most visually appealing at 70 days.

Glycoalkaloid Levels in *S. microdontum* and *S. jamesii* Accessions: A Consideration in Parental Selection When Breeding for High Antioxidant Activity in Potato

M. Ndambe Nzaramba¹, John B. Bamberg², and J. Creighton Miller, Jr.¹, Department of Horticultural Sciences, Texas A&M University, College Station, TX, 77843-2133; ²U.S. Potato Genebank, Sturgeon Bay, WI 54235-9620

Antioxidants are useful in reducing risk of several diseases associated with free radicals. While potatoes are not as high in antioxidants as fruits, the fact that large quantities of potatoes are consumed (≈ 130 lb per capita) suggests that any increase in tuber antioxidants would greatly benefit human nutrition. Certain accessions of tuber-bearing wild potato species (*S. jamesii*, *S. pinnatisectum*, *S. megistacrolobum*, and *S. microdontum*) are higher in antioxidant activity (AOA) and total phenolics (TP) than commercially grown potato cultivars, and could be potential sources of genes in breeding for high AOA. However, most wild species are reported to contain high levels (>200 mg·kg⁻¹) of glycoalkaloids which are toxic to humans. Hence, use of wild species as parental material in breeding for high AOA and TP might also result in progenies with unacceptable glycoalkaloid (TGA) levels, if the traits are positively correlated. Therefore, the objective of this study was to screen all accessions of *S. jamesii* and *S. microdontum* in the National Potato Germplasm Bank (NPGB) for AOA, TP, TGA, individual phenolics and glycoalkaloids, and investigate their correlations. Ninety-two *S. jamesii* and 86 *S. microdontum* accessions were obtained from NPGB, Sturgeon Bay, WI. The DPPH and ABTS assays were used to evaluate AOA, while TP was estimated using the Folin-Ciocalteu method. Individual phenolics and glycoalkaloids were analyzed with HPLC. The glycoalkaloids -solanine and -chaconine were found in both *S. jamesii* and *S. microdontum*, while tomatine and dehydrotomatine were quantified in several *S. microdontum* accessions, but not in *S. jamesii*. Accessions of *S. microdontum* were higher in all traits measured than *S. jamesii*, and both species were higher than the cultivars Atlantic, Red LaSoda, and Yukon Gold. More than 90% of *S. jamesii* accessions had TGA levels <200 mg·kg⁻¹, while only 2 (PI 500041 and PI 473171) of the 86 *S. microdontum* accessions exhibited TGA content <200 mg·kg⁻¹. Significant correlations were observed between AOA and TP in *S. jamesii* ($r = 0.8$) and *S. microdontum* ($r = 0.9$). However, neither AOA nor TP was significantly correlated with TGA in *S. jamesii* ($r = 0.026$ and 0.132) and in *S. microdontum* ($r = 0.248$ and 0.274). Also chlorogenic acid, caffeic acid, rutin hydrate, and myricetin were not significantly correlated with TGA in either *S. jamesii* or *S. microdontum*. Therefore, since AOA and TP are not correlated with TGA, using wild accessions in breeding for high AOA would not necessarily increase glycoalkaloids in newly developed potato cultivars.

Interference of Bacterial Cell-Cell Signaling by Citrus Flavonoids

Amit Vikram¹, Palmy R. Jesudhasan², G.K. Jayaprakasha¹, Suresh D. Pillai^{1,2}, and Bhimanagouda S. Patil¹, ¹Vegetable and Fruit Improvement Center, Department of Horticultural Sciences; ²Department of Poultry Science, Texas A&M University, College Station, TX 77845

Citrus fruits contain a multitude of bioactive compounds with various health promoting properties. Flavonoids are important bioactive constituents of citrus fruits and numerous studies have demonstrated their benefits as anticarcinogenic, antithrombotic, anti-inflammatory and antioxidant activities. Certain flavonoids exhibit antibacterial activity particularly against Gram-positive bacteria; however, literature does not present consistent bioactivity against Gram-negative bacteria. In the present investigation five citrus flavonoids such as naringenin, quercetin, rutin, kaempferol, and apigenin were evaluated for their potential to inhibit bacterial cell-to-cell signaling and biofilm formation. *Vibrio harveyi* based bioluminescence reporter assay was used to determine the inhibition of autoinducer-2 (AI-2) mediated cell-to-cell signaling using AI-2 molecules produced by *Escherichia coli*. Potential of flavonoids to inhibit biofilm formation in *Escherichia coli* O157:H7 was studied in a 96-well plate assay. All the flavonoids were found to inhibit the cell-to-cell signaling and biofilm formation in concentration dependent manner. Moreover, structure-activity study revealed that presence or absence of double bond and/or hydroxyl groups at certain positions may be important for the antagonistic activity of citrus flavonoids in this model. This project is based upon work supported by the USDA-CSREES No. 2006-34402-17121 "Designing Foods for Health" through the Vegetable & Fruit Improvement Center.

Lemon Seed Extracts: Antioxidant Capacity and Inhibition of Breast Cancer Cells

Jinhee Kim, G.K. Jayaprakasha, K.N.C. Murthy, and Bhimanagouda S. Patil, Vegetable and Fruit Improvement Center, Department of Horticultural Sciences, Texas A&M University, College Station, TX 77845

Citrus fruits and their bioactive compounds demonstrated to prevent certain chronic, degenerative and cardiovascular diseases based on cell culture and animal studies. In the present study, potential of lemon seed extracts for radical scavenging ability and their role in programmed cell death induction using breast cancer cells (MCF-7) has been studied. Lemon seed powder was extracted with solvents of different polarity such as ethyl acetate (EtOAc), methanol (MeOH), and MeOH: water (8:2) using Soxhlet type extractor. Freeze dried extracts were screened for their radical scavenging activity using ABTS^{•+} and 1,1-diphenyl-2-picrylhydrazyl (DPPH). Among the four extracts, the highest antioxidant activity of 54.3 and 55.8% was exhibited by MeOH: water at 417 ppm in DPPH and ABTS, respectively. The phenolics were found to be higher in MeOH:water extract. Moreover, we also found apoptotic evidences through the morphological change, DNA fragmentation, cell proliferation, and Bax protein level. All the extracts have shown inhibition of proliferation and apoptotic morphological changes in the MCF-7 cells. Methanolic extracts induced fragmentation of DNA upon treatment for 24 hours. Incubation of cells with MeOH extract has shown elevation in the level of the Bax protein (bcl-2 associated X protein), which is an indicator of apoptosis as a possible mechanism. Results of the current study provided first hand evidence on lemon seed bioactives, as inducers of apoptosis in breast cancer. This project is funded by the USDA-CSREES No. 2006-34402-17121 "Designing Foods for Health" through the Vegetable and Fruit Improvement Center.

Education Section

An Analysis of Learning Styles and Attitudes toward Science of Gifted and Talented Students

Thomas W. Broyles, 268 Litton Reaves Hall, Department of Agricultural and Extension Education, Virginia Tech, Blacksburg, VA 24061

This descriptive study sought to investigate students' attitude toward science and also their preferred learning style. Attitudes toward

science may play a role in determining career choice or possibly choice of an agricultural major. Learning styles were measured using Kolb's learning theory to determine the student preference for learning. Ninety-seven high school rising juniors and seniors identified as gifted and talented attending a summer enrichment program for one month were surveyed to determine their preferred learning style and attitude toward science. The students completed coursework and a major research project in the broad fields of agriculture prior to completing the instruments. The participants were administered two instruments at the conclusion of the program. Ninety-seven students was the population of the program. The instruments were deemed valid by a team of faculty at the host institution and pilot tested to a group of junior and senior high school students not attending the program. The learning style instrument asked the participant to rank 36 statements that best characterized how they learn. From the participant's ranking, the researcher was able to categorize the participant's learning style into four categories of concrete, abstract, reflective, or active. Further, analysis of the data allowed the researcher to combine categories into concrete-reflective, concrete-active, abstract-reflective, or abstract-active. The attitudes toward science instrument measured the participants' perceptions in relation to self-efficacy, active learning strategies, science learning value, performance goal, achievement goal, and learning environment stimulations.

International Travel Preferences of Undergraduate and Graduate Horticulture Students

C.W. Robinson, L. Waters, Jr., and A.N. Wright, 101 Funchess Hall, Department of Horticulture, Auburn University, Auburn, AL 36849

Most academics would concur that international experiences help develop the multicultural competence of students as well as help them compete in our global marketplace. The Horticulture Department at Auburn University understands these needs and works to provide opportunities for students to develop these areas of their potential. The department created a needs assessment to appraise current international programs as well as potential programs in order to improve current opportunities and develop new options that would be most accepted and available to undergraduate and graduate students. The survey consisted of 30 questions regarding country selection, type of program, length of stay, and other aspects of academic travel abroad. Question formats included ratings using a Likert Scale, rankings in terms of importance, yes/no, and multiple choice. The student surveys were administered in Nov. 2006 to undergraduate classes offered by the Horticulture Department ($n = 145$, 65% response rate) and to the graduate students via their departmental mailboxes ($n = 15$, 50% response rate). Sixty-six percent of horticulture undergraduates and 93% of horticulture graduate students think international experience is somewhat or very important to their degree. Both undergraduates and graduate students felt that the educational benefits of international travel were more important than the cultural or career benefits (64% and 73%, respectively). The top factor in choosing an international experience was cost for the undergraduate students (95%) and benefits or activities of the trip for graduate students (100%), but both groups listed cost as the number one barrier to that travel (85% and 100% respectively). The top two desired locations by both groups for the international programs were Australia/New Zealand and western Europe. By understanding these needs and barriers, we can work to provide opportunities for students that will be both meaningful and viable to promote their professional and academic growth.

Incorporating Horticultural Training into an Undergraduate Sustainable Agriculture Curriculum

Timothy Coolong, Mark Williams, and Mark Keating, 318 Ag Sciences North, Department of Horticulture, University of Kentucky, Lexington, KY 40546-0091

An increasing number of land grant and non-land grant schools are implementing undergraduate degree programs in alternative, sustainable, and/or organic agriculture. Many of these programs originate as areas of specialized study or concentration within more traditional agricultural science majors, including horticulture. Maintaining the essential elements of an agricultural science major while finding room

for the additional requirements of an interdisciplinary discipline such as sustainable agriculture can be challenging. In 2007, the University of Kentucky (UK) introduced a sustainable agriculture curriculum with options for students to major or minor. The curriculum's requirements are closely modeled on the definition of sustainability used by the USDA's Sustainable Agriculture Research and Education (SARE) program. SARE defines sustainability as a management system applicable to any farm in which the producer optimizes environmental, economic, and social resources for the operation's long-term success. Maintaining a strong foundation in the coursework characteristic of agricultural science majors, UK's sustainable agriculture curriculum adds significant requirements in non-traditional areas including agricultural economics, sociology, and human nutrition. Horticulture plays a significant role in the curriculum through required coursework and a two-semester apprenticeship on the University-operated community supported agriculture farm.

Pursuing Victory with Honor: A Survey of Ethics and Sportsmanship in the Show Ring

Stanley F. Kelley and Marcy M. Beverly, Box 2088, Department of Agricultural and Industrial Sciences, Sam Houston State University, Huntsville, TX 77341-2088

Nationally, Texas has the largest participation of youth in livestock projects (>71,196). The 4-H and FFA livestock programs teach management skills and competencies in responsibility, respect, trustworthiness, fairness, caring, and citizenship which comprise the pillars of character outlined by Texas' Quality Counts Program and a part of the educational curriculum for these programs. A survey was administered to 848 youth participating in stock shows, clinics, and 4-H/FFA meetings to determine attitudes and predict perceptions of ethics and character. Respondents were grouped: 4-H ($n = 484$) or FFA ($n = 336$), gender (male = 447; female = 401), and age (8–9, $n = 81$; 10–12, $n = 159$; 13–14, $n = 149$; 15–16, $n = 165$; 17–18, $n = 112$; >19, $n = 182$). They agreed (99%) it was important to be a person of good character. However, 3% (13–16 age group) and males were more likely to disagree ($P = 0.001$). Ninety-one percent agreed ($P < 0.03$) adults in their life consistently set good examples of character (FFA members were more likely to disagree) with 94% indicating their parents wanted them to do what was ethically right (males and FFA members were more likely to disagree). Only 74% agreed they were better than most they knew when making the right choices, nonetheless, 92% were satisfied with their own ethics. But, 12% (15–16 age group) were less satisfied with their character than younger and older age groups and males and FFA members were more likely to be dissatisfied ($P < 0.01$). "People should play by the rules even if it means they will lose" received 13% negative responses (15–16; 17–18 age groups), though differing in their response 91% still agreed (males, less likely to agree) ($P < 0.02$). Likewise, 23% (15–16 age group) had no opinion or thought it was not considered cheating if everyone was doing it ($P < 0.025$), 12% (15–16 age group) felt it was not as essential to treat others with respect ($P < 0.001$). "Successful people do what it takes to win even if it is considered cheating" (43% agreed) while expressing anger in public was more acceptable ($P = 0.02$) by males, females agreed being fair was more important than winning ($P = 0.001$). A majority of the youth realized the importance of ethical values and character. Yet, those aged between 13 and 18, males, and FFA members differed from their counterparts in many of their ethical decisions and assessment of right vs. wrong judgment.

Service Learning in Horticulture: What We've Learned

David Knauff¹, David Berle¹, Anna Scott², and Steve Oliver², ¹Horticulture Department; ²Mathematics and Science Education Department, University of Georgia, Athens, GA 30602

Service learning has been incorporated into four courses taught in the Horticulture Department at the University of Georgia. One course requires semester-long teaching of science in elementary schools, and the other three courses include projects in residential design, landscape construction, and GIS/GPS applications in horticulture. Several components have contributed to success of the service learning experiences. Community-based need for projects and close collaboration

with community partners have been essential. The elementary science teaching course has benefited from weekly reflective journals by students, as well as from school teacher partner input that constitutes 30% of students' grades. Student laboratory fees have been used to purchase supplies needed for projects in all courses. Strong community demand has allowed instructors to choose projects that most closely align with course needs and that, because of location or specifics of a project, have greater chances for success. A range of assessment tools have been used in these four courses to document the value of service learning. Benefits have included quantitative changes in students' learn styles and knowledge construction; improvements in their time management skills; changes in a range of their attitudes, particularly as they relate to individuals with lower incomes; improvements in student course evaluations; and in one course the service learning experience has resulted in approximately 20% of the students changing career goals.

Do Service Activities Really Attract Students?

Dwayne Pavelock, Doug Ullrich, and Doug Kingman, Department of Agricultural Sciences, Sam Houston State University, Box 2088, Huntsville, TX 77341

University faculty are constantly aware of the importance of teaching, research, and grantsmanship. Oftentimes, that importance can be seen in annual evaluations and during the tenure review process. And then there's service activities ... the importance of such is often debatable. They are conducted to serve our profession, our university, our college, and our community. But are they really a recruiting tool? Do service activities, especially the hosting of competitions, affect the higher education plans of its participants? Participants in the 2006 Texas FFA Leadership Development Events (LDEs), held at Sam Houston State University, comprised the study's population. Via a mailed survey instrument following the conclusion of the event, a total of 928 participants were asked various questions regarding their experience and future plans. A 31.8% response rate was achieved. Data analysis consisted of simple descriptive statistics via Microsoft Excel. The data revealed some interesting perspectives and indicated that such service activities do affect the outlook of its participants on the host institution. Almost 97% intended to attend a four-year university. Over one-third (36.1%) expressed an interest in attending the host university (Sam Houston State University), and 77.2% intended to be on the campus again. A great majority (82.4%) had not previously been on the campus for a non-FFA activity, but 79.3% had been to another university for a non-FFA activity, and 71.5% had been to another university for a FFA activity. Almost one-half (49.5%) indicated that participating in events on university campuses influenced them to choose a particular university. Most (80.7%) respondents also indicated that the FFA provided them with opportunities to visit a university that they otherwise would not have had. Participants were also asked to rank six factors (ranked 1–6, with 1 being highest) influencing their choice of a university. The degree desired (2.26 mean) and scholarships available (2.49 mean) were given the highest consideration. Other factors and means included cost compared to other universities (3.29 mean), location (3.34 mean), and reputation of university (3.77 mean).

Contributions of Collegiate and Pre-collegiate Leadership Experiences to Alumni Leadership Development

John C. Ricketts, 110 Four Towers, Agricultural Leadership, Education, and Communication, University of Georgia, Athens, GA 30602

There is a need for strong leaders in the agricultural industry, and organizations are looking for college of agriculture graduates who demonstrate strong leadership abilities. This descriptive study presented in the Education Section of the 68th Annual Southern Region American Society for Horticultural Science meeting illustrates the most formative leadership-building experiences of college of agriculture alumni. Based on Ajzen's (1991) theory of planned behavior, researchers sought to describe the leadership experiences of undergraduate positional leaders at a land grant university; Compare collegiate leadership experiences based on pre-collegiate activities;

and Identify experiences participants believed had the greatest impact on their leadership development. College of agriculture alumni reported the highest pre-collegiate participation in 4-H and the FFA. The collegiate organizations they participated in the most were the Agriculture Honors Society (AGHON) and Ag Hill Council. Former 4-H and FFA members were more likely to be members of college of agriculture organizations, more likely to be officers in collegiate organizations, and more likely to participate, lead, and receive honors in organizations outside of the college of agriculture. Alumni perceived that collegiate leadership organizations had the greatest impact on their leadership development.

Extension Section

Design Your Own Herbicide Application Equipment

Joe Masabni, University of Kentucky Research and Education Center, P.O. Box 469, Princeton, KY 42445*

Fruit and vegetable industries in Kentucky are small in terms of acreage and sales dollars relative to agronomic crops in Kentucky. Many tobacco farmers took advantage of the tobacco buyout and are now raising fruits and vegetables. In addition, new farms are established as non-traditional farmers are planting fruits, small fruits, or grapes. As a result, small size farms can't invest in large or expensive spray equipment. Several pieces of herbicide spray equipment have been built and are being used at our research station as educational material to demonstrate to growers that a large capital is not necessary for efficient herbicide application. The first piece of equipment is a modified plastic layer that includes a nozzle directing the herbicide spray on top of the newly formed raised bed, just before the plastic mulch is laid. An example of such use is halosulfuron application under plastic in tomato production, per label recommendation. This design is essential in Kentucky as our growers use equipment that shapes the bed and lays plastic at the same time, unlike equipment used elsewhere, where bed formation and plastic laying are two separate operations. The second piece of equipment applies herbicides in orchards and vineyards by installing a two-nozzle boom on the side of a gator. Used with a speedometer and an electric on-off switch, one person can spray herbicides simply by driving a constant speed. The third piece of equipment modifies a ZTR mower to include a pull-behind sprayer and a two-nozzle boom attached to the front. This allows a grape grower to spray herbicides and mow the row middles in one pass.

Private-Public Collaboration in Developing an Organic Vidalia Onion Industry

*George Boyhan*¹, Ray Hicks², Reid Torrance³, Mike Dollar⁴, David Spaid⁵, Randy Hill⁶, and Relinda Walker⁷, ¹Department of Horticulture, University of Georgia, Southeast Georgia Extension Center, P.O. Box 8112, GSU, Statesboro, GA 30460; ²Screven County Extension, 321 Rocky Ford Rd., Sylvania, GA 30457; ³Tatnall County Extension, P.O. Box 558, Reidsville, GA 30453; ⁴Evans County Extension, 102 Daniel St., Claxton, GA 30417; ⁵Chandler County Extension, 1075 E. Hiawatha St., Suite B, Metter, GA 30439; ⁶Vidalia Onion and Vegetable Research Center, 8163 Hwy 178, Lyons, GA 30436; ⁷Walker Farm, Sylvania, GA*

Georgia Organics, the organic growers group in Georgia, acquired a grant from the Environmental Protection Agency to reduce pesticide use among three important crops in Georgia—blueberries, peanuts, and onions. Georgia is well known for sweet, mild onion production marketed under the Vidalia trade name. Several years ago growers began hearing from their buyers for a desire to purchase organically produced Vidalia onions. This dovetailed well with this grant initiative. Georgia Organics organized working groups with these three commodities and developed educational sessions in cooperation with University of Georgia personnel, most notably a full-day session each year for the past three years at the Georgia Fruit and Vegetable Grower Association Conference held annually in Savannah, GA. In addition, Georgia Organics and the University of Georgia have cooperated on county agent education and field days to help this emerging industry. In 2006, 45 acres of organic Vidalia onions were produced and in 2007 over 200 acres were produced.

AgrAbility: Techniques for Making Gardening Accessible

Richard G. Snyder^{*1} and *Wayne Porter*², *Mississippi State University, ¹Professor and Vegetable Specialist, Truck Crops Experiment Station, P.O. Box 231, Crystal Springs, MS 39059; ²Area Horticulture Agent, 410 Constitution Avenue 5th Floor, Meridian, MS 39301*

AgrAbility is a national program, funded by USDA–CSREES, that assists anyone in agriculture with their disabilities (<http://www.agrabilityproject.org>). Qualifying disabilities can be congenital, or caused by injury, disease, or mental illness. In the continuing quest to keep the Fall Flower & Garden Fest (<http://msucare.com/fallfest>) new and informative after 30 years, we added a component on gardening accessibility to the program. The target audience were the growing numbers of accessible-challenged individuals participating in the event, making up a larger portion of the 6000+ attendees in recent years. These included people using canes, crutches, and walkers; those in wheelchairs and electric scooters; and a growing number of elderly with age-related limited mobility. Many people still want to enjoy their passion of gardening but have found it difficult. Several types of planters were constructed to demonstrate creative ways to garden other than in the ground. These included hay bale planter, raised bed planter, wheelchair planter, wall bed planter, stepladder planter, bag culture, whiskey barrels, etc. Tools to assist with gardening were also displayed. Some were modifications of standard gardening tools (thicker handles, foam-covered handles, handle extenders) while others were selected for special needs (smaller size, ergonomic design, etc.). In the second year of the project, a new AgrAbility tent and signage were purchased to give the demonstration higher visibility and focus. In phase three, 2007, modular gardening was added to show how to make varying configurations of height and garden design, as well as portability, with milk crates. Also added this past year were disabled accessible picnic tables to promote inclusiveness in the food and drink area of the Fest; a low-profile accessible tour wagon was purchased as well so that people with any of the assisted mobility devices already mentioned could enjoy the wagon ride farm tours along with the others. The entire Fall Flower & Garden Fest is now promoted as a disabled accessible event. A summary of the project can be seen at <http://msucare.com/safety/agrability/mini-grant/garden-crystal/index.html>.

An Extension-based Viticulture Education Program for Oklahoma

Eric T. Stafne^{*}, *Brian Kahn*, and *Dale Maronek*, *360 Agricultural Hall, Department of Horticulture and Landscape Architecture, Oklahoma State University, Stillwater, OK 74078*

High-value horticultural crops are increasingly grown by Oklahoma producers who have found that traditional crops are no longer as profitable as they were in the past. In-state wineries desire Oklahoma-grown grapes, but the demand greatly outpaces the supply. One significant reason for the lack of supply is poor management of existing vineyards and poor decisions in the vineyard development stages. An extension course in basic grape management already exists, but students often state in end-of-course evaluations that they would like to continue their education with more advanced topics as well; therefore, a new program was developed to accommodate these requests. The new program is a cooperative effort among Oklahoma State University–Stillwater (OSU-S), Oklahoma State University–Oklahoma City (OSU-OKC), Tulsa Community College (TCC), and the Oklahoma Grape Growers and Winemakers Association (OGGWMA). It is administered by OSU-S and is a two-tier professional education program. The Basic level provides college training in the fundamentals of horticultural science, plus applied training in viticulture and related techniques through OSU Cooperative Extension. The Advanced level provides further college training in horticultural science and related disciplines, plus further applied training through OSU Cooperative Extension. There is a five-year total time limit to complete the program. The Basic level would need to be completed in two years, and the Advanced level would need to be completed no more than three years after completing the Basic level. Knowledge testing is required at completion of short courses and Extension workshops. A grade of “C” or better is required in all college-level courses.

Participants completing each level of the Viticulture Education Program will be duly recognized with a framed certificate at the annual conference of the OGGWMA. The program also serves as a recruitment tool, since participants have the potential to earn college credit that can go toward a four-year degree.

Working with Local Industry to Develop a Value-added Product

Kathryn C. Taylor^{*}, *Department of Horticulture, University of Georgia, 21 Dunbar Road, Byron, GA 31008*

Southeastern peach production provides an adequate profit for producers in years of optimum conditions. However, more profit can be gained from the crop if a suitable value-added fresh product is available. Our studies to develop a fresh slice from small size peaches that normally gain less profit has revealed that fruit ripeness must not be excessively advanced and the fruit must be free of bruising to have a pleasing appearance. We have developed a series of coatings that are effective in reducing browning while maintaining good fruit flavor and texture. County extension staff and industry leaders are participating in the testing of the product by consumers. Peach producers are supplying taste testing opportunities for fresh peach slices in their retail areas. With their participation, we are collecting data concerning preferred edible coatings, firmness of the slices, and varieties of peaches for slicing. Through their involvement we will be able to accelerate the introduction of this product to the market at large.

Fruit Crops Section

A Retrospective Analysis of Two Decades of Production and Climate Data at Mill Creek Blueberry Farm, Nacogdoches, Texas

*David Creech*¹ and *Henry Sunda*², *¹Department of Agriculture, P.O. Box 13000, Stephen F. Austin State University, Nacogdoches, TX 75962; ²Mill Creek Blueberry Farm, Route 1 Box 3170, Douglass, TX 75943*

Rabbiteye blueberries were introduced in East Texas in the 1960s and commercial fields were established in the 1970s and 1980s. Mill Creek Blueberry Farm is located 6 miles west of Nacogdoches on Highway 59, and 50 acres of ‘Climax’, ‘Premier’, ‘Brightwell’, ‘Tifblue’, and ‘Powderblue’ were planted in 1988. The site is a very well drained xeric sand and the water source is an 8-acre spring-fed lake with very high quality water. The preplant strategy involved clearing the primarily scrub forest and smoothing the acreage. That was followed by a crop of pearl millet that was mowed and tilled under. Prior to planting 1-gal containers, 90 cubic yards of composted pine bark and fines was banded down the rows (15-ft spacing) and tilled in. After planting, the rows were mulched on the surface with another 90 cubic yards of pine bark. The drip irrigation system has performed well for 20 years without replacement of field lines. Late spring freezes in the early 1990s dramatically reduced production. A sprinkler system for frost protection was installed in 1993 and has benefited the field several times when conditions allowed. In 2003, a 15-acre field of ‘Tifblue’ and ‘Powderblue’ was planted adjacent to the blueberry field. Field performance has been superior with a 2007 production of 751,072 lbs (11,210 lbs/acre picked, packed, and sold). Average production for the last 5 years in lbs/acre is as follows: ‘Climax’ (6530), ‘Premier’ (6641), ‘Tifblue’ (8132), ‘Brightwell’ (12,063), and ‘Powderblue’ (16,063). Mill Creek Blueberry Farm also serves as the cooperater site for Stephen F. Austin State University’s blueberry germplasm evaluation program, a cooperative effort with the USDA.

Images of and Reflections on the Developing Blueberry Industry in China

David Creech, *Department of Agriculture, P.O. Box 13000, Stephen F. Austin State University, Nacogdoches, TX 75962*

China’s growing blueberry industry is receiving great attention inside and outside of the country. The first China Blueberry Development Conference was held in Hangzhou in June 2007. Participants included university and government scientists, growers, and

international participants from Holland, Canada, USA, and other countries. Central and provincial governments have provided financial incentives to encourage growth of blueberry production in China. There are two primary groups in China's blueberry research and development: Professor Li Yadong's research and development team at Jilin University, Changchun, China (in the north); and Professors He Shanan and Yu Hong at the Nanjing Botanical Garden, Nanjing, China (in the south). Research projects include care and culture studies, variety evaluation, breeding and selection, postharvest trials, and new product development. A wide range of products (wine, candy, drinks, pills, pastries, etc.) have been developed and test marketed in the country and in the Pacific Rim. While fields are going in north of the Bohai Sea (highbush, northern highbush, and half-high), intense winter cold and dry conditions have limited plant growth. Shandong province, south of the Bohai Sea, is considered most promising and acreage there is increasing. In the south, rabbiteye blueberry plantings in Jiangsu, Anhui, Hubei, Yunnan, and Zhejiang provinces are young and vary in the success of growth and production. While accurate estimates are difficult to obtain, total area of production in China is still less than 1000 ha. However, the nursery base is enormous in the north and south, with production of nursery plants in the millions. Practices include very high density plantings and minimal applications of organic matter (in-ground and mulch). Site selection, summer rains, irrigation, and water quality are issues of concern.

Impact of Tree Girdling on Crop Load of 'Sunprince' Peach after Late Frost Event

*Kathryn C. Taylor**, Department of Horticulture, University of Georgia, 21 Dunbar Rd., Byron, GA 31008

Previous reports [J. Amer. Pomological Soc. 58:210–214; Compact Fruit Tree 39(3):25–28] have demonstrated that winter girdling trees of mid and late season peach varieties with cable ties improves yield, fruit size, earliness and return bloom without the level of damage caused by standard knife girdling. Fall application of ties to make similar improvements for early season varieties was compared to winter application of cable ties. The trial was interrupted by the Easter freeze of 2007, with significant crop loss. However, it was visually apparent that there might be yield and fruit size differences during a spring perusal of the crop. Thus, yield of 'Sunprince' peach trees that received cable ties applied during the fall or winter of 2006 was compared to that of control trees receiving no cable tie girdling. Yield of fall and winter cable tie treated trees was greater than yield of trees receiving no cable tie application. Yields were assessed from trees receiving these treatments and receiving no thinning after the natural thinning effects of the 23 °F freeze event of Apr. 2007. The 'Sunprince' trees with fall cable tie application had fruit that were 15% smaller than winter cable tie girdled trees, likely due to the higher average crop load (5%) than the winter cable tie girdled trees. Finally, trees receiving fall application of cable ties had 7.4% less frost damage than winter girdled trees and 19.74% less damage than the non-girdled control trees.

Performance of Muscadine Grape Cultivars in Alabama

*Elina D. Coneva*¹, *Floyd M. Woods*¹, *Bryan S. Wilkins*¹, *Jeff L. Sibley*¹, *William A. Dozier, Jr.*¹, and *Jason Burkett*², ¹101 Funchess Hall, Department of Horticulture, Auburn University, Auburn, AL 36849; ²Alabama Cooperative Extension System, 4725 County Rd. 40, Shorter, AL 36075

Nine fresh market and processing muscadine grape cultivars were selected to study their vegetative and generative potential in Alabama's environment. Vines were planted at the E.V. Smith Research Station in 1996. Vines from seven fresh market cultivars: 'African Queen', 'Black Beauty', 'Black Fry', 'Darlene', 'Early Fry', 'Janet', and 'Pam', were included in the study. 'Noble' and 'Ison'—two muscadine cultivars recommended for fruit processing—were also studied. Muscadine grape phenology and canopy performance were observed. Data were collected to evaluate yield and fruit quality characteristics. The results from our study suggest that 'Darlene', 'Black Fry', and 'Ison' had delayed budbreak compared with other cultivars in the test. 'Noble' muscadine grape had the greatest number of berries per cluster at set (16.8) and at harvest (16.1), followed by 'Ison' (12.1 and 10.9,

respectively). Among the fresh market muscadine cultivars, 'Pam' had the greatest number of berries per cluster. 'Noble' grape had the highest crop level (number of fruiting clusters per unit shoot length), followed by 'Early Fry' and 'Black Fry'. 'Noble' had the largest leaf area of 1976 cm² (measured on 30 leaves/vine). 'Pam' resulted in 81 kg/vine fruit harvested, while 'Noble' and 'African Queen' had 26, and 23 kg/vine harvested, respectively. 'Darlene' had the largest berry weight at 16 g, with berries up to 13 g recorded for 'Pam', 'Black Fry', and 'Janet'. Fruit sap pH for 'Early Fry' and 'Black Fry' was 4.0, while 'Ison' resulted in a pH of 3.5. 'Early Fry', 'Darlene', and 'Black Beauty' fruit had soluble solids of 16.7%, 16.1%, and 15.5%, respectively. Our first year data indicate that based on the grape yield, mean berry size, and fruit quality, muscadine cultivars Pam, Black Beauty, Early Fry, and Darlene could be suitable for production in Alabama with sustainable fruit production. Further research is needed to evaluate the muscadine cultivar performance under different environmental conditions in coming years.

Influence of Rootstock and Fruit Thinning on Fruit Quality and Yield of 'Jupiter', 'Mars', 'Marquis', and 'Neptune' Grapes

Kenda R. Woodburn^{1*}, *M. Elena Garcia*¹, and *R.K. Striegler*², ¹316 Plant Science, Department of Horticulture, University of Arkansas, Fayetteville, AR 72701; ²Institute for Continental Climate Viticulture and Enology, 108 Eckles Hall, 1406 East Rollins St., University of Missouri–Columbia, Columbia, MO 65211-5140

'Mars', 'Marquis', 'Jupiter', and 'Neptune' grapes on grafted Couderc 3309 (3309C) and own-rooted vines were harvested for 4 years (2002–2005). Vegetative growth, fruit quality, and yield were collected to see if there was an effect of cultivar, rootstock, and/or thinning. The experiment was set up as a split-plot experiment whose main plot is a randomized complete-block design (RCBD) with main plot treatment structure of a two-factor factorial (cultivar vs. rootstock) whose subplot contains replicated levels of one factor (thinning or non-thinning). For the first 4 years, pruning weights showed that the grafted vines were significantly more vigorous than the own-rooted vines. Grafted vines broke vegetative bud at least 2 days earlier than own-rooted. In 2002 only the grafted vines were allowed to fruit based on pruning weight (>454 g). Total yield (2002–2005) was significantly higher for both non-thinned and thinned grafted 'Marquis' and 'Mars' than for own-rooted. Grafted 'Neptune' and 'Jupiter' both had higher yields than own-rooted some years. Own-rooted vines were never significantly higher yielding than grafted vines within the same cultivar. Grafted and non-thinned 'Mars' and 'Jupiter' had the highest number of clusters per vine, followed by 'Marquis' and 'Jupiter' and then 'Neptune'. 'Neptune' had the largest packable clusters (g) followed by 'Marquis' and then 'Mars' and 'Jupiter'. Fruit clusters were separated into packable and non-packable clusters (a 100-g difference in most years). Thinned vines had a higher packable percentage over non-thinned vines for all cultivars. 'Marquis' and 'Neptune' had the largest berries followed by 'Jupiter' then 'Mars'. For earlier production of these cultivars, 3309C rootstock should be used in regions similar to Clarksville. Thinning should be done to improve the percentage of packable fruit for table grape marketing. Further testing to determine cultivar and rootstock adaptability should be conducted using these cultivars, 3309C and other rootstocks.

Influence of Rootstock on Gas Exchange of Field Grown Merlot Grapevines

*Michael Krawitzky**, *Thayne Montague*, and *Ed Hellman*, Texas AgriLife Research and Extension Center, Lubbock, TX 79403-6603; Department of Plant and Soil Science, Texas Tech University, Lubbock, TX 79409-2122

Currently there are over 1500 ha of vineyards and approximately 140 wineries in Texas. In West Texas there is a great need to evaluate rootstocks for adaptability to the semi-arid climate. To determine rootstock and varietal response to West Texas climatic conditions, an experimental vineyard was planted in Lubbock in 2006. The objective of this experiment was to determine gas exchange response of Merlot grapevines grafted to four different rootstocks in a semi-arid climate. Rootstocks selected were rootstocks which have potential for adaptability

to West Texas, and rootstocks commonly used in West Texas. Rootstocks selected were: 110R, 1103, 44-53, and 5BB. *Vitis vinifera* cv. Merlot scions were benchgrafted to selected rootstocks. The experimental design was a completely randomized block with five blocks and 20 plants within each block. For each rootstock/scion combination there were a total of 25 plants. During a 10-week period in the 2007 growing season, weekly mid-day water potential and stomatal conductance were measured. Weekly and seasonal data were analyzed using analysis of variance and the least significant difference procedure in SAS. Mean daily water potential data indicate few differences in water potential between rootstock/scion combinations. Mean water potential for the entire measurement period indicates no rootstock differences. Rootstock/scion differences for mean daily stomatal conductance were found on several occasions. However, as was found with mid-day mean water potential data, means for the entire measurement period indicate no differences between rootstock/scion combinations. Despite descriptions of adaptability to drought conditions, our data indicates that during the experimental period overall differences in gas exchange between rootstock/scion combinations were not found. To further assist growers in West Texas and other semi-arid climates, additional rootstock/scion information is needed.

Fall Yield Characteristics of Primocane Fruiting Blackberries from the University of Arkansas Breeding Program Grown in Kentucky

Jeremiah D. Lowe¹, Kirk W. Pomper¹, Sheri B. Crabtree¹, John R. Clark², and John G. Strang³, ¹Atwood Research Facility, Land Grant Program, Kentucky State University, Frankfort, KY 40601; ²Fruit Culture and Breeding, 316 Plant Science Bldg., University of Arkansas, Fayetteville, AR 72701; ³Department of Horticulture, N-318 Agricultural Sciences North, University of Kentucky, Lexington, KY 40546

Primocane fruiting blackberries have the potential to produce a niche-market crop for Kentucky growers from late summer until frost. The objective of this study was to determine if advanced selections developed by the University of Arkansas Blackberry Breeding Program were superior to Prime-Jim[®] and Prime-Jan[®] in terms of yield and fruit size under Kentucky growing conditions. In June 2006, six selections of primocane fruiting blackberries from the University of Arkansas breeding program (APF-27, APF-40, APF-41, APF-42, APF-46, and APF-77) and the commercially available primocane fruiting cultivars Prime-Jim[®] and Prime-Jan[®], were established at the Kentucky State University (KSU) Research Farm. In 2007, primocane fruit production was evaluated for all selections. The selection APF-40 had the greatest yield (3180 lbs/acre) during this time period with Prime-Jim[®] displaying the smallest yield (367 lbs/acre). Berry weight was significantly larger for the selections APF-40 and APF-41 (about 3.9 g/berry) than the other selections evaluated. Harvest periods began in early August for all selections except APF-41; harvest period began in late August for this selection. In Aug. 2007, taste test evaluations were performed on freshly harvested fruit from all selections. The selection APF-40 ranked highest in flavor, sweetness, color, and appearance and ranked lowest in bitterness, tartness, and seediness. Additional evaluations will be needed over the next several years before decisions are made on whether any APF selections will be released by the University of Arkansas.

Cultivar, Rootstock, and Training Method Influence Flower Bud Production in Pawpaw

Kirk W. Pomper¹, Sheri B. Crabtree¹, Jeremiah D. Lowe¹ and Desmond R. Layne², ¹Land Grant Program, Atwood Research Facility, Kentucky State University, Frankfort, KY 40601; ²Dept. of Horticulture, Clemson University, Clemson, SC 29634

The pawpaw [*Asimina triloba* (L.) Dunal] is a native tree fruit in the southeastern United States that is in the early stages of commercial production. Clonal rootstocks are not currently available for pawpaw cultivars; therefore, nurseries are interested in seedling rootstocks that have high establishment rates and could promote scion precocity. The objectives of this study were to determine if cultivar, rootstock source, and training system influenced precocity and field establishment of two

pawpaw cultivars. In May 2004, a rootstock trial was planted at the Kentucky State University Research Farm that consisted of Sunflower and Susquehanna budded onto five seedling rootstocks (PA-Golden, Sunflower, Susquehanna, K8-2, and commercially available seed) with either a minimal or central leader training system. There were eight replicate blocks with each treatment combination for a total of 160 trees. By Fall 2007, field mortality was greatest (52%) for Susquehanna budded onto Susquehanna seedling rootstock, whereas mortality was about 25% with other scion/rootstock combinations. The number of flower buds present per tree was evaluated in Feb. 2007. The cultivar Sunflower was more precocious than Susquehanna; Sunflower had a three-fold greater flower density than Susquehanna. In 2007, rootstocks did not influence flower bud number per tree or tree vigor as measured by trunk cross-sectional area (cm²). Central leader training produced trees with strong scaffold limbs. Minimally pruned trees had 25% more flower buds than central leader trained trees. Further evaluation will be required to determine if this training system will benefit fruit production and harvest methods.

Performance of New Peach Rootstocks in South Carolina

Gregory L. Reighard^{*}, David R. Ouellette, and Kathy H. Brock, Clemson University, Department of Horticulture, Clemson SC 29634-0319

Three rootstock trials consisting of 'Redtop' on 14 rootstocks, 'Redhaven' on 9 rootstocks and 'Redhaven' on 11 rootstocks were planted, respectively, in the Piedmont (2001, 2002) and Sandhills (2003) of South Carolina. In the 2001 and 2002 plantings, 'Cadaman[®]', 'Cornerstone', 'Lovell', 'Pumiselect[®]' and 'Guardian[®]' selection SC-17 were the most vigorous; while 'Empyrean[®] 101', 'Julior', 'Jaspi[®]', 'Mr.S. 2/5', 'Controller 5', 'Krymsk[®]1' and 'Krymsk[®]2' were the most dwarfing. Plum hybrid rootstocks 'Julior', 'Jaspi[®]', 'Empyrean[®] 101', 'Mr.S. 2/5', 'Krymsk[®]1', and 'Krymsk[®]2' had significant root suckering. Mortality was high for 'Empyrean[®] 101' and 'Jaspi[®]'. Some 'Cadaman[®]' trees died of unknown causes. Within cultivars, there was a 1–2 day range in bloom date and a 4–5 day range in maturity date among rootstocks. Trees on 'Empyrean[®]2', 'Julior', and 'Empyrean[®] 101' bloomed earliest, and trees on 'Cadaman[®]' bloomed last. 'Redhaven' fruit from trees on 'Mr.S.' 2/5, 'Empyrean[®] 101', 'Krymsk[®]1', and 'Krymsk[®]2' rootstocks matured earliest, 4–5 days before 'Lovell'. No rootstock produced fruit significantly larger than those on 'Lovell'. 'Mr.S. 2/5' and 'Jaspi[®]' produced the smallest fruit. 'Cadaman[®]', 'Cornerstone', 'Guardian[®]' selection SC-17, 'Bailey' and 'Lovell' had the highest fruit yields, and 'Julior', 'Jaspi[®]', 'Mr.S. 2/5', 'Krymsk[®]1' and 'Krymsk[®]2' had the lowest. 'Bailey' had the highest cumulative yield efficiency. Most dwarfing rootstocks except 'Krymsk[®]2' had low yield efficiencies. At the Sandhills location, which was on a severe bacterial canker replant site, all trees on 'Empyrean[®] 101', 'Monegro', and 'Krymsk[®]1', and most trees on 'Controller 5' died as a result of bacterial canker. 'Lovell', 'Mr.S. 2/5' and 'Pumiselect[®]' were the only rootstocks with 100% survival after 4 years.

Blueberry Cultivar Trials in Western Kentucky

Joseph G. Masabni^{*1}, Dwight Wolfe¹, John Strang², and John Snyder², ¹University of Kentucky Research and Education Center, P.O. Box 469, Princeton, KY, 42445; ²N308A Ag. Science Center North, Department of Horticulture, Lexington, KY 40546

A study was initiated in order to evaluate performance of 6 northern highbush, 10 southern highbush, and 7 rabbiteye blueberry cultivars to local soil and climatic conditions in Lexington, central Kentucky, and Princeton, western Kentucky. Temperatures during Summer 2005 were above average and rainfall was below normal. In 2006, average temperatures were warmer than normal statewide in January and April. Rainfall in central and western Kentucky was near normal during most of 2006. In 2007, plants were exposed to temperatures of 24°, 22°, and 24° on the mornings of 6, 7, and 8 Apr., respectively. This eliminated most of the crop and caused severe shoot injury on most plants. The spring freeze was followed by an extended drought. 'Aurora', the latest blooming and maturing highbush cultivar, had the lowest level of flower injury and some of the least shoot injury. 'NC-2927', a southern

highbush; 'Bluecrop', a northern highbush; and 'Ira', a rabbiteye, also tended to have lower levels of flower. Mortality was rated in Oct. 2005, Feb. 2007, and Jan. 2008. All plants of 'Echota' (northern highbush), and 'Arlen', 'Duplin', and 'Lenoir' (southern highbush) were dead within 1 year of planting. None of the rabbiteye blueberry cultivars had 100% mortality after 1 year. 'Columbus' had the highest mortality at 67%, and 'Onslow' and 'Powderblue' had 0% mortality. Four years after transplanting, the cultivar trial in western Kentucky indicated that only one northern highbush cultivar ('NC-1871') had decent survival rate (<50% mortality), while 'Bluecrop', 'Echota', and 'Spartan' were dead. Of the 10 southern highbush cultivars, only 'NC-2927', 'Misty', and 'Star' had less than 50% mortality. The rabbiteye cultivars Ira, Onslow, and Powderblue had the lowest mortality (17%) rates. From the result of the two locations, it is evident that 'Ira', a rabbiteye cultivar, and 'NC-2927', a southern highbush cultivar, have the most potential for use in Kentucky as they had the least flower injury and mortality rate.

Galletta Strawberry

*James R. Ballington**, Kerry Olive and Susan Bryson, Horticultural Science Department, Box 7609, North Carolina State University, Raleigh NC 27695-7609

'Galletta' resulted from the cross NCH 87-22 'Earliglow'. It is a large-fruited, very attractive variety with good firmness and fruit quality. The berries are conic in shape with glossy, dark red skin color and medium red flesh. 'Galletta' ripens early, before 'Bish' and 'Camarosa', but not as early as 'Sweet Charlie'. Yields are often equal to standard varieties like 'Camarosa' and 'Chandler'. It is not resistant to anthracnose fruit rot caused by *Colletotrichum acutatum*; however, under natural conditions it is more tolerant to this disease than 'Camarosa' or 'Chandler'. It is resistant to the races of red stele (*Phytophthora fragariae*) common in eastern North America. 'Galletta' is quite promising as an attractive, large-fruited, high-quality plasticulture-adapted variety for the southeastern United States. It is also a promising new variety for home gardeners. A U.S. Plant Patent Application for 'Galletta' has been submitted, so only licensed plant producers can offer plants for sale. For information on availability of plants and licensing procedures, contact James R. Ballington.

First Year Results with High Tunnel Strawberry Production Research in the Piedmont of North Carolina

*James R. Ballington**¹, Kerry Olive¹, Andy Myers², and Joanne Maury², ¹Horticultural Science Department, Box 7609, North Carolina State University, Raleigh, NC 27695-7609; ²Piedmont Research Station, 8350 Sherills Ford Rd., Salisbury, NC 28147-9124

The objectives of this experiment in 2006–2007 were to identify strawberry varieties adapted to off-season and extended season production and to compare white/black and black plastic mulches for suitability for strawberry production in high tunnels. The tunnel bay was 24 ft wide by 150 ft long with four raised beds in a split plot by plastic type. Eight varieties were included: 'Albion', 'Araza', 'Carmine', 'Chandler', 'Seascape', 'Strawberry Festival', 'Sweet Charlie', and 'Winterdawn'. All varieties except 'Albion' and 'Seascape' were "conditioned" for 6 weeks at Laurel Springs, NC (3000 ft elevation) prior to planting. The plots were planted 19 Sept. 2006, in double rows with plants 18 inches apart in rows and rows on beds 12 inches apart with 14 plants/plot. Standard strawberry plasticulture management recommendations were followed. Medium weight row covers (1.5 oz) were placed over the beds in the tunnel bay during cold periods and were very effective in preventing loss of flowers and fruit. Wind and air movement were relied on for pollination. The first off-season harvest took place 22 Nov. 2006, and weekly harvests continued through 25 Jan. 2007 (10 weeks). The spring (extended season) harvests began 7 Apr. 2007, and continued through 4 June (8 weeks). There were no differences between white/black and black plastic mulch for any variety. Percent marketable fruit was very high. 'Strawberry Festival' was the best performer overall with 36% to 44% of the total marketable yield produced in fall/early winter, and total marketable yields over 900 g/plant, good fruit size, and superior

fruit quality characteristics. 'Seascape' and 'Albion' were second best, but only produced approximately 25% of their total marketable yield in fall/early winter. 'Sweet Charlie' produced 37% to 48% of its fruit in fall/early winter, but had pale skin color and unacceptably white flesh. 'Chandler' was highest yielding, but only produced 15% of total marketable yield in fall/early winter.

'Nantahala' Red Raspberry

*James R. Ballington**, Gina E. Fernandez, and Susan Bryson, Horticultural Science Department, Box 7609, North Carolina State University, Raleigh, NC 27695-7609

'Nantahala' is a new primocane fruiting red raspberry developed by North Carolina State University. It resulted from the cross of NC 245 ('Algonquin' 'Royalty') 'Rossana' ('Malling Promise' O. P.) made in Raleigh, NC, by James R. Ballington in 1994. It was selected at Reidsville, NC, in 1998 for large size, good fruit firmness and superior quality, and assigned selection number NC 451. It was evaluated in replicated trials at Laurel Springs and Fletcher in western North Carolina. In the replicated trials, the berry size of 'Nantahala' was larger than both 'Caroline' and 'Heritage'. Yield was not as high as 'Heritage' or 'Caroline', but 'Nantahala' was selected as a later-developing primocane fruiting type so that fruit would not ripen during the heat of late summer in the southeastern United States. This should make it especially useful for extended season production in high tunnels. Berry firmness was equal to 'Caroline' but not 'Heritage'. Berry crumbliness was equal to 'Heritage' and superior to 'Caroline'. Percent brix was also equal to 'Heritage' and superior to 'Caroline'. In a sensory taste panel, 'Nantahala' was rated numerically best overall in comparison to 'Caroline', 'Heritage', and an unnamed commercial cultivar from California. A U.S. Plant Patent Application has been filed for 'Nantahala' so plants can only be sold by licensed nurseries. For information on availability of plants and licensing procedures, contact Gina Fernandez.

Early Performance during Establishment of an Organic Apple Orchard in the Upper Mid-South

C.R. Rom, J. McAfee, H. Friedrich, H. Choi, M.E. Garcia, D. Johnson, J. Popp, and M. Savin, Department of Horticulture, University of Arkansas, Fayetteville, AR 72701

An organic apple orchard was established in 2005 to evaluate the interaction of ground cover management system and nutrient source effects on nutrient availability and uptake, soil biology, tree physiology, growth, development and productivity. The land and orchard were managed to meet USDA organic certification standards of the National Organic Program. Land was prepared in 2005 and trees of 'Enterprise' M26 planted in 2006. Trees were given one of four ground cover management treatments to control competitive vegetation: 1) wood chip mulch (WC), 2) municipal green compost (GC) mulch, 3) shredded discarded white paper (SP) mulch, and 4) mow-and-blow (MB) of all undertree and between row vegetation mowed and moved under the tree. To study the interaction of nutrient source with ground cover management, the plots were split for one of three nutrient source treatments: A) control, where the ground cover system provided nutrients (NF); B) composted poultry litter (PL); and C) a certified commercial poultry based pelletized fertilizer (CF). During the first two growing seasons, although nutrient source treatments resulted in significant effects on soil nutrient content, soil microbiological activity, and soil respiration, the effects of ground cover were more significant than effects of nutrient source on tree growth. The GC and CF treatments resulted in the highest levels of soil NO₃ at both 0–10 and 10–30 cm soil depths. The GC resulted in significant soil NO₃ late in the growing season compared to all other treatments. GC and SP resulted in increased soil pH (>7.2) at 0–10 and 10–30 cm depths, and increased soil electrical conductivity. Throughout the second season, MB plots had lowest soil respiration while GC and WC typically had among the greatest. SP treatments resulted in reduced foliar N but increased P, K, and Ca. SP treatments resulted in decreased foliar chlorophyll content and lower daily photosynthetic rates. GC and WC treatments resulted in larger trees in trunk cross-sectional area, tree height, spread, and canopy volume, and had increased leaf number,

average leaf size, leaf area index, and leaf area density. Trees treated with SP were smallest. Trees with GC and WC exceeded 3.25-m height and filled allotted space in the orchard and have floral bud development. Trees treated with SP were small (<2.75-m height), did not fill space, and will not crop in the third season. This project was funded in part by the Southern SARE Research and Education program.

Potential for High Tunnel Organic Berry Production for Extended and Alternative Season

C.R. Rom¹, H. Friedrich¹, J. McAfee¹, M.E. Garcia¹, D. Johnson¹, J. Popp¹, C. Vincent¹, and M. van Iersel², ¹Department of Horticulture, University of Arkansas, Fayetteville, AR 72701; ²Department of Horticulture, University of Georgia, Athens, GA 30602

Three studies have been established to develop organic production systems for blackberries and raspberries in high tunnels to extend or provide alternate production seasons to capture high value markets. Study I evaluates advancing the summer production season of florican blackberries and raspberries. Cultivars studied were 'Navaho', 'Arapaho', and 'Ouachita' blackberries, and 'Encore', 'Prelude', and 'Dormanred' red raspberries. Study II evaluates extending the fall production season of primocane fruiting brambles using the cultivars of 'Prime Jim[®]', 'Prime Jan[®]', and selection APF46 blackberry, and 'Autumn Bliss', 'Caroline', and 'Dinkum' red raspberries. Study III evaluates the potential for both extended fall primocane production and advanced spring florican production using the same cultivars as in Study II. All studies were grown in replicated plots with main treatments of high tunnel protected production (HT) compared to unprotected field production (FP). Tunnels were built at time of planting (2006) and results of the first two seasons are presented. Tunnels were typically closed when temperatures were predicted to be <10 °C, and tunnels were opened when temperatures were >15 °C. All plants are managed following USDA Organic certification standards of the National Organic Program. There was no primocane yield of red raspberry in the year of planting. In the initial planting year, 'Prime Jan[®]' and 'Prime Jim[®]' had significantly greater production in HT than FP with both more and larger fruit. There was no difference between HT and FP for APF 46. Florican crop was lost due to a severe freeze on 7–9 Apr. 2007. In the second year of production between August and December, APF46 and 'Prime Jim[®]' had greater production in HT than FP, however, the opposite occurred for 'Prime Jan[®]'. Fruit size of all blackberries was larger in HT than FP. All raspberry cultivars had greater yields, average weekly harvest, and larger fruit size in HT compared to FP. In both the planting year and second year, HT provided 3 to 5 weeks of additional harvest compared to FP with larger weekly harvests during the last third of the cropping season. HT also provided rain shelter reducing fruit losses from rots and increasing marketable yields. This project was funded in part by a grant from the USDA Integrated Organic Program.

Floriculture, Ornamentals, and Turf Section

Expression of Leaf Blight Symptoms Vary among Provenances of *Taxodium distichum* (L.) L.C. Richard

Garry V. McDonald¹, Geoffrey C. Denny², Andrew R. King³, Donita L. Bryan³, Michael A. Arnold³, Larry W. Barnes⁴, and David L. Creech⁵, ¹316 Plant Science Department of Horticulture, University of Arkansas, Fayetteville, AR 72701; ²Gulf Coast Research and Education Center, University of Florida IFAS, 14625 CR 672, Wimauma, FL 33598; ³Department of Horticultural Sciences, Texas A&M University, College Station, TX 77843-2133; ⁴Department of Plant Pathology and Microbiology, Texas A&M University, College Station, TX 77843-2132; ⁵Agriculture Department, Stephen F. Austin State University, P.O. Box 13000 SFA Station, Nacogdoches, TX 75962

Taxodium distichum (L.) L.C. Richard seed were collected from native stands ranging from Mexico, Texas, Louisiana, and Mississippi

to Alabama. Twenty-two provenance selections were planted in Spring 2003 in College Station, TX in replicated blocks for a total of 792 trees. Below average mid-summer temperatures and above average number of days with rainfall were conducive to the development of a leaf blight associated with *Cercosporidium sequoiae* (Ellis and Everh.) W.A. Baker and Partridge. A survey was conducted in Oct. 2007 to rate differential defoliation responses among provenances. Selections of *Taxodium distichum* var. *mexicana* from Mexico and southern Texas showed defoliation rates from 89% to 96% while *T. distichum* var. *distichum* from central Texas had defoliation ratings from 79% to 99%. With the exception of one family collected from the Sabinal River in Texas, the central Texas selections had similar or greater defoliation than those from southern Texas. Selections of *T. distichum* var. *distichum* and one selection of *Taxodium distichum* var. *imbricarium* from southeastern regions (Alabama, Louisiana, Mississippi, and eastern Texas) showed greater tolerance to leaf blight with ratings from 52% to 80%. Some individuals within these families exhibited no symptoms of the leaf blight. In general, those selections from high rainfall, high humidity areas had greater tolerance to leaf blight although there was variable defoliation among provenances from these geographical regions. These results suggest that tolerance to defoliation from *C. sequoiae* could be included in selection criteria when choosing possible germplasm releases from *T. distichum*.

Effect of Provenance on Salt Tolerance of *Taxodium distichum* Geoffrey C. Denny¹ and Michael A. Arnold², ¹IFAS Gulf Coast REC, University of Florida, Wimauma, FL 33598-6101; ²Department of Horticultural Sciences, Texas A&M University, College Station, TX 77843-2133

Plants from five open-pollinated families of *Taxodium distichum* (L.) Rich. from the Gulf Coast, central and southern Texas, and Mexico were evaluated for tolerance of both substrate and foliar salt exposure under greenhouse conditions. Plants were evaluated based on growth, biomass allocation, xylem water potentials, level of leaf necrosis, and survival. All of the open-pollinated families screened were relatively tolerant of low levels of substrate salinities. Foliar damage ratings, pre-dawn xylem water potential and plant survival of open-pollinated families were significantly affected by higher substrate salinity levels. The effects did not seem to have a geographic pattern, instead substrate salt tolerance appearing to be genotype dependent. Only foliar damage varied among open-pollinated families in the foliar salt tolerance screening. In general, open-pollinated families from Mexico were more tolerant of salt spray than families from the southeastern U.S. The family from central Texas was intermediate in tolerance. Although there seems to be a geographic pattern to the tolerance differences observed, the difference may be due to the differential leaf wetting times. These studies suggest that when selecting plant material for a soil borne salts, Mexican and southern Texas genotypes should be preferred at low levels, and at high levels tolerance is genotype dependent. For tolerance to foliar applied salts, Mexican and western populations seem the most tolerant.

Continuing Studies in Salinity Tolerance of *Taxodium*

Lijing Zhou^{*} and Dave Creech, SFA Mast Arboretum, P.O. Box 13000, Stephen F. Austin State University, Nacogdoches, TX 75962

Three genotypes of *Taxodium* were evaluated for salinity tolerance: baldcypress (*Taxodium distichum* var. *distichum*), montezuma cypress (*Taxodium distichum* var. *mexicanum*), and *Taxodium distichum* 'Nanjing Beauty' (a hybrid between baldcypress and montezuma cypress), abbreviated as BC, MC, and hybrid, respectively. In study 1, beginning 11 July 2007, four sea salt rates (0, 204, 408, and 612 moles/m³) were applied one time per week for 8 weeks to container plants. When no salt damage was visually evident, the frequency was changed to two times per week and that regime continued for the final 8 weeks of the 16-week project. Irrigation between salt solution applications was via sprinkler when needed. Plants were harvested on 20 Nov. 2007. A two-way factorial design with three randomized blocks was utilized. In spite of doubling the application frequency in mid-course of this study, all plants survived and few exhibited salt damage.

However, there were significant effects of salt rates on leaf tissue nutrient levels and growth (plant height change and dry weight of above ground parts). Increasing salt rates reduced growth in all three genotypes. Leaf Na values reached very high levels. In study 2, to determine the speed of decline in a chronic high-salt environment, the three genotypes described above were subjected to daily applications of a high rate of salt solution (612 moles/m³) starting from 31 Aug. 2007. The experiment followed a random block design with two blocks. Leaf samples were collected every 2 days during the course of this 3-week study. BC was the first to exhibit damage (8 days), followed by MC (10 days), and the hybrid (15 days). Leaf Na peaked in each genotype at the onset of visual damage. MC exhibited lower levels of leaf Na than BC and the hybrid.

Salt Tolerance of Three Rose Rootstocks

*Genhua Niu** and *Denise Rodriguez*, Texas AgriLife Research and Extension Center at El Paso, Texas A&M University, 1380 A&M Circle, El Paso, TX 79927

Salt tolerant nursery and landscape plants are needed for arid and semi-arid regions where high quality water supply is limited and soil salinization often occurs. This study evaluated growth and ion uptake characteristics of three rose rootstocks [*Rosa fortuniana* Lindl., *R. multiflora* Thunb., and *R. odorata* (Andr.) Sweet] in a greenhouse by irrigating the plants with saline solutions at four salinity levels, 1.6 (control), 3.0, 6.0, or 9.0 dS/m. After 15 weeks, most plants died at 9.0 dS/m, regardless of species. Significant growth reduction was observed in all species at 6.0 dS/m compared to the control and 3.0 dS/m, but the reduction in *R. fortuniana* was smaller compared to the other two species. The root to shoot DW ratio at 6.0 dS/m was higher in *R. multiflora* and *R. odorata* but not in *R. fortuniana* compared to the control and the 3.0 dS/m treatment. Shoot Na concentration was highest in *R. odorata*, followed by *R. multiflora*; however, root Na concentration was highest in *R. multiflora*. All species had higher Cl accumulation in all plant parts at elevated salinities, and no substantial differences exist among the species, except for a higher leaf Cl concentration in *R. multiflora* compared to the other species. Elevated salinity reduced relative chlorophyll concentrations, measured as leaf SPAD readings, and maximal photochemical efficiency of PSII, F_v/F_m , but the reduction in F_v/F_m was only 2.4%. All species can be irrigated with saline water up to 3.0 dS/m without growth reduction and foliar salt damage.

Screening Native and Ornamental Plants for Nutrient Abatement in Retention Ponds

*Yan Chen** and *Regina Bracy*, Hammond Research Station, LSU AgCenter, 21549 Old Covington Hwy., Hammond, LA 70403

Native aquatic plants pickerelweed (*Pontederia cordata*), arrow arum (*Peltandra virginica*), bulltongue (*Sagittaria lancifolia*), and non-invasive ornamental species sweet flag iris, dwarf papyrus (*Cyperus haspan*), and canna (cv. Australia) were evaluated for their use in urban area retention pond or constructed wetlands for stormwater mitigation. Six independent recycling hydroponic systems were constructed to evaluate three plant species with two levels of nitrogen (N) treatment solutions, 25 or 50 mg·L⁻¹ at the same time. These N levels were chosen to simulate stormwater events with low and high runoff loads. Phosphorous and other nutrient elements possibly found in runoff waters were held consistent in treatment solutions. Plants were treated for 8 weeks and sampled for leaf, rhizome and root tissue N and P concentrations. Among species evaluated, Canna 'Australia' had the greatest biomass accumulation and total tissue N content. Bulltongue grew less vigorously than pickerelweed and arrow arum but had similar N recovery ability (measured as foliage N content) due to its high foliage N concentration. Dwarf papyrus can be good accompanying plants for the above three with fair N recovery ability. Nitrogen recovery from species with large size rhizomes such as arrow arum and iris may not be practical because a major portion of recovered N was stored in the rhizome.

Long-term Benefits of Dairy Manure Compost to Urban Landscape Performance.

*John Sloan*¹*, *Raul Cabrera¹*, *Cynthia McKenney²*, and *Wayne Mackay³*, ¹Texas AgriLife Research–Dallas Center, 17360 Coit Rd., Dallas, TX 75252; ²Department of Plant and Soil Science, Texas Tech University, Lubbock, TX 79409-2122; ³University of Florida, Mid-Florida Research and Education Center, 2725 S. Binion Rd., Apopka, FL 32703

Topsoil is usually removed during the construction of urban residences and businesses. Following construction, the soil is poorly prepared prior to establishing turf grass and ornamental plants, resulting in a landscape that requires frequent fertilization and watering in order to maintain plant quality and performance. Dairy manure compost (DMC) may be an effective soil amendment when establishing new urban landscapes. The objective of this study was to evaluate the long-term effects of DMC on plant performance and soil nutrient levels. In Mar. 2003, DMC rates of 0, 9, 18, and 27 kg·m⁻² (0, 1.25, 2.5, 5 cm) were incorporated into the top 5 to 10 cm of Austin silty clay soil. Half of each 6 m plot was established with bermudagrass sod and the other half with six types of ornamental plants consisting of annual, perennial, and woody species. Plant growth parameters were measured monthly during the 2003 to 2004 growing seasons, and then once per growing season from 2005 to 2007. Growth and development of annual and perennial plants generally exhibited favorable responses to DMC applications during the first 3 years after application. Woody ornamentals were mixed in their response to DMC applications. Knockout rose and crape myrtles showed little response to DMC applications, but burford holly and yaupon holly showed significant increases in growth with increasing DMC application rate. Annual soil analyses showed a lingering increase in plant available concentrations of P, K, S, Fe, and Zn, as well as an increase in organic matter in the soils amended with DMC. The increases were most pronounced in the upper 7.5 cm of the soil and were not discernible below 15 cm. Results of this study show that after five growing seasons (2003–2007) with no additional fertilization, a 1- to 2-cm application of dairy manure compost is sufficient to provide continued fertility to landscape plants. Incorporation of the DMC into the upper 15 cm of soil will protect the nutrients from loss by erosion and will ensure adequate fertility within the plant rooting zone.

Differences in Seasonal Landscape Performance of Liriope and Ophiopogons

Catherine Broussard, *Edward Bush**, and *Allen Owings*, LSU AgCenter, SPESS, Baton Rouge, LA 70803

Eighteen liriope and mondograss cultivars were evaluated for landscape performance in sun and shade (63%) over a 3-year period. Cultivars in *Liriope muscari*, *L. gigantea*, *L. spicata*, *Ophiopogon japonicus*, and *O. intermidias*. The objective of this experiment was to determine seasonal performance in sun and shade. *Liriope muscari* 'Big Blue' performed well in sun and shade with a slight decrease in plant quality during the winter months. *Liriope gigantea* 'Evergreen Giant' and 'Super Green' maintained excellent quality in sun and shade over a 3-year period. *Ophiopogon japonicus* and *O. japonicus* "dwarf mondo" also maintained excellent quality as well. Optimal year-round performance is strongly dependent on winter performance. Plants achieving the goal included 'Evergreen Giant', 'Super Green', green mondograss, and dwarf mondograss. Future criteria for improved liriope and ophiopogon cultivars should strive to improve winter landscape performance.

Amending Recycled Hardwood Waste Products for Production of Acid Loving Nursery Plants

*Edward Bush**, *Al Owings*, and *Kathryn Fontenot*, LSU AgCenter, 137 J.C. Miller Hall, Baton Rouge, LA 70803

Recycled hardwood products are being used in place of traditional pine bark. Pine bark shortages are being caused by the wood industry burning bark for fuel due to rising fuel cost. Adjusting the chemical properties of hardwood is imperative to the success of nursery production. The objective of this research is to determine the efficacy of using fertilizer amendments to produce a quality acid-loving nursery

crops using hardwood bark. A randomized complete-block design with seven treatments and five replications. Fertilizer treatments consisted of combinations of dolomitic lime (4.5 and 9 lb/cubic yard), gypsum (9 lb/cubic yard), Epsom salt (9 lb/cubic yard), iron sulfate (1 lb/cubic yard) and elemental sulfur (1 lb/cubic yard). Plants grown in hardwood bark and lime produced greater plant quality as compared to hardwood bark amended with gypsum, lime, and sulfur. Statistically, hardwood bark amended with gypsum, Epsom salt, S, and or iron sulfate produced similar plant quality as pine bark controls. Measured growth indices were similar for all treatments. Thus, we determined that acid loving crops produced in nurseries using hardwood bark produced quality nursery crops with the proper fertilizer amendments.

Nutrient Applications to Reverse Whitening of Ivy Geraniums *Ritu Dhir* and Richard L. Harkess, Department of Plant and Soil Sciences, Mississippi State University, Mississippi State, MS 39762*

The young developing leaves of ivy geranium (*Pelargonium peltatum*) turn white, expand less, and develop an upward cupped appearance when heat stressed. This physiological disorder is referred to as "whitening." Plants resume normal growth as the temperature moderates. It is unknown if there are effective nutritional means to reverse whitening in ivy geranium. The present study was conducted to determine if Fe, Mn, Zn, S, and Mg applications reverse whitening and to determine the effects of nutrient application on growth of ivy geraniums. Rooted cuttings of ivy geranium 'Beach' and 'Butterfly' with whitening were potted on 28 July 2006 into 15 cm pots filled with sphagnum peat and perlite (70:30 by volume). Plants were fertilized with 200 mg-L⁻¹ N (Peters Peat-lite 20N-4.4P-16.7K, Scotts Company, Marysville, OH) as a continuous liquid feed. Treatments were control (distilled water), Fe (at 7 mg as Fe-EDDHA or FeSO₄), Mn (at 9 mg as MnSO₄), Zn (at 3.2 mg as ZnSO₄), Mg (at 13.7 mg as MgSO₄) or S (at 18 mg as elemental S) drench per pot on 6 Sept., 26 Sept., and 16 Oct. 2006. Plant height, width, growth index, SPAD-chlorophyll index, pigments contents, fresh weight, dry weight and extent of whitening were measured. Extent of whitening was measured at the start (6 Sept. 2006) and end of the experiment (1 Nov. 2006). The experiment was a completely randomized design with three replications (two subsamples per replication) for each application treatment. Plant height, width, growth index, SPAD-chlorophyll index, chlorophyll *a*, chlorophyll *b*, carotenoids, fresh and dry weights were not affected by nutrient applications in either cultivar. None of the nutrient applications affected initial or final extent of whitening. The reversal of whitening from initial to final stage was improved with Fe-application from Fe-EDDHA in both cultivars and with FeSO₄ in 'Beach'. Applications of Fe significantly reversed whitening of ivy geraniums.

Yield and Quality Effects of Colored Plastic Mulch on Four Field-grown Cut Flowers

Kathryn Crowley and J. Raymond Kessler, Jr., 101 Funchess Hall, Auburn University, AL 36849*

The effects of colored plastic films on cut flower size and yield of *Antirrhinum majus* 'Sonnet Mix', *Penstemon digitalis* 'Husker's Red', *Achillea* 'Coronation Gold', and *Dianthus barbatus* 'Bouquet Purple' were evaluated at two locations, Auburn or Cullman, AL. Species were grown outdoors on six rows mulched with red, white, black, or blue plastic films, pine bark, or bare ground. All plants were harvested, date of harvest recorded, and cut flowers were measured for shoot height, stem count, and stem diameter. Additionally, dianthus and penstemon were measured for node count, and inflorescence length was recorded for penstemon and snapdragons. Results for yarrow, snapdragon and dianthus grown in two different locations were variable and support the idea that response to colored plastic films is related to climate differences. Effects from colored films on penstemon were few and small. Red film produced snapdragon stems 28% longer than stems grown on pine bark in Auburn, but in Cullman plants grown on red film performed well, but longest stems were grown on white film, 12% longer than on pine bark. In Auburn, black film produced 50 more stems per plot than bare ground or white film. In dianthus, plants grown in Auburn produced the longest stems on black film, 14% longer than plants grown on bare ground, and white film produced eight stems more per plot than bare ground. Dianthus plants grown in Cullman had

longest stems on white film and were 21% longer than stems grown on pine bark. The highest stem count was produced on red film, 13 more stems per plot than pine bark which had the lowest. Blue and black films produced the longest yarrow stems in Auburn, 8% longer than pine bark plants. In Cullman these two treatments effects were reversed. Yarrow grown on blue and white films had the largest flower diameters in Cullman, 17% larger than flowers grown on pine bark. Plants grown on red film were 22% larger in diameter than plants grown on pine bark in Auburn.

Cajanus cajan as a Potential Ornamental Vegetable for the Southern United States

*S.P. Metz¹, J. McCormick¹, and C.B. McKenney^{*2}, ¹Texas AgriLife Research Center, 17360 Coit Road, Dallas, TX 75252; ²Department of Plant and Soil Science, Texas Tech University, Lubbock, TX 79409-2122*

Cajanus cajan (pigeon pea) is used for both dry and green vegetable pea production throughout the old and new world semi-tropical and tropical regions. Due to the heterogeneity of this drought tolerant crop, a stand of pigeon pea has attractive and diverse flowers. In this preliminary study, 19 pigeon pea lines from the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT) and two lines from the University of Georgia were screened for both dry and green pea production and use as an ornamental vegetable for use in container gardening. Color characterization was determined using a Minolta Chroma Meter CR-400 which helped to discriminate between the flower color attributes and for comparisons within the study; however, the results did not agree with the Royal Horticulture Society Color Chart. Significant differences in percent establishment, plant height, flowering rate and yield were determined. Two lines appeared to have promise and will be evaluated in the future for container productivity and best management practices.

Cannas: Cultivar Observations in 2007 Landscape Trials

Allen D. Owings and Yan Chen, Research Station, Louisiana State University Agricultural Center, 21549 Old Covington Highway, Hammond, LA 70403*

A landscape trial evaluating performance and leaf roller susceptibility of 21 *Canna* cultivars ('Black Knight', 'City of Portland', 'Cleopatra', 'Crimson Beauty', 'Dawn Pink', 'Firebird', 'King City Gold', 'Maudie Malcolm', 'Orange Beauty', 'President', 'Pretoria', 'Red Dazzler', 'Red King Humbert', 'Richard Wallace', 'Stadt Feltbach', 'Striped Beauty', 'Tropical Sunrise', 'Wyoming', 'Yellow King Humbert', 'Miss Oklahoma', and 'Lenape') was initiated in 2007 at the Hammond Research Station, Hammond, LA, and Burden Center, Baton Rouge, LA. Plants were planted in raised native soil beds amended with pine bark in mid-spring at both locations and grown in full sun with drip irrigation under recommended fertilization practices. Cultivars with slight susceptibility to canna leaf roller damage in Hammond were 'Orange Beauty', 'Pretoria', 'Red Dazzler', 'Striped Beauty', and 'Yellow King Humbert'. Cultivars with slight susceptibility to canna leaf roller damage in Baton Rouge were 'Striped Beauty', 'Miss Oklahoma', 'King Orange Humbert', 'Cleopatra', 'Red Dazzler', 'Richard Wallace', 'Tropical Sunrise', 'Maudie Malcolm', and 'Crimson Beauty'. Best quality performance (overall for both locations) was 'Black Knight', 'Yellow King Humbert', 'Red King Humbert', 'Orange Beauty', 'Richard Wallace', 'Tropical Sunrise', and 'King City Gold'. Average performance was observed for 'Pretoria', 'Dawn Pink', 'Cleopatra', 'Red Dazzler', 'Firebird', 'Crimson Beauty', 'Lenape', and 'Stadt Feltbach'. Poor performance was observed for 'Striped Beauty', 'Miss Oklahoma', 'Wyoming', 'Maudie Malcolm', 'City of Portland', 'Rosemond', and 'President'. Studies will be continued in 2008 to quantify seasonal quality performance and canna leaf roller susceptibility. In addition, several more cultivars will be added.

Petunias: Summary of Recent Landscape Performance Observations

Allen D. Owings, Hammond Research Station, Louisiana State University Agricultural Center, 21549 Old Covington Highway, Hammond, LA 70403*

Petunia cultivars have been evaluated for fall through spring and late winter through early summer landscape performance at Burden

Center, Baton Rouge, LA, annually since 2000. Cultivars studied included the following series: Wave, Easy Wave, Tidal Wave, Shock Wave, Supercascade, Avalanche, Fantasy, Plush, Celebrity, Madness, Explorer and Ramblin'. Overall, Tidal Wave has been the best performing series. Wave and Easy Wave have comparable landscape performance. There are differences within series in regard to cultivar performance. In Wave petunias, Purple and Blue have not done as well in terms of visual quality ratings as Lavender, Misty Lilac, Rose and Pink. The new Plush series has only been evaluated one year but has been very comparable to the Wave and Easy Wave series in performance. Deep pink, salmon and lavender have been the best colors in the Plush series. Supercascade, Madness and Celebrity have been poorer performers, especially once the growing season moves into late April and May. Most of these cultivars have peak spring performance between 1 Apr. and 15 May. Tidal Waves are the longest lasting into the late spring (early to mid June). Mixes generally have lower quality ratings than solid color cultivars. Avalanche, Explorer and Ramblin' series merit growing. Main diseases observed in our landscape trials have been *Alternaria* leaf spot, *Sclerotinia* blight, and *Choanephora cucurbitarium*.

Caladium Height Control Using Plant Growth Regulators

Brian W. Trader*¹ and Mengmeng Gu¹, 117 Dorman Hall, Box 9555, Department of Plant and Soil Sciences, Mississippi State University, Mississippi State, MS

The effect of several plant growth regulators (PGRs) was evaluated for height control in caladium cultivar Mrs. Arno Hehrling from July to Sept. 2007. PGR treatments included a pre-plant tuber soak of ancymidol (1, 2, 4, and 8 ppm), dikegulac (370 and 2960 ppm), chlomequat (1250, 2500, 3750, and 5000 ppm) and daminozide (750, 1250, 3750, and 7500 ppm). Drench applications to actively growing 'Mrs. Arno Hehrling' were also evaluated for ancymidol (1, 2, 4, and 8 ppm), dikegulac (370, 1480, and 2960 ppm), chlomequat (1475, 2950, 5900, and 11800 ppm) and daminozide (750, 1250, 3750, and 7500 ppm). Lastly, a spray application of dikegulac at 231, 925, and 1850 ppm was incorporated. Eyes were removed from tubers prior to planting and treatments. Tubers were maintained under greenhouse conditions and grown two tubers per 6-inch pot in a peat-based soilless media. Data were collected every 2 weeks for 10 weeks on height, average width, phytotoxicity and shoot number. Plants were arranged in a completely randomized design with six single-plant repetitions. Treatments evaluated did not induce phytotoxicity in 'Mrs. Arno Hehrling' caladium. Ancymidol drenches at 4 and 8 ppm initially controlled caladium height, however the soaks were not effective and drench treatments rapidly grew out from initial control. Dikegulac drenches delayed shoot emergence but controlled caladium height up to 10 weeks at 925 and 1850 ppm. Chlomequat and daminozide treatments were not effective in controlling height in 'Mrs. Arno Hehrling' caladium at the rates evaluated. Higher application rates and later application timings may be more effective in control of caladium height.

Increased Shoot Production in Caladium with Plant Growth Regulators

Brian W. Trader*¹ and Mengmeng Gu¹, 117 Dorman Hall, Box 9555, Department of Plant and Soil Sciences, Mississippi State University, Mississippi State, MS 39762

The effect of several plant growth regulators (PGRs) was evaluated for increased shoot production in caladium cultivar Candidum from July to Sept. 2007. PGR treatments included a preplant tuber soak of Configure™ [6-benzyladenine (6-BA), cyclanilide, and Fresco™ (6-BA + gibberellic acid) at 50, 100, 200 and 400 ppm in addition to ProGibb® (gibberellic acid) at 10, 20, 40, and 80 ppm. Drench applications to actively growing 'Candidum' were also evaluated for Configure™, cyclanilide, and Fascination™ (6-BA + gibberellic acid) at 50, 100, 200 and 400 ppm in addition to Novagib™ (gibberellic acid) at 10, 20, 40, and 80 ppm. Eyes were removed from tubers prior to planting and treatments. Tubers were maintained under greenhouse conditions and grown two tubers per 6-inch pot in a peat-based soilless media. Data were collected every 2 weeks for 10 weeks on height,

average width, phytotoxicity, and shoot number. Plants were arranged in a completely randomized design with six single-plant repetitions. None of the treatments induced phytotoxicity in caladium 'Candidum'. Only applications of cyclanilide increased shoot number in 'Candidum' when applied as a soak; however, these shoots did not fully develop and remained just emerged above the soil surface for the duration of the 10-week experiment. Treatments of Fresco™ and Fascination™ increased height of caladium and resulted in elongated plants. Caladiums treated with Configure™ were generally shorter, especially when applied as a soak at 200 and 400 ppm. More research is necessary to determine a safe rate of pre-tuber soak of cyclanilide to increase shoot number in caladium. In addition, an experiment evaluating a pre-tuber soak of cyclanilide followed by a spray application of gibberellic acid is planned.

Preliminary Evaluation of Open Cell Foam for Extensive Green Roof Systems in Texas

Derald A. Harp^{1*}, Raul I. Cabrera², Wayne A. Mackay³, John J. Sloan², and Michael A. Arnold⁴, ¹Texas A&M University-Commerce, 2600 S. Neal P.O. Box 3011, Commerce, TX 75429; ²Texas A&M University, TAES-Dallas, 17360 Coit Rd., Dallas, TX 75252; ³University of Florida, Mid-Florida Research and Education Center, 2725 S. Binion Rd., Apopka, FL 32703; ⁴Department of Horticultural Sciences, Texas A&M University, College Station, TX 77843-2133

Primary considerations of green roof media are light weight and the ability to retain ample water supplies for plant growth. In Summer 2007, we evaluated an experimental open cell foam (OCF) for use in a green roof garden by conducting experiments in the lab and in a green roof test garden. Lab evaluations included comparisons of OCF to polyurethane fabric foam, synthetic sponge, sand, a 3:1:1 mix of peat moss, bark, and sand, and a commercially available green roof mix for water holding capacity (WHC), total porosity, and bulk density. From these calculations we determined dead load for the various media sources. We also created a green roof with nine 107-cm² OCF modules, three 107-cm-diameter round OCF modules, and sixteen 61-cm² green roof modules planted with *Sedum kamschaticum*, *Sedum sieboldii* 'October Daphne', *Lippia nodiflora*, and *Santolina virens*. The modules were evaluated in a RCB design, with four plants from each species evaluated as an experimental unit within each block. Plants were planted and grown in the greenhouse for 2 weeks prior to installation on the roof. On the roof, plants were watered as needed and fertilized weekly with a 20–10–20 water soluble fertilizer at 100 ppm N. WHC of the OCF is similar to the peat mix (56.5% and 51.9%, respectively), but lower than the sponge (65.9%) or the fabric foam (71.9%). The WHC of the sand and green roof mix were lowest at 36.3% and 30.3%. However, only the OCF and green roof mix were below the recognized design standard of 97.6 kg·m⁻² dead load at container capacity. In three of the four species tested, plant growth was similar regardless of media type. However, due to above normal precipitation and module drainage design, plants in the OCF had excessive water in the root zone resulting in severe loss of quality and the complete loss of *S. kamschaticum*. Further testing is necessary to determine the appropriate drainage and irrigation strategy, fertilization, alternative species composition, and to solve problems encountered with wind and UV degradation.

Postharvest/Plant Biotechnology Section

Antioxidant Properties of Oklahoma Grapes

Eric T. Stafne^{1*}, Sandra Peterson², and Edralin A. Lucas², ¹360 Agricultural Hall, Department of Horticulture and Landscape Architecture, Oklahoma State University, Stillwater, OK 74078; ²422 HES, Nutritional Sciences Department, Oklahoma State University, Stillwater, OK 74078

Cardiovascular disease (CVD) is a major public health concern with an associated health care cost of approximately \$438.1 billion and is the leading cause of death in the United States each year.

Atherosclerosis, the formation of fatty deposits in the artery, is the common cause of CVD. Numerous studies have consistently linked diets rich in fruits and vegetables to reduced CVD risk. Grapes constitute one of the major sources of phenolic compounds among different fruits. Findings from human studies have shown that consumption of grapes is beneficial to the heart; therefore, it is important to evaluate grape varieties grown in Oklahoma and determine the potential of each in preventing CVD. The objective of this project was to examine the anti-inflammatory properties of juice from grape varieties grown in Oklahoma. Thirty-three varieties of Oklahoma grapes were tested for their total phenolic content and antioxidant capacity as assessed by Folin assay and ferric reducing ability assay (FRAP), respectively. Grapes were either smashed or pureed for the analyses. Genotypes with the highest phenolic content (>100 mg/mL) when pureed were 'Corot noir', OK249, 'Petit Verdot', 'Rubaiyat', 'Sunbelt', 'Riesling', and 'Zinfandel'. Those with the highest antioxidant capacity (>10,000 μM) when pureed were 'Corot noir', OK249, 'Petit Verdot', and 'Zinfandel'. When the smashed technique was employed, the genotypes with the highest phenolic content (>60 mg·mL⁻¹) were 'Chardonnay', 'Cynthiana', 'Frontenac', OK249, 'Petit Verdot', and 'Rubaiyat'. The highest for antioxidant capacity (>5000 μM) were 'Rubaiyat' and 'Vignoles'.

Postharvest Sterilization of Feverfew (*Tanacetum parthenium*) Leaves using Heat, Chlorine Dioxide, or Ethylene Gas

N. K. Damayanthi Ranwala* and James W. Rushing, Clemson University Coastal Research and Education Center, 2700 Savannah Hwy., Charleston, SC 29414

Studies were conducted to determine the effects of heat and fumigation as sanitizing treatments on microbiological load and parthenolide content in dried feverfew leaves. Heat treatments included dry heat (60 °C for 48 hours), steam heat (121 °C for 20 minutes), or microwave heat (high for 3 minutes). Fumigation treatments included chlorine dioxide (ClO₂) at 2.2, 5, or 50 mg ClO₂/L or ethylene oxide (EO) at 4% or 12% v/v for selected time periods. Each replicate was 5–10 g of dried leaves with a moisture content of ~10% of dry weight. Before and after each treatment, leaf powder was used to enumerate aerobic, coliform and E-coli counts using 3M Petrifilm count plates. Parthenolide was analyzed using high performance liquid chromatography (HPLC). Steam heat effectively eliminated microbiological contamination but reduced parthenolide content by about 50% and changed leaf color from green to brown. Dry heat and microwave treatments both reduced microbiological load by about 40% but dry heat reduced parthenolide by about 10%. Microwave heat did not affect parthenolide content. The ClO₂ gas up to 5 mg ClO₂/L had no effects on microbial load or parthenolide while the 50 mg ClO₂/L reduced the microbial load by about 60% but also lowered the parthenolide content by 30% and caused leaf chlorosis. While 4% EO gas had no effects, 12% gas concentration killed all the microbes present without affecting parthenolide content. Leaf color was not affected by EO gas. These results suggest the EO fumigation and microwave heat have potential to be used as sterilants for feverfew without affecting apparent medicinal quality.

Chemical Profiles of the Basil Varieties Grown in Oklahoma

Elif Kalkan*, Niels O. Maness, and Donna Chrz, 360 Agricultural Hall, Department of Horticulture and Landscape Architecture, Oklahoma State University, Stillwater, OK 74078

Basil (*Ocimum* spp. L.) are diverse in flavor, aroma and chemical composition. They have been used to impart a characteristic flavor in various food products and as an ingredient in traditional medicines. Our work focuses on documenting chemical profiles and chemical stabilities of basil varieties over the course of the harvest season and in different years as a field crop in Oklahoma. 'Genovese', 'Italian Large Leaf', 'Ethiopian', 'Sweet Thai' (*Ocimum basilicum* L.) and 'Mrs. Burns' Lemon' (*Ocimum basilicum citriodora* L.) were harvested from field plants in 2005 during late June to early October at 3-week intervals and in single harvests in 2006 and 2007. Samples were either dried immediately at ambient temperature or after storage for 1 week at 10 °C. Ground samples were extracted with hexane and chemical

components were identified and quantified by gas chromatography. Based on chemotype, the five varieties could be separated into three categories: the pesto-type basil ('Genovese' and 'Italian Large Leaf') featuring linalool and eugenol; the clove-scented basil ('Ethiopian' and 'Sweet Thai') featuring methyl chavicol and eugenol; and the citrus-flavored basil ('Mrs. Burns' Lemon') featuring linalool, geraniol, and neral. Eugenol in all varieties except 'Italian Large Leaf' decreased after storage, and methyl chavicol was constant after storage. In terms of in-season production potential, methyl chavicol, eugenol, geraniol, and neral increased linearly for 'Italian Large Leaf', 'Ethiopian', and 'Sweet Thai'. However, linalool increased until mid-season and then started to decline for 'Mrs. Burns' Lemon' and 'Genovese'. The relative chemical profiles of the basil categories were not affected by growing season or year.

Mother Nature's Packaging and Organization of Carotenoids in Watermelon and Cantaloupe

Wayne W. Fish*, U.S. Department of Agriculture, Agricultural Research Service, South Central Agricultural Research Laboratory, 911 Hwy. 3 West, Lane, OK 74555

Carotenoids are one of the classes of compounds occupying an ever-increasing role as food supplements. Nutritional and physiological effects of carotenoids are, in general, limited by their bio-availability. As a means to better understand the factors that influence the bioavailability of carotenoids in their natural sources, the properties of plant-derived precipitates of watermelon lycopene and cantaloupe β -carotene were examined in water and in aqueous sodium dodecyl sulfate (SDS). Electron microscopy and chemical analyses revealed that the carotenoids were packaged inside a membrane to form a chromoplast. Watermelon chromoplasts ranged in apparent diameter from 0.1 to 6 μm while cantaloupe chromoplasts ranged in apparent diameter between 0.1 to about 1 μm . The chromoplasts could be made more water soluble by treating them with SDS; only SDS in its monomeric state appeared to bind to the membrane to effect solubilization. Binding measurements indicated that about 120 molecules of SDS were bound to the watermelon chromoplast membrane per molecule of lycopene inside the chromoplast. Around 90% of the chromoplast-SDS complexes from both sources were retained on a 0.45 μm membrane filter. Spectral peaks in the visible region of both sources of chromoplasts in SDS exhibited a wavelength shift toward the red from their location in organic solvent. Carotenoid-containing melon chromoplasts dispersed in aqueous SDS obeyed Beer's law; thus, this system can be used for quantitation of lycopene in watermelon or β -carotene in cantaloupe. Watermelon chromoplasts in SDS exhibited a pronounced circular dichroic activity in the visible region. Taken together, these spectral observations are consistent with the carotenoid monomers being assembled into a chiral aggregate inside the membrane. The binding of SDS molecules to the chromoplast membrane forms a complex that is extensively more water-soluble than the chromoplast alone.

Lycopene Accumulation in Watermelon

Angela Davis*¹, Penelope Perkins-Veazie¹, Charles Webber III¹, Stephen King², Jennifer Jeffery², and Haejeen Bang², ¹USDA-ARS, South Central Agricultural Research Lab, Lane, OK; ²Texas A&M University, Vegetable and Fruit Improvement Center

Lycopene is a red pigmented antioxidant that has been linked to various health benefits. Because of its intense coloring and health promoting properties, lycopene has been used as a natural food colorant and is used in supplements. It has been established in the literature that variety, location, grafting, deficit irrigation, and production intensity have an affect on the amount of lycopene accumulated in watermelon fruit. Still, varieties grown in the same location, harvested at the same time, and from the same variety, can have drastically different levels of lycopene, even when only fully ripe fruit are assayed. We performed a study to determine if physical properties within a plant can be the cause of this variation in carotenoid accumulation. We found that time of harvest can affect lycopene accumulation by up to 47%. Fruit size can change the amount of this compound by 29%, with higher weight positively correlating with

higher lycopene. The number of fruit per plant slightly impacted lycopene accumulation. Fruit from plants producing five fruit demonstrating on average 10% less lycopene than fruit from plants that produce only one fruit. Location on the plant affected the amount of lycopene, with crown set fruit containing on average 15% more lycopene than fruit set three or more feet from the crown. Days past pollination affected lycopene accumulation, with up to a 31% increase with increasing days past pollination. These results imply that the fruit-to-fruit variability in lycopene accumulation may be influenced by light quality/quantity and/or carbohydrate allocation.

Ripeness Determination in Personal-size Seedless Watermelons: Preliminary Results

Edgar L. Vinson, III¹, Floyd M. Woods¹, Penelope Perkins-Veazie², Joseph M. Kemble¹, Angela Davis², Wheeler G. Foshee III¹, and Jason E. Burkett³, ¹101 Funchess Hall, Department of Horticulture, Auburn University, Auburn, AL 36849; ²USDA-ARS, South Central Research Laboratory, 911 Hwy. 3W, Lane, OK; ³E.V. Smith Research Center, Horticulture Unit, Shorter, AL

In order to develop a non-destructive means of determining ripeness in personal-size melons, external maturity indices commonly associated with watermelon ripeness, were compared to internal characteristics that change during fruit maturation. As a result of this comparison, a statistical model can be developed to predict stage of ripeness. Personal watermelon varieties 'Valdoria' and 'Vanessa' were harvested at 20, 30, 40, and 50 days post-anthesis. At harvest, external indices weight, circumference, number of proximal senescent tendrils, and hunter a groundspot values were determined for each watermelon. Internal ripeness indicators, percent soluble solids, pH, sugar : acid ratio, and lycopene were also measured for each melon. Using the external maturity indices as predictors and soluble solids as the internal indicator of ripeness, a statistical model was developed. In 'Vanessa', given the current data, the number of proximal senescent tendrils was the only external variable in the model that could be used to predict ripeness. In 'Valdoria', no model could be developed with the current data. Given the model in the case of 'Vanessa', two to three senescent tendrils were sufficient in predicting adequate sugar content (<10%) and hence maturity. At this stage, lycopene content is in decline while sugar : acid ratio has reached a plateau.

Effect of Maturity at Harvest on Lycopene Content and Antioxidant Activity in 'Vanessa' Personal-sized Watermelon

F.M. Woods^{1*}, E.L. Vinson III¹, P. Perkins-Veazie², A. Davis², J.M. Kemble¹, W.G. Foshee¹ and J.E. Burkett³, ¹101 Funchess Hall, Department of Horticulture, Auburn University, AL 36849; ²USDA-ARS, SCARL 911 East Hwy. 3, Lane, OK 74555; ³Alabama Agriculture Experiment Station, 4725 County Rd. 40, Shorter, AL 36075

The stage of maturity at harvest of fresh fruit has a profound effect on marketing and storage of a number of small to medium sized horticultural commodities. In many instances there are established USDA grades and maturity indices to assist growers and the produce industry alike. However, in the case of personal-sized watermelons there is a paucity of information relating physicochemical and internal quality attributes during development and ripening. The present study was therefore designed to characterize two antioxidants in personal-sized watermelon under Alabama growing conditions. Two personal-sized watermelon (*Citrullus lunatus* cvs. Valdoria and Vanessa) were grown during two seasons (FYs 2006 and 2007) at Auburn University's E.V. Smith Research Station located in Shorter, AL in order to determine the effect of maturity at harvest on lycopene and -carotene content. Fruit quality parameters were determined after 20, 30, 40, and 50 days post-anthesis. In both cultivars, lycopene content peaked at 30 days post-anthesis and thereafter declined during both years of determination. In contrast, -carotene content increased continuously throughout the study. Total carotenoid content similarly peaked at 30 days after anthesis and remained constant between 30 and 40 days and declined thereafter. Our preliminary findings are useful in determining developmental and ripening changes in personal-sized watermelons. Further studies are needed to definitively establish maturity standards for this fruit.

Effect of High Tunnel and Shade Cloth on Carotenoid Content and Antioxidant Activity in Selected Bell Pepper Cultivars

F.M. Woods^{1*}, E.L. Vinson III¹, W.G. Foshee III¹, J.M. Kemble¹, W.G. Sherrer¹, J.E. Burkett², and J.D. Wesley¹, ¹101 Funchess Hall, Department of Horticulture, Auburn University, AL 36849; ²Alabama Agriculture Experiment Station, 4725 County Rd. 40, Shorter, AL 36075

A preliminary study was conducted in order to determine the effects of simplified growing system (high tunnel and colored shade cloth material) on growth, photosynthetic potential as assessed by chlorophyll a, b and total chlorophyll content and antioxidant content as assessed by -carotene, lycopene, total carotenoid, total carotenoid/total chlorophyll content in ripened pepper fruit (*Capsicum annum* L. cv. Stiletto). Peppers were grown in a high tunnel system in combination with five selective colors of shade cloth which differed in potential utilization of solar radiation (black, red, blue, gray, pearl) in comparison to bare ground and conducted at the E.V. Smith Research Station in Shorter, AL during Fall 2007. Ambient temperature probe readings (°F) of colored shade cloth environments were significantly lower than bare ground readings indicating that less temperature stress occurred under these conditions. Chlorophyll a content was highest in bare ground and blue shade cloth when compared to all other treatments in contrast; chlorophyll b content readings were not significantly different. Total Chlorophyll content results were similar to chlorophyll a content with respect to treatment differences. -carotene content was significantly higher in colored cloth material with the exception of pearl when compared with bare ground. Lycopene content was significantly higher in colored cloth material with the exception of gray and pearl when compared to bare ground. Total carotenoid/chlorophyll ratio an indicator of stage of ripeness revealed that black and blue shade cloth treatments hastened ripening when compared to all other treatments. Results from this study indicate that the use of high tunnels in combination with selective colored shade cloth material has potential benefits in altering growth, nutritional status and fruit quality of bell pepper under Alabama growing conditions.

Seasonal and Postharvest Temperature Impact on Novel Orange-fleshed Honey Dew Fruit Antioxidants

Gene E. Lester^{1*} and D. Mark Hodges², ¹Kika de la Garza Subtropical Agricultural Research Center, Agricultural Research Service, U.S. Department of Agriculture, Weslaco, TX 78596; ²Atlantic Food and Horticulture Research Centre, Agriculture and Agri-Food Canada, Kentville, Nova Scotia, B4N 1J5 Canada

Orange-fleshed cantaloupe fruit (*Cucumis melo* L. Reticulatus group) continues to raise food-safety concerns due to attachment of enteric bacteria to sites on the netted surface inaccessible to sanitation. Non-netted, orange-fleshed honey dew fruit (*Cucumis melo* L. Inodorous group) vs. cantaloupe offers a safer and a healthier (nutritional content) option. Some commercially available non-netted orange-fleshed honey dew genotype fruits were compared for antioxidants associated with storage quality following autumn and spring production cycles, harvested at abscission (mature) and stored for up to 24 d at 5 °C or 10 °C. Spring versus autumn production generally yielded higher overall levels of 5-methyltetrahydrofolate (folic acid), calcium, malondialdehyde (MDA), and lipophilic total antioxidant capacities. 'Orange Delight' and 'Orange Dew' were generally superior to 'Honey Gold', 'Temptation', and a breeding line, as they consistently demonstrated some of the highest levels of total ascorbic acid, β-carotene, and potassium. 'Orange Delight' and 'Orange Dew' were also among the cultivars with the highest activities of ascorbate peroxidase (EC 1.15.1.1), catalase (EC1.11.1.6), and superoxide dismutase (EC 1.15.1.1). These two cultivars also exhibited the least increase in MDA (i.e., lipid peroxidation) during storage, indicating antioxidant levels limited oxidative-related senescence compared to the other genotypes. Results indicate that there are significant differences in human-health- and storage quality-related phytochemical profiles between orange-fleshed honey dew cultivars, and that high antioxidant levels are associated with reduced lipid peroxidation during fruit cold storage.

Vegetable Crops Section

Weed Control in Sweet Corn

Joseph G. Masabni, University of Kentucky Research and Education Center, P.O. Box 469, Princeton, KY 42445

An experiment was conducted at Princeton, KY in 2007 to evaluate the performance and safety of AE 0172747 (Laudis) applied post-emergence at the V3-V4 stage on four sweet corn cultivars: 'Candy Corn', 'Incredible', 'Providence', and Silver Queen'. Laudis was applied at 3 and 6 oz/acre in tank mixtures with atrazine 1 and 2 pt/acre with MSO and UAN adjuvants. Western Kentucky experienced a long draught period in 2007 that resulted in reduced weed pressure in all treatments including the untreated control. Sweet corn was seeded at the rate of 33 seeds per cultivar per plot. Sweet corn cultivars were harvested between 70 and 79 days after seeding. No significant differences were observed in number and weight of ears per plot for 'Candy Corn' and 'Incredible'. Number of ears ranged between 27 and 35 ears/plot for 'Candy Corn' and 35 to 55 ears/plot for 'Incredible', while weight of ears/plot ranged between 15 to 22 lb/plot and 23 to 32 lb/plot for 'Candy Corn' and 'Incredible', respectively. Number of ears/plot for 'Providence' wasn't significantly different among all treatments and ranged from 16 to 29 ears/plot. Harvest weight for 'Providence' was highest for all herbicides and rates when applied alone and was significantly reduced in all mixed treatments of Laudis and atrazine. No trend was observed with the cultivar Silver Queen where harvest weight was nonsignificant for all treatments, while number of ears/plot was highest for Laudis 6 oz tank-mixed with atrazine and lowest for Laudis 3 oz applied alone.

Evaluation of Cabbage, Broccoli, Cauliflower and Brussels Sprouts Varieties in Georgia

William Terry Kelley* and Denne Bertrand, Department of Horticulture, University of Georgia, 4604 Research Way, P.O. Box 748, Tifton, GA 31793

Traditionally cabbage and leafy greens have been the primary *Brassica* crops produced commercially in Georgia. However, due to rising transportation costs, broccoli production in Georgia has been increasing. The same circumstances could open new opportunities for Georgia growers in cauliflower and brussels sprouts. It has been several years since cabbage and broccoli variety trials have been conducted, and cauliflower and brussels sprouts may have never been evaluated in Georgia. The objective then was to determine what varieties of cabbage, broccoli, cauliflower and brussels sprouts are best suited for production in Georgia. Seedlings of all four crops were produced in an experiment station greenhouse and transplanted to the field on 2 Mar. 2006 in Tifton, GA. All four crops were planted in rows 36 inches apart with cabbage and broccoli plants spaced 12 inches apart in the row, and cauliflower and brussels sprouts 15 inches apart. Plots were 10 ft long and were replicated four times in a randomized complete-block design. Each crop was harvested at the appropriate maturity stage and yield and quality data taken at harvest. Normal cultural practices were used for each crop. Among the 20 varieties of broccoli, 'TLALOC', 'Decathlon', 'Greenbelt', 'Gypsy', 'Patriot', and 'Patron' were similar in yield to 'Arcadia' (340 boxes/acre). 'Bravo', 'Early Thunder', 'Emblem', 'Green-cup', 'Rio Verde', 'HMX 3241', and 'Royal Vantage' were all similar to 'Golden Dynasty' (1220 boxes/acre) among the 18 cabbage varieties. 'Candid Charm', 'Freedom', 'Incline', and 'Symphony' were similar to 'White Magic' (378 boxes/acre) among the 14 cauliflower varieties. 'Oliver' was similar to 'Jade Cross' (337 boxes/acre) among the three brussels sprouts tested. Some differences in quality and marketability were noted for each crop and some varieties appeared in this single evaluation to be inferior.

Plant Response of Onion Cultivars Developed from Greenhouse-grown Transplants to Plant Density and Fertilizer Rate

V.M. Russo, USDA, ARS, SCARL, P.O. Box 159, Lane, OK 74555

Onions (*Allium cepa* L.) can be established from seed or transplants. The latter planting material can be dormant or actively growing when

transplanted to the field. Onion transplants can be produced in a greenhouse, but there are gaps in the knowledge of the cultural requirements for these plants after transplanting. Greenhouse-grown transplants of 'Candy', intermediate-day plant, and 'Texas Grano 1015 Y', short-day plant, were established at densities of 41,000, 82,000 or 124,000 plants/ha and 100 (recommended) and 400 kg-ha⁻¹ of nitrogen in mid-Mar. 2006 and 2007. Nitrogen fertilizer rate did not affect yield; yield increased as density increased, and yield of 'Texas Grano 1015 Y' was higher in 2006 than in 2007. 'Candy' had a higher number of large size bulbs and 'Texas Grano 1015 Y' more small bulbs. Bulb nutrient content was affected only by year with nitrate-N, K, Na and SO₄ were higher in 2006 and nitrite-N, Ca, Mg, and PO₄ were higher in 2007. Precipitation levels in the two years were different, with 2007 being the wetter. This may have contributed to the responses to year and it appears that 'Candy' was better able to respond in a more uniform manner to the changed environmental conditions. For plants developed from greenhouse-grown transplants, the recommended rate of fertilizer and the highest plant density are beneficial to improved marketable yield.

Sowing Date, Transplanting Date, Plant Population, and Variety Effect on Transplanted Short-day Onion Production

George E. Boyhan¹, Reid L. Torrance², Jeff Cook³, Cliff Riner², and C. Randell Hill⁴, ¹Department of Horticulture, University of Georgia, East Georgia Extension Center, P.O. Box 8112, GSU, Statesboro, GA 30460; ²Tattnall County Extension, P.O. Box 558, Reidsville, GA 30453; ³Crawford County Extension, P.O. Box 397, Butler, GA 31006; ⁴Vidalia Onion and Vegetable Research Center, 8163 Hwy. 178, Lyons, GA 30436

Onions grown in southeastern Georgia are produced from on-farm grown transplants. These plants are sown in September and are ready for harvest in 8 to 10 weeks. This study evaluated the effect of transplant date on onion yield and quality. Onions could be transplanted from mid-November to the end of December without any loss in yield or quality. Certain varieties such as 'Ohoopoe Sweet' and 'Sweet Advantage' have a propensity to form doubled bulbs. Evaluation of delayed sowing and transplanting date indicated that delayed sowing to the beginning of October reduced doubled bulbs in these varieties. Increasing plant population by 75% increased yield, but only by about 20% to 30% in 'WI-131' and 'Georgia Boy' and not at all in 'Sweet Vidalia'.

Pumpkin Quality and Yield in the Southeastern United States

Annette L. Wszelaki¹, Jonathan R. Schultheis², and W. Terry Kelley³, ¹Department of Plant Sciences, University of Tennessee, 252 Ellington Plant Sciences Bldg, 2431 Joe Johnson Dr., Knoxville, TN 37996; ²Department of Horticultural Science, 264 Kilgore Hall, Box 7609, North Carolina State University, Raleigh, NC 27695-7609; ³University of Georgia, Department of Horticulture, 4604 Research Way, P.O. Box 748, Tifton, GA 31793

Twenty-six advanced lines or cultivars (cultigens) were grown in a pumpkin trial conducted at the Mountain Research Station in Waynesville, NC. The purpose of the trial was to compare yield, quality and adaptation of cultigens to growing conditions in the high elevations of the southeastern United States. The experiment was arranged in a randomized complete-block design, with four replications per cultivar. Seeds were planted on 26 June 2007. Recommended cultural practices for pumpkins were used during the season. A once-over harvest was conducted 105 days after planting. The cultivars were sorted into six size classes: giant (>50 lbs), extra large (40–50 lb), large (25–40 lb), medium (10–25 lb), small (5–10 lb), and mini (<5 lb). The characteristics measured included yield (weight and number of fruit); percentage of fruit mature at harvest; and average fruit weight, length, and width. Rind color, rind suturing, stem attachment, stem length, stem thickness, vine type, and powdery mildew severity were evaluated. Rind color varied from white to burnt orange. Suturing ranged from smooth to deep sutures. Long, thick, well-attached handles were most desirable for jack o'lantern-type pumpkins. 'Prizewinner', a giant pumpkin, was the highest yielding cultivar by weight, while 'Bumpkin', a mini pumpkin, yielded the highest number

of fruit per acre. Of the large jack o'lantern pumpkins, 'Harvest Time' yielded the most weight per acre, with an average fruit weight of 32.5 lb. 'Gold Medal' yielded the highest number of fruit per acre, with an average fruit weight of 26.3 lb. For medium size fruit, 'Pro Gold 510' was the highest yielding by both weight and number of fruit per acre. Disease pressure was generally low in the trial, due to hot, dry conditions during the production season. However, there were significant differences in powdery mildew severity among the cultigens. 'Magic Wand', a medium-sized pumpkin, had the least powdery mildew of the cultigens. 'Bumpkin' and 'Pro Gold 510' had the highest powdery mildew ratings in the trial (moderate-severe); however, the powdery mildew did not seem to impact their yields. There were a number of high quality, high yielding pumpkin cultigens that were well adapted to the high elevation regions of the southeastern United States. This may provide additional or new marketing opportunities for growers in the region.

Spinach Planting Density and Effects on Weed Control, Crop, and Yield

Russell W. Wallace^{1*}, Alisa K. Petty¹, and Aaron L. Phillips²,
¹Department of Horticultural Sciences, Texas AgriLife Research & Extension Center, 1102 East FM 1294, Lubbock, TX 79403; ²Del Monte Foods, 2205 Old Uvalde Hwy., Crystal City, TX 78839

Trials were conducted in 2006 to 2008 at the Del Monte Research Farm located in the Texas Wintergarden to evaluate the effects of spinach (*Spinacia oleracea*) density (low = 525,000 plants/acre; medium = 900,000 plants/acre; or high = 1.1 million plants/acre) on the rates of three preemergence herbicides for crop injury, weed control, and yield. Ro-Neet 6E (cycloate, 3.4 and 1.7 lb a.i./acre) was applied preplant incorporated, while Dual Magnum [s-metolachlor, 0.65 (grower standard rate) and 0.33 lb a.i./acre] and Outlook (dimethenamid-p, 0.5 and 0.25 lb a.i./acre) were applied preemergence immediately following planting. Crop density influenced fumitory (*Fumaria officinalis* L.) populations, with higher spinach densities having fewer weeds in the untreated plots. Fumitory averaged 3641 plants/acre in the lowest spinach density, while averaging 2991 and 1040 plants/acre in the medium and high densities, respectively. Regardless of herbicide rate, Dual Magnum and Outlook gave excellent control of fumitory in all three spinach densities; Ro-Neet control was less. Injury ratings showed that Outlook caused significant crop stunting (40% to 50%), regardless of planting density. Dual Magnum also caused minor stunting (15%), while Ro-Neet was safe. Yields in Outlook-treated plots were reduced 41% compared to the nontreated control plots, while Dual Magnum caused 15% lower yields. Only Ro-Neet had yields comparable to the nontreated controls, though more weeds were present at harvest. Averaged across planting densities, yield increased 4.4% when seeding rates increased from low to medium densities. However, when planted at the high density, yield increased 17.6%. This may indicate that it is more profitable to plant spinach at the higher rates in fields where weeds are difficult to control, thus reducing costly hand labor. These results suggest that increasing spinach density at planting aids in weed suppression, especially when herbicides fail to provide adequate control and that the high seeding rate gave the greatest yields regardless of herbicide rate. Outlook is too injurious for spinach, and should not be further researched. Ro-Neet, already registered, continues to be a viable option, although performance should be enhanced with higher seeding rates.

Racer Efficacy Study Fall 2007

Lynn Brandenberger^{1*}, Charles Webber III², James Shreffler³, and Lynda Wells¹, ¹Department of Horticulture, Oklahoma State University, 360 Ag Hall, Stillwater, OK 74078-6027; ²USDA, ARS, SCARL, P.O. Box 159, Lane, OK 74555; ³Wes Watkins Research and Extension Center, Box 128, Lane, OK 74555-0128

Stale seedbeds are used in conventional crop production. Having an available organic contact herbicide would make it possible to use stale seedbed weed control in organic production. Organic contact herbicides could also be used as post directed applications using directed sprays or hooded sprayers. Racer (ammonium nonanoate) is labeled for non-food use with efforts currently under way to label it for organically

grown food crops. Treatments included two nozzle types (TeeJet XR8003 at 59 psi and TeeJet XR8005 at 83 psi), three application rates of Racer (8.0, 11.2, and 14.4 lbs ai/acre), and two application volumes (35 and 70 gpa) for a total of 12 treatments. Herbicide activity on weed populations present in the study included burning and subsequent necrosis of plant tissues present at the time of application. In general, Racer proved to be an effective contact herbicide for controlling the three weed species that were included in the study (Palmer amaranth, carpetweed, crabgrass). The two higher rates of Racer (11.2 and 14.4 lbs ai/acre) were more effective than the 8.0 lbs ai/acre rate, although even the low rate resulted in higher levels of weed control than the untreated control. It appears that the overall spray application rate of 70 gal/acre probably diluted the active ingredient enough to reduce its effectiveness. Based upon the results, the authors would recommend further study to determine if similar results would be observed during a different season under different conditions, but would recommend examining rates of 11.2 and 14.4 lbs ai/acre and overall application rates of 35 gpa.

Summer Cover Crop Performance in the Gulf States

W.B. Evans^{1*} and C. Motsenbocker², Mississippi State University, Truck Crops Branch, Crystal Springs, MS 39059-0231; ²137 Julian Miller Hall, Louisiana State University, LSU AgCenter, Baton Rouge, LA 70803

In a preliminary study, we evaluated six cover crops for biomass production in Summer 2007. Species and seeding rates included: sunnhemp (*Crotalaria juncea*, 44 kg·ha⁻¹); southernpea (*Vigna unguiculata*, 44 kg·ha⁻¹), buckwheat (*Fagopyrum esculentum*, 66 kg·ha⁻¹); sesame (*Sesamum indicum*, 5.5 kg·ha⁻¹); sesbania (*Sesbania macrocarpa*, 27.5 kg·ha⁻¹); and a proprietary mix of 70% buckwheat and 30% southernpeas (44 kg·ha⁻¹). Untreated or certified organic seeds were broadcast and incorporated at recommended rates in June. Plots received irrigation until emergence, but received no fertilizer or pesticides prior to or during growth. A 1-m² area of crop and weed shoot mass was harvested at 60 days after planting (DAP), and another at 90 DAP from each 1.5-m 6.1-m plot. Poor stand establishment reduced the quality of data in the southernpea, buckwheat, and mix plots. Greatest total fresh (FM) and dry matter (DM) crop biomass production from two harvests at 60 and 90 DAP was from sesame (114.5 Mg·ha⁻¹ FM; 24.4 Mg·ha⁻¹ DM), and sunnhemp (75.0 Mg·ha⁻¹ FM, 22.3 Mg·ha⁻¹ DM), and sesbania (63.7 Mg·ha⁻¹ FW, 23.9 kg·ha⁻¹ DM). Weed biomass was less than 15% of total fresh or dry biomass in these three crops. Weed biomass exceeded crop biomass in the other three crops.

Corn Starch as a Soil Amendment: Deal or No Deal?

Eric Simonne^{*}, Bob Hochmuth, Lani Davis, April Warner, Aparna Gazula, Debbie Gast, and Audrey Simonne, Horticultural Sciences Department, University of Florida, Gainesville, FL 32611-0690

Because of high water holding capacity, corn starch may become a best management practice that would help reduce nutrient movement below the root zone of vegetables. Amending a Blanton-Foxworth-Alpin complex fine sandy soil with a commercially available hydrolyzed starch-polyacrylonile graft copolymers product at rates of 0 to 0.5 and 0 to 6 g/12-kg pot did not significantly increase soil water retention. Leachate volume and electrical conductivity were not significantly reduced by these rates of cornstarch when summer squash was planted in the pots. Based on the manufacturer's information, the recommended rate of 9 kg·ha⁻¹ (0.5 g/12-kg pot; \$110/ha) banded-applied would only hold the equivalent of water delivered by a 13-minute drip irrigation event. These results suggest that current manufacturer's rate is too low to practically affect irrigation management of drip-irrigated vegetables. Increasing cornstarch rate 20-fold would allow for a theoretical increase in water storage equivalent to 4 hours of drip irrigation (greatest daily volume applied), but would require a change in pricing structure.

Flow Rates and Shape of the Wetted Zone Responses to Drip Irrigation System Operating Pressure

Aparna Gazula*, Eric Simonne, and Robert Hochmuth, *Horticultural Sciences Department, 1241 Fifield Hall, University of Florida, Gainesville, FL 32611-0690*

Increasing lateral water movement as an attempt to reduce vertical water movement may help reduce nutrients loss below the root zone of vegetables grown with plasticulture. Because lateral movement of water may be increased with reduced operating pressures (OP), our objectives were to measure (1) the effects of low OP on drip tape (DT) flow rate (FR), (2) the effect of DTFR on depth and width (inches) of the wetted zone using soluble dye. Target OP were achieved with two medium flow pressure regulators (6 and 12 PSI with 4-16 and 2-20 gal/minute FR, respectively). For objective 1, six treatments were achieved through a combination of commercial DT (12-inch emitter spacing; with 20 (DT1), 24 (DT2), 39 (DT3) gal/hour per 100-ft FR) and OP (12 and 6 PSI). For objective 2, a total of 24 volume of water applied (VW) treatments were achieved through a combination of the above six treatments applied at four irrigation lengths (45, 90, 180, and 240 minutes). In objective 1, treatments had a significant effect on FR, mean FR was significantly higher at 12 PSI OP than at 6 PSI OP (23.61 and 17.96 gal/hour per 100-ft respectively). DTFR significantly affected depth and width of the wetted zone. Contrary to what we expected, depth and width of the wetted zone were significantly higher at 12 PSI OP than at 6 PSI OP. Within the range of VW (6.3–93.6 gal), the relationship between mean width and VW was quadratic (mean width = $-0.0007 \text{ volume}^2 + 0.17 \text{ volume} + 9.35$; $R^2 = 0.94$), and relationship between mean depth and VW was linear (depth = $0.038 \text{ volume} + 22.11$; $R^2 = 0.32$). Hence, reducing OP reduces FR but the reduction depends on the DT, but increasing FR increases the lateral movement of water in the soil, which was contrary to what we expected.

Greenhouse Production of Grafted Tomato Transplants

Xin Zhao*, Eric H. Simonne¹, Jeremy D. Edwards², and J.W. Scott², *¹Horticultural Sciences Department, University of Florida, Gainesville, FL 32611; ²Gulf Coast Research and Education Center, University of Florida, Wimauma, FL 33598*

Interest in vegetable grafting is currently emerging in the U.S. In addition to disease resistance, grafted plants may exhibit improved tolerance to various environmental stresses as well as enhanced uptake of water and nutrients, resulting in vigorous growth, extended growing period, and possible yield increase. This greenhouse study was carried out to investigate the grafting efficiency of tomato transplants using the splice grafting method. 'Florida-47', a popular tomato variety grown in Florida while susceptible to root-knot nematode, Fusarium wilt race 3, and Fusarium crown rot, was grafted onto a commercially available disease resistant rootstock 'Maxifort'. Grafting was conducted at the five- to six-leaf stage. Both scion and rootstock plants were cut on stems above the two lower leaves at a 45° angle and then held together by plastic grafting clips. In the greenhouse, grafts were placed in a closed healing chamber where temperature ranged from 22 to 32 °C and relative humidity was maintained above 80%. Light and ventilation were introduced gradually after a dark period of 3 days. The overall healing process was completed with 5-7 days. An average grafting survival rate of 93% was achieved in this experiment, which was calculated as the ratio of the number of completely healed grafts to the total number of plants grafted. Further studies are warranted to evaluate the influence of microclimate conditions in the healing chamber on tomato grafting efficiency. Moreover, different grafting methods need to be trialed to compare the production costs of grafted tomato transplants.

Evaluation of the Growth and Production of Sorrel Germplasm on Calcareous Soils

Thomas W. Zimmerman, *University of the Virgin Islands, Agricultural Experiment Station, RR1 Box 10,000, Kingshill, VI 00850*

Sorrel (*Hibiscus sabdariffa*) is a plant originally native to Africa that has been grown in the Caribbean for centuries. Sorrell or roselle is used fresh during the winter months, or dried to make a nonalcoholic

drink. Germplasm of 60 accessions, obtained from the USDA-ARS in Griffin, GA, were used. Seedlings of the sorrel germplasm accessions were transplanted in calcareous soils, with a pH range of 8.0–8.9, and compared with seven local cultivars. All sorrel developed interveinal chlorosis. Many of the accessions also developed terminal necrosis. The local sorrel outperformed all the sorrel in the USDA seed germplasm collection. This indicates that farmers in the Virgin Islands have been selecting plants that have tolerance to our local high pH soils. However, five accessions from the USDA germplasm collection were found that have potential for production in the Virgin Islands: numbers 268097, 496717, 496938, 464809, and 500721.

Evaluation of Carrot Cultivars for Farm to School Use

James Shreffler*, Lynn Brandenberger², Lynda Wells², Warren Roberts¹, and Merritt Taylor¹, *¹Wes Watkins Agricultural Research and Extension Center, P.O. Box 128, Lane, OK, 74555; ²Department of Horticulture and Landscape Architecture, 360 Ag Hall, Oklahoma State University, Stillwater, OK 74078*

A "Farm to School" (FS) program was established in Oklahoma with the goals of increasing the use of fresh, high quality, and locally grown produce in public school cafeterias and of getting youth interested in healthy eating habits. Formally established in 2006 through state legislation, the program is administered by the state's Department of Agriculture. With watermelon and honeydew being the first crops used in the program, additional crops that can be harvested during school sessions are needed. Sixteen carrot cultivars were evaluated for fresh use suitability for FS in field trials at Lane in Spring and Fall 2007. Carrots were seeded with a 1-inch plant spacing in rows spaced 12 inches apart. Spring and fall plantings were made on 2 Apr. and 6 Sept., respectively, and harvested on 20 June and 13 Dec. Carrots were counted, weighed, and length and diameter were measured. Significant differences were found between cultivars for root weight, root length, and root diameter but not for yields or culls (splits or multiple growing points). For root weights, 'Abaco', 'Anushka', 'Austria', 'Bejo 2546', and 'Rainbow' were in the top group of means for spring and fall plantings. 'Crème de Lite', 'Invicta', 'SugarSnax 54', 'Sun 255', 'TopCut 93', and 'Tripleplay 58' were in the top group only in the fall. Root lengths differed only in the fall, ranging from 4.5 to 8.3 inches. 'Abaco' and 'Anushka' had greatest diameters in spring and fall and 'Invicta' did not differ from them in the fall. Most carrots fell in the diameter class of 3/4 to 1-1/4 inches. 'Austria', 'Bejo 2546', 'Kamran', 'Nelson', and 'Rainbow' fell in this size class in the spring and fall. 'SugarSnax54', 'Sun 255', 'TenderSnax', 'Topcut 93', and 'Tripleplay 58' fell in this class in the fall and were smaller in the spring. Cultivars showing consistency in size across seasons may be good candidates for FT carrot production. Earlier planting dates may be needed to achieve harvest dates that fall during the school year.

Evaluation of Cowpea Genotypes for Adaptation to Low Soil P Conditions and Rock Phosphate Application

Sabiou Mahamane*, W.A. Payne¹, R.H. Loeppert¹, J.C. Miller, Jr.², and D.W. Reed², *¹Department of Soil and Crop Sciences; ²Department of Horticultural Sciences, Texas A&M University, College Station, TX 77843*

Cowpea (*Vigna unguiculata* L Walp.) is a major food and fodder legume which is produced worldwide on 12.5 million hectares. It is often grown on low-P, low-yielding, sandy, acid soils. Commercial fertilizer P has been shown to increase yield; however, commercial fertilizers are expensive and seldom available to farmers in developing countries. In West Africa, rock phosphate (Ca-P) mines exist that could provide an alternative to commercially processed fertilizers. Preliminary studies have shown that cowpea cultivars might respond differently to low-P availability and to rock phosphate addition. Therefore, the objective of this investigation was to assess the variability among 696 accessions from the U.S. Cowpea Core Collection, Griffin, GA, and 15 selections from the International Institute for Tropical Agriculture, Ibadan, Nigeria, for tolerance to low P (3 ppm) availability in acidic (4.7) sandy, siliceous soil grown in 200 g cone-tainers and their response to zero added P or 300 mg/kg Tahua rock phosphate application. This information would be useful in the identification of

parental material for breeding programs. All other nutrients were applied at optimal rates in Hoagland's solution, alternating with water. Parameters measured included shoot and root dry weight, plant height, shoot-to-root ratio, total biomass, and P concentration. A completely randomized design with three replications was used, with data analyzed using SYSTAT. Wide variability was found both for adaptation to low P and response to added rock phosphate. High performing genotypes under low P included PI 582469, PI 582352, and PI 164979, while high performers under added rock phosphate included PI 610533 and PI 582353. This variability is evidence for genetic control of the trait, and suggests that it should be possible to breed cultivars with enhanced ability to perform under low-p conditions, as well as with enhanced response to rock phosphate application.

Vegetable Crops Section—Sweetpotato

Relationships between Preharvest Conditions and Increased Susceptibility of Sweetpotatoes to Rhizopus and Bacterial Soft Rots in Louisiana and North Carolina

B.A. Edmunds¹, C.A. Clark², G.J. Holmes¹, and E.D. Gray²,
¹North Carolina State University, Department of Plant Pathology;
²Louisiana State University AgCenter, Department of Plant Pathology and Crop Physiology

In 2004–06, the interaction of preharvest factors and susceptibility to rhizopus (*Rhizopus stolonifer*) and bacterial (*Erwinia chrysanthemi*) soft rots was studied in 73 Louisiana and 124 North Carolina sweetpotato fields (cv. Beauregard). Preharvest parameters (including pesticide use, soil nutrients, and weather) were recorded for each field and roots were harvested. After 100 days storage, one-half of the roots were uniformly wounded and inoculated with a *R. stolonifer* suspension. The remaining roots were stab-inoculated with a pipet containing a suspension of *E. chrysanthemi* cells. Preharvest parameters were related to disease incidence after 7 days using Pearson correlations ($P < 0.05$). There was a wide range in susceptibility to both diseases found in roots from different fields in all 3 years. A negative correlation was found between soil phosphorus index and *R. stolonifer* in all 3 years in LA. This relationship was not found in North Carolina and may be due to the differences in the range of the soil phosphorus index (Louisiana: mean = 51, range = 6–104; North Carolina: mean = 141, range 35–279). In both states, seasonal soil moisture levels correlated negatively to *E. chrysanthemi* and positively to *R. stolonifer* susceptibility. The results suggest there are complex interactions of field variables that have a profound influence on susceptibility to both diseases and that the two pathogens respond differently to these variables.

Using GIS/GPS Techniques to Evaluate Soil Insect and/or Nematode Pest Control Strategies in Sweetpotato

Eugene Burris¹, D. Burns¹, T. Smith², and K.S. McCarter³,
¹LSU AgCenter, Northeast Research Station, P.O. Box 4589, St. Joseph, LA, 71366; ²LSU AgCenter Sweet Potato Research Station, P.O. Box 120, Chase, LA, 71324; ³Department of Experimental Statistics Louisiana State University Agricultural Center, Baton Rouge, LA 70803

This research attempts to characterize the source of variability within loess soils by using tools such as the Veris cart[®] for measuring apparent electrical conductivity (EC_a), Real Time Kinetic Geographical Position Systems (RTK GPS), normalized vegetative index (NDVI) and variable rate treatments applied “as needed” for correction of soil Ph and nutrient deficiencies in sweetpotato. Use of variable-rate applications has several benefits, including effective use of treatment resources, a potential reduction of input costs, and a reduction in environmental impacts resulting from use of the treatments. Selected tests data were analyzed using Veris EC_a, RTK GPS for measuring elevation, RTK for measuring yield data, NDVI to assist in identification of variable portions of fields and soil sampling to identify plant parasitic nematodes and aid in correction of Ph and nutrient problems. In 2006, the precision Ag techniques were used to conduct and analyze an on-farm wheat cover crop experiment in sweetpotato, applied with

and without Telone II nematicide. The RTK methods simulated yield across the test plots and indicated no differences in yield for the plots treated with wheat cover crop compared to no cover crop. In the Telone II, 5 GPA plots, yield estimates indicated that the plots receiving a fumigation treatment sometimes exceeded 100 bu/acre. The RTK simulation of yield demonstrated field effects that reduced or increased the harvest of U.S. No.1s. In 2007, research included evaluation of insects across irrigated and non-irrigated portions of a field. Insect data was collected throughout the season from 1-acre grid plots. The grid pattern allowed observations of insect movement across the field and yield effects due to irrigation were detected using GPS simulations for yield monitor data. Test plot Data was analyzed using GeoStatistical and GeoSpatial methods. Data points were converted to centroids using SSTool Box and Geostatistical and GeoSpatial analysis was accomplished using ArcGis9 and GeoDa 0.9. Global spatial correlation was evaluated using Univariate Moran scatter plots and Univariate Lisa was used to create significance maps. Field prescriptions for soil Ph or nutrients were made using Farm Works and SSTool Box GIS software.

Weed Management in Evangeline and Beauregard Sweet Potato

D. Miller¹, T. Smith², and M. Mathews¹,
¹LSU AgCenter Northeast Research Station, P.O. Box 4589, St. Joseph, LA, 71366; ²LSU AgCenter Sweet Potato Research Station, P.O. Box 120, Chase, LA 71324

Studies were conducted in 2007 to evaluate the tolerance of ‘Beauregard’ and ‘Evangeline’ sweetpotato to labeled herbicides and potential ability of each variety to compete against weeds. Herbicide treatments included clomazone (Command 3 ME) at 1.3, 2, 2.5, or 3 pt/acre post-transplant, flumioxazin (Valor SX) at 2 or 2.5 oz/acre pre-transplant, metolachlor (Dual Magnum) at 1 pt/acre pre-transplant, flumioxazin at 2 oz/acre pre-transplant followed by clomazone at 2 or 2.5 pt/acre or metolachlor at 1 pt/acre post-transplant, and flumioxazin at 2 oz/acre pre-transplant followed by clomazone at 2 pt/acre post-transplant followed by halosulfuron (Sanda) at 0.6 oz/acre 34 days post-transplant. A weed-free control was included for comparison. Experimental design was a randomized complete block with four replications. Crop injury and weed control were visually rated 13 and 34 d after treatment, respectively. Plots were harvested on 18 Oct. Yield comparison was made between varieties within each respective herbicide treatment and the weed-free control. In addition, yield comparison was made for each variety within a herbicide treatment and the weed-free for that respective variety. Control of carpetweed, cutleaf groundcherry, spiny amaranth, yellow nutsedge, and purple nutsedge was no greater than 54%, 79%, 75%, 5%, and 46%, respectively, when clomazone was applied alone. Flumioxazin at 2.5 oz/acre provided 86%, 100%, 98%, 76%, and 73% control of these respective weeds while control with metolachlor was 60%, 96%, 89%, 85%, and 83%. U.S. #1 yield and total yield (U.S. #1, canner, and jumbo) were statistically similar comparing ‘Beauregard’ to ‘Evangeline’ within each treatment and weed-free control. Under weed-free conditions, yield of U.S. #1s and total yield grade for ‘Beauregard’ was 291 and 526 bu/acre, respectively, compared to 378 and 655 bu/acre for ‘Evangeline’. For clomazone alone treatments, yield of U.S. #1s for ‘Evangeline’ was reduced 72% to 77% compared to the weed-free ‘Evangeline’ treatment while total yield was reduced 53% to 63%. With respect to ‘Beauregard’ and the clomazone treatments, U.S. #1 yield was reduced 53% to 59% compared to the weed-free ‘Beauregard’ treatment while total yield was reduced 0% to 42%. All other herbicide treatments did not result in yield reductions when comparing each variety within each herbicide treatment to its respective weed-free control.

Assessing the Effects of Preplant Insecticides on Insect Damage and Yield in Beauregard, Evangeline and Covington Sweetpotatoes

Tara P. Smith, LSU AgCenter, Sweet Potato Research Station, P.O. Box 120, Chase, LA, 71324

Soil insects can be a limiting factor in sweet potato production in the southeastern United States. Soil insects most often feed on the roots

of sweet potatoes, creating unattractive scars and blemishes which drastically affect the marketability of the crop. Studies were conducted in 2006 and 2007 which examined the effect of various preplant insecticide regimes on subsequent insect damage and yield in three sweet potato varieties. Sweet potato producers commonly apply one or more preplant insecticides prior to transplanting. Recent research suggests that “timing” of these preplant chemicals is critical to achieve maximum benefit and residual activity from the insecticides. These experiments sought to examine the degree of insect control received when select insecticides were applied as close to transplanting as possible without the addition of foliar applied insecticide applications throughout the season. Experimental design was a split plot with insecticides as the main plot and varieties as a sub plot within each insecticide treatment. Main plots (insecticide) were 4 rows centered on 42 inches by 75 ft. Each variety was randomly assigned to a 25-ft section on the center two rows of each plot. Transplants of all varieties were planted at a rate of one plant per foot. Four replications of each treatment were conducted in each year. Insect damage was significantly affected by several of the insecticide treatments evaluated for all varieties examined. Insect damage and yield were significantly different between years with less insect damage recorded in 2007. Insect damage was significantly different between varieties in 2006. The majority of damage in 2006 and 2007 was attributed to cucumber beetles “rootworms”, but damage was recorded for other species such as whitefringed beetle and sugarcane beetle. Yields in 2006 and 2007 were below average. U.S. #1 and total yield grade was significantly higher for the ‘Beauregard’ variety compared to ‘Covington’ and ‘Evangeline’ varieties. Yield data was variable between insecticide treatments; however, the non-treated control plots consistently out yielded other insecticide treatments evaluated in the current study.

The Effect of Dual Formulation and Rate on Weed Control in Sweetpotato

Mark W. Shankle*, Trevor F. Garrett, and Jeff L. Main, Mississippi State University, Pontotoc Ridge-Flatwoods Branch Experiment Station, Pontotoc, MS 38863

A trial was conducted in Pontotoc County, Mississippi, on a Falkner silt loam (Fine-silty, siliceous, thermic Aquic Paleudalfs) in 2007. Field-grown ‘Beauregard B-63’ slips were transplanted on 13 June. The experimental design was a randomized complete-block design with 4 replications. Treatments included *S*-metolachlor and metolachlor at 0.76, 0.95, and 1.27 lb ai/acre applied alone and with clomazone at 0.75 lb ai/acre. Visual observations of crop injury and weed control were made at 2, 3, 4, and 5 weeks after transplant (WAT). Sweetpotato roots were harvested at 124 growing days and graded into U.S. No. 1, Canner, Cull, and Jumbo grade yields and reported as number of 40 lb boxes/acre. Analysis of variance was conducted using Fisher’s protected LSD ($\alpha = 0.05$). Grass control was at least 95% for all treatments at 2 WAT. At 5 WAT, all treatments of *S*-metolachlor and metolachlor applied with clomazone controlled grass at least 90%. Clomazone alone controlled grass 87% and *S*-metolachlor at rates of 0.76, 0.95, and 1.27 lb ai/acre controlled grass at 65, 80, and 86%, respectively, which was greater than metolachlor at the same rates. The addition of clomazone to either *S*-metolachlor or metolachlor improved grass control. Pigweed control at 2 WAT was at least 98% for all treatments. At 5 WAT, pigweed control was at least 88% for all treatments except metolachlor at 0.76 lb ai/acre (78%) and clomazone applied alone (74%). Pigweed control was increased with higher rates of *S*-metolachlor and metolachlor when applied alone. U.S. No. 1 yield ranged from 9 to 505 boxes/acre for treatments of untreated and *S*-metolachlor at 0.76 lb ai/acre + clomazone at 0.75 lb ai/acre. Total marketable yield ranged from 11 to 666 boxes/ac for untreated and *S*-metolachlor at 0.76 lb ai/acre + clomazone at 0.75 lb ai/acre treatments. U.S. No. 1 and total marketable yield was higher with treatments of *S*-metolachlor and metolachlor plus clomazone than when applied alone. Marketable grade yields were higher with *S*-metolachlor compared to equivalent rates of metolachlor except for the 0.76 lb ai/acre rate.

Differential Clomazone, Herbicide Tolerance among Sweetpotato Genotypes

Howard F. Harrison, Jr.* and D. Michael Jackson, U.S. Vegetable Laboratory, ARS-USDA, Charleston, SC

Clomazone (Command 3ME) is a broad spectrum preemergence herbicide that is registered for use in sweetpotato [*Ipomoea batatas* L. (Lam.)]. It controls several important annual weeds that are not controlled by the other sweetpotato herbicides. Following clomazone application for weed control in the plant beds of the U.S. Vegetable Laboratory breeding program, we observed genotypic differences in response to the herbicide. The most susceptible clones exhibited extensive foliar bleaching; whereas, bleaching was not observed on the most tolerant genotypes. All clones were rated for bleaching, and 12 with differential response to the herbicide were selected for further evaluation. Most of the highly susceptible clones that we identified originated from the USVL program. In a greenhouse concentration-response experiment, the most tolerant clones (‘Beauregard’ and SC 1149-19) were injured less by 16 mg clomazone/kg potting soil than the most susceptible clones were by 1 mg/kg. This indicates that there are substantial differences in clomazone tolerance among sweetpotato clones. Similar differences in foliar bleaching were observed in a field study; however, clomazone injury did not appear to greatly reduce yields of even the most susceptible clones. Susceptibility to clomazone is undesirable, and clones exhibiting the trait should be removed from sweetpotato breeding programs.

Anatomical Study of Sweetpotato Storage Root Initiation and Formation in the Leading Israeli Variety Georgia Jet

Yanir Kfir¹, Etan Pressman¹, Levia Althan¹, Rachel Shaked¹, Amnon Schwartz², and Nurit Firon^{*1}, ¹Institute of Plant Sciences, The Volcani Center, Agricultural Research Organization, P.O.Box 6, Bet Dagan, 50250, Israel; ²Faculty of Agriculture, Hebrew University of Jerusalem, Rehovot, 76-100, Israel

The most economically important physiological process in sweetpotato production is storage root (SR) development. Initially white adventitious roots develop, and some of these roots subsequently undergo sudden changes in their growth pattern and develop into SRs. Storage root production is inconsistent from plant to plant; some plants have few or no SRs while others have four or more marketable ones. Substantial information is missing with relation to the factors that promote formation of sweetpotato SRs in general and in the most common variety in Israel, ‘Georgia-Jet’, in particular. Morphological and anatomical studies indicate that the SR induction phase in ‘Georgia-Jet’ is marked by pink pigmentation in the epidermis and by formation of anomalous cambium cells around xylem vessels, respectively, appearing between 3–4 weeks after planting. The effect of environmental factors on induction of SR formation and SR development will be discussed. More than 5-fold increase in starch levels is detected in ‘Georgia-Jet’ roots at 4 weeks after planting as compared to roots sampled at 3 weeks after planting. The accumulated data are currently used for identifying genes specific to storage root formation through expression profiling of roots sampled before and during the SR induction phase.

Class I *knotted1*-like Homeobox Genes Are Expressed in Storage Roots of Sweetpotato

Masaru Tanaka^{*1}, Nakao Kato¹, Hiroki Nakayama¹, Yasuhiro Takahata¹, and Makoto Nakatani², ¹National Agricultural Experiment Station for Kyushu Okinawa Region, Miyakonojo, Miyazaki 885-0091, Japan; ²Agriculture, Forestry and Fisheries Research Council Secretariat, MAFF, Chiyoda-ku, Tokyo 100-8950, Japan

Class I *knotted1*-like homeobox (*KNOX1*) genes encode transcription factors belong to the TALE superclass of homeobox proteins. In many plants, *KNOX1* genes are specifically expressed around the shoot apex and play important roles in meristem maintenance and proper organ patterning by regulating cytokinin and gibberellin biosynthesis. Recently, we have isolated four *KNOX1* cDNA, named *Ibkn1* to *Ibkn4*, expressed in storage roots of sweetpotato. Phylogenetic analysis showed that *Ibkn1* is homologous to the *SHOOTMERISTEMLESS*

genes of *Arabidopsis*, while *Ibkn2* and *Ibkn3* are homologous to the *BREVIPEDICELLUS* gene. *Ibkn4* was homologous to the *KNAT2* and *KNAT6* gene of *Arabidopsis*. Semi-quantitative RT-PCR analysis showed that the expression of *Ibkn1*, *Ibkn2* and *Ibkn4* are upregulated in storage roots compared to fibrous roots in all sweetpotato cultivar analyzed, suggesting their involvements in the storage root development. In storage roots, these *KNOXI* genes showed slightly different expression patterns. Putative functions of these *KNOXI* genes in storage root development will be discussed.

Transcription Profiles of Fibrous Roots and Storage Roots of Sweetpotato

C.M. McGregor and D.R. La Bonte*, School of Plant, Environmental, and Soil Sciences Louisiana State University AgCenter, Baton Rouge, LA 70803

Storage root formation is the most economically important process in sweetpotato [*Ipomoea batatas* (L.) Lam.] development. In an effort to understand this process, RNA from fibrous and storage roots of the cultivar Jewel were harvested 6 weeks after planting and hybridized to the ARCS_SP02 sweetpotato microarray. The array contains 1060 features originating from a sweetpotato leaf library and 1728 features from a storage root library. Differential expression was observed for 966 expressed sequence tags. A variety of transcription-related genes were differentially expressed including a MADS-box gene and homeobox genes. Our results also indicate a possible role for auxin and other hormones, such as gibberellin, ethylene and jasmonic acid in storage root development.

The “Rootcam” and Other Methods for Observing and Quantifying Sweetpotato Adventitious Root Initiation, Growth, and Development

A. Villordon*¹ and D. LaBonte², ¹LSU AgCenter Sweet Potato Research Station; ²LSU AgCenter School for Plant, Environmental, and Soil Sciences

Relatively few studies have documented how the interaction of biological and environmental variables influences the early initiation, growth, development, and morpho-anatomical characteristics of sweetpotato adventitious roots (ARs). Yet, these studies appear to underscore the significance of AR initiation and development on the timing of storage initiation events and final storage root yield. Although destructive sampling methods have provided information on some quantifiable morphological and anatomical characteristics, not all aspects of AR initiation and early development can be captured by these conventional sampling approaches. For example, the phenomenon of diurnal growth can be more effectively quantified by time-course measurements of in-situ samples. We used consumer-grade webcams in tracking the early development of roots from transplants grown in liquid growing medium. Timed images of initiating and developing ARs were captured every 2–4 hours by off-the-shelf software. Such images provided data on time of initiation as well as AR root number, diameter, and length. We describe the basic components of this real-time AR observation system as well as its potential applications and limitations. We will also describe the use of sand-based growing medium in conducting limited tracking of root development as well as quantifying the effects of external variables on morpho-anatomical characteristics and other quantifiable traits of newly-initiated and developing ARs.

A Conservation Tillage System for Sweetpotato: Effects on Pests and Beneficial Insects

D. Michael Jackson* and Howard F. Harrison, Jr., U.S. Vegetable Laboratory, ARS-USDA, Charleston, SC

In conventional tillage systems, sweetpotatoes are grown on beds formed from bare soil, which can lead to erosion before the expanding root system stabilizes the soil. Conventional tillage systems also favor the establishment of annual weeds until the sweetpotato canopy is fully established. Conservation tillage systems for sweetpotato may help alleviate these problems. Therefore, we grew three genotypes of sweetpotato (Beauregard, Ruddy, and SC1149-19) in either conventionally tilled plots or in a killed-cover crop tillage system at the U.S.

Vegetable Laboratory, Charleston, SC, in 2002–2004. The four tillage treatments were: 1) conventional tillage, hand-weeded (CT-HW); 2) killed-cover crop, hand-weeded (KCC-HW); 3) conventional tillage, weedy (CT-WE); and 4) killed-cover crop, weedy (KCC-WE). In the fall, one-half of the pre-formed beds were planted to a winter cover crop of an oat and crimson clover mixture, while the other one-half of the beds were left fallow then re-bedded before sweetpotato slips were planted. One-half of each 4-row plot (100 plants per plot) was hand-weeded while the other one-half was not. The center-two rows of sweetpotatoes from each plot were harvested, weighed, and rated for insect damage. The insect resistance of Ruddy held up well under the killed-cover crop conditions, and this cultivar had significantly higher percent of clean roots and lower infestations by soil insect pests than the two susceptible genotypes. In general, injury to sweetpotato roots by soil insect pests was significantly lower in the KCC plots than in the CT plots. Pitfall traps and fire ant sampling indicated that more insect predators were present in the killed cover crop plots.

Monitoring Insects in Sweetpotatoes with Sweep Net and Sticky Traps across Mississippi Delta: A Comparative Study

T. Rashid*¹, A. Muhammad¹, C. Abel², and L. Adams², ¹Alcorn State University, Extension/Research Demonstration Farm & Technology Transfer Center, 294 Grainger Dorsey Road, Mound Bayou, MS 38762; ²USDA/ARS Southern Insect Management Research Unit P.O. Box 346, Stoneville, MS 38776

Insect populations in sweetpotato fields in the Mississippi Delta were monitored in 2007 by comparing traditional sweep net sampling with purple and yellow sticky traps. Four sweep net samples each consisting of 25 sweeps were taken weekly from each of four different locations from 2 July to 3 Sept. On 31 July, eight replications of each purple sticky and Pherocon AM yellow sticky traps were installed at each of three locations. The traps were checked on 9, 17, 29 Aug. and 14 Sept. Insect samples were collected and identified. Three species of click beetles (adult wireworms, mostly *Conoderus vespertinus*), *Ceratomyia trifurcata*, *Lygus lineolaris*, *Diabrotica undecimpunctata*, and several species of tortoise and flea beetles were collected in purple/yellow sticky traps or sweep net samples. Significantly ($P < 0.001$) higher numbers of click beetles were collected in purple traps during August than in mid September. Purple traps installed along private farmers' fields collected more click beetles than did traps along research field plots. Consistent numbers of other insect species were collected in both purple and yellow traps. Sweep net sampling collected all insect species except *C. trifurcata*, whereas, click beetles and flea beetles were only collected during the period of 2 July to 6 Aug. Significantly ($P < 0.001$) higher numbers of click beetles and *L. lineolaris* were collected in purple sticky traps, whereas, the numbers of tortoise beetles trapped in yellow sticky traps were significantly ($P < 0.001$) higher than those in purple traps. The numbers of *D. undecimpunctata* collected on 17 and 29 Aug. in purple sticky traps were significantly ($P < 0.001$) higher. Purple sticky traps may provide a viable alternate method to sweep net sampling for insect pests of sweetpotatoes in Mississippi.

Influence of a Plant Growth Regulator on Sweetpotato Yield

Jeff L. Main, Mark W. Shankle, and Trevor F. Garrett, Mississippi State University, Pontotoc Ridge–Flatwoods Branch Experiment Station, Pontotoc, MS 38863

Sweetpotato is a valuable crop to Mississippi agriculture with acreage of 8093 ha and an estimated \$80 million in revenue to the state in 2007. It is thought that much of the sweetpotato plant's energy is going to the sink of vine growth instead of the root sink. Most mepiquat growth regulators are used in cotton to control excessive vegetative growth. The effect of mepiquat products are a function of plant size and rate of product application, mepiquat products only affect new growth. The objective of the following study was to determine the effect of mepiquat pentaborate (Pentia) on the yield and quality of sweetpotato in northern Mississippi. Pentia treatments in all years were applied using CO₂ pressurized spray equipment at 30 and or 60 days after transplanting (DAT). US no. 1 yield over the 5 years of the study ranged from 728 to 437 boxes/ha for Pentia 584 mL·ha⁻¹ at 30 DAT fb

Pentia 1170 mL·ha⁻¹ at 60 DAT and Pentia 1170 mL·ha⁻¹ at 30 DAT fb Pentia 292 mL·ha⁻¹ at 60 DAT rates, respectively. Total marketable yields ranged from 1170 to 720 boxes/ha for Pentia 584 mL·ha⁻¹ at 30 DAT fb Pentia 1170 mL·ha⁻¹ at 60 DAT and Pentia 1170 mL·ha⁻¹ at 30 DAT fb Pentia 584 mL·ha⁻¹ at 60 DAT, respectively. Canner yields ranged from 336 to 149 boxes/ha over the 5 years of the study for Pentia 292 mL·ha⁻¹ at 30 DAT and Pentia 1170 mL·ha⁻¹ at 30 DAT fb Pentia 584 mL·ha⁻¹ at 60 DAT, respectively. Over the five years of this study three treatments Pentia at 584 mL·ha⁻¹ at 30 DAT followed by either Pentia at 292, 584, or 1170 mL·ha⁻¹ at 60 DAT tended to produce the most US no. 1, jumbo, and total marketable yield. The use of a growth regulator to slow vegetative vine growth in certain areas of a field that may increase the root number and size would be of considerable economic benefit to the sweetpotato producers.

Reaction of Sweetpotato Genotypes to Different Isolates of *Meloidogyne incognita*

Judy A. Thies^{*1}, Howard Harrison¹, and Don LaBonte², ¹U.S. Vegetable Laboratory, USDA, ARS, 2700 Savannah Highway, Charleston, SC 29414; ²LSU AgCenter, Baton Rouge, LA 70803

Fourteen sweetpotato [*Ipomoea batatas* (L.) Lam.] genotypes were characterized for reaction to three isolates of *Meloidogyne incognita* in greenhouse tests. The following sweetpotato genotypes were evaluated: Sumor, U.S. Plant Introduction (PI) 399163, Liberty, Nemagold, Excel, Regal, Jewel, Bienville, L02-21, L99-35, L02-32, L01-29, Sulfur, and Beauregard. Sumor, PI 399163, and Liberty were resistant to all isolates of *M. incognita* in all tests. Nemagold, Excel, Regal, Bienville, L99-35, and L02-32 were moderately to highly resistant to isolates N and M, but exhibited intermediate to susceptible reactions to isolate A. L01-29 exhibited resistance to isolate N, but was susceptible to isolates A and M. Isolate A was the most virulent to sweetpotato. The results of our studies indicate the importance of selecting breeding lines with resistance to multiple isolates of *M. incognita* in order to develop germplasm with resistance to a broad range of populations of southern root-knot nematode.

Vegetable Crops Section—Watermelon

Watermelon Research and Development Group 28th Annual Meeting

Stephen R. King^{*1}, Elisabetta Vivoda², and Angela R. Davis³, ¹Vegetable & Fruit Improvement Center, Department of Horticultural Sciences, Texas A&M University, College Station, TX; ²Harris Moran Seed Co., Davis, CA; ³USDA-ARS, SCARL, Lane, OK

The 28th annual meeting of the watermelon research and development group was held on 3 Feb. in Dallas, TX in conjunction with the SR-ASHS annual meetings. The agenda included seed company updates, regional trial results, a presentation from the National Watermelon Promotion Board, research reports, general discussions and administrative items. Characteristics of fresh cut were discussed and it was pointed out that flesh firmness may not always correlate to leaky flesh, and that the degree of leakiness is probably the most important trait for fresh cut fruit. There was considerable discussion on size classifications for small fruited watermelon, with the general consensus being that a 3- to 8-lb fruit would be considered a “mini,” 9- to 13-lb fruit an “icebox,” and the anticipated class of “micro” was proposed for fruit less than 3 pounds. There was also a reminder that the name “melon” refers to *Cucumis melo*, and should not be used when referring to watermelon fruit. Mark Arney showed a DVD video promoting watermelon and announced that the DVD is available to members of our group from the Watermelon Promotion Board. Mark also discussed the research that they funded on the effects of citrulline on Zucker rats, and that watermelon was in the “Worlds Healthiest Foods” report. David Thompson discussed the IR-4 project and Dan Egel presented his IR-4 funded research on Topsin to control fusarium wilt in watermelon. Todd Wehner led a discussion on the genes of watermelon and the need to have seed representing all the known genes in watermelon. Anyone with stocks of representative genes was asked

to send seed to one of the watermelon gene curators (Todd Wehner or Steve King). There were 10 research presentations (abstracts below) that generated additional discussion. Following the research presentations the group discussed and eventually passed a set of bylaws that will be used to organize the activities of the Watermelon Research and Development Group in the future. Zeraim Gedera and Seminis Vegetable Seeds sponsored the refreshments for the meeting.

2007 Watermelon Cultigen Yield and Quality Trial in North Carolina

Jonathan R. Schultheis^{*1} and W. Bradfred Thompson¹, ¹Department of Horticultural Science, Kilgore Hall, Box 7609, North Carolina State University, Raleigh, NC 27695-7609

Forty-two advanced lines or cultivars (cultigens) and three scions were grafted onto Emphasis (*Lagenaria*) root stock and grown at the Central Crops Research Station in Clayton, NC. The purpose of the trial was to compare watermelon yield and quality among cultigens or grafted plants grown in the southeastern United States. The experiment was arranged in a randomized complete-block design, with four replications per entry. Seeds were planted on 5 Apr. 2007. 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 120–0–260 (N–P₂O₅–K₂O). Transplants were set in-row 2.5 ft apart while row centers were 10 ft. Four harvests were made weekly beginning 62 days after planting with the concluding harvest on 20 Aug., 93 days after harvest. Each fruit was harvested and weighed. Fruit were considered marketable when fruit ranged from 8 to 22 lb. Fruit number and mass were determined on a per acre basis. Fruit quality characteristics measured included average fruit weight, soluble solids of the mesocarp, percentage and severity hollow heart, and firmness of the mesocarp. ‘Crunchy Red’, ‘Vagabond’, and ‘CS 4804’ had the firmest mesocarp with an average firmness of 4.0 lbs or more. Nearly all fruit had minimal hollow heart; however, the following cultigens had the most unmarketable fruit (25%) when hollow heart was the factor considered; ‘Sweet Slice Plus’ and ‘SW 2988’. The cultigens that produced the largest average fruit size (16+ lb) were ‘Crunchy Red’, ‘ACX 7125’, ‘SS 9651’, and ‘Matrix’, while the smallest average fruit size (<12 lb) were produced by ‘Triple Threat’ scion ‘Emphasis’ root stock, ‘CS 4804’, ‘SW 139’, ‘Amarillo’ (yellow flesh type), and ‘SW 3988’. The cultigens producing the most fruit number per acre (>4500) were ‘SW 806’, ‘Amarillo’, ‘NUN 7561’, ‘WX 1008’, and ‘NUN 6032’. ‘SW 806’, ‘RWT 8174’, ‘NUN 6032’, and ‘NUN 6033’ produced the greatest tonnage per acre (>65,000 lb). Increasingly, fruit quality such as hollow heart and mesocarp firmness are being given more consideration, especially for the cut fruit, value added markets. Yield is still critical but fruit quality must accompany high yields.

Response of Watermelon Germplasm to Southern Root-knot Nematode in Field Tests

Jennifer J. Ariss^{*1}, Judy A. Thies¹, Chandrasekar S. Kousik¹, and Richard L. Hassell², ¹U.S. Vegetable Laboratory, USDA, ARS, Charleston, SC; ²Coastal Research and Education Center, Clemson University, Charleston, SC

Southern root-knot nematode (*Meloidogyne incognita*) is a serious pest of cultivated watermelon (*Citrullus lanatus* var. *lanatus*) in southern regions of the United States. While there is no known resistance to southern root-knot nematode in commercial watermelon cultivars to date, wild watermelon relatives (*C. lanatus* var. *citroides*) have been shown in greenhouse studies to possess various degrees of resistance to root-knot nematode species. In order to evaluate levels of resistance of *C. lanatus* var. *citroides* in field tests, two experiments were undertaken over two years to assess experimental lines in an artificially infested field site. In the first study (2006), 19 experimental lines of *C. lanatus* var. *citroides* derived from Plant Introduction accessions (USDA, ARS, GRIN) were compared with susceptible entries of *C. colocynthis* and watermelon cultivars. Of the wild watermelon lines, two entries (USVL-303 and USVL-315) exhibited significantly less galling than all other entries. Five of the best performing *C. lanatus* var. *citroides* experimental lines were evaluated

with and without preplant methyl bromide fumigation at the same field site in 2007. Overall, most entries of *C. lanatus* var. *citroides* performed similarly with and without preplant methyl bromide treatment in regard to root galling, visible egg masses, root vigor, and root mass. In both years of field evaluations, most *C. lanatus* var. *citroides* lines showed lesser degrees of nematode reproduction and higher root vigor and root mass than *C. colocynthis* and watermelon cultivars, with USVL-303 consistently being one of the best performers. The results of these two field evaluations suggest wild watermelon populations may be useful sources of resistance to southern root-knot nematode.

Is Grafting Useful for Managing Root-knot Nematodes in Watermelon?

Judy A. Thies^{*1}, Jennifer J. Ariss¹, Chandrasekar S. Kousik¹, and Richard L. Hassell², ¹U.S. Vegetable Laboratory, USDA, ARS, 2700 Savannah Highway, Charleston, SC; ²Coastal Research and Education Center, Clemson University, 2700 Savannah Highway, Charleston, SC

Five *Citrullus lanatus* var. *citroides* germplasm lines, four *Lagenaria siceraria* cultivars, one *Cucurbita moschata* *C. maxima* hybrid, and one commercial wild watermelon (*Citrullus lanatus* spp.) cultivar were evaluated as rootstocks for watermelon in a field infested with the southern root-knot nematode, *Meloidogyne incognita*, in Charleston, SC. 'Fiesta', a diploid watermelon (*C. lanatus* var. *lanatus*) grafted on the rootstocks was transplanted to the field on 30 July 2007. On 8 Oct. 2007, roots of all plants were dug and evaluated for percentage of root system galled by *M. incognita*. Root galling was severe in rootstocks of *Lagenaria siceraria* (80% to 96%) and *Cucurbita moschata* *C. maxima* hybrid (98%), and was moderately severe (40%) for non-grafted 'Fiesta' watermelon. Root galling of germplasm lines derived from *Citrullus lanatus* var. *citroides* ranged from 11% to 34% and galling of the commercial wild watermelon rootstock was 24%. Four of the *C. lanatus* var. *citroides* germplasm lines and the commercial wild watermelon rootstock had significantly less ($P < 0.05$) root galling than 'Fiesta', and than the *L. siceraria* and *C. moschata* *C. maxima* hybrid rootstocks. Selected germplasm lines of *C. lanatus* var. *citroides* may provide a source of resistance that will be useful in development of root-knot nematode resistant rootstocks for watermelon.

Planting Density and Its Effects on Yield and Quality of Grafted Triploid Watermelon

Jonathan R. Schultheis^{*1}, Richard L. Hassell², Gilbert Miller³, W. Terry Kelley⁴, Steve Olson⁵, Rakesh Kumar¹, and Todd C. Wehner¹, ¹Department of Horticultural Science, Kilgore Hall, Box 7609, North Carolina State University, Raleigh, NC 27695-7609; ²Department of Horticulture, 2700 Savannah Highway, Charleston, SC 29414; ³Gilbert Miller, Edisto Research & Education Center, 64 Research Rd., Blackville, SC 29817; ⁴University of Georgia, Department of Horticulture, 4604 Research Way, P.O. Box 748, Tifton, GA 31793; ⁵North Florida Research and Education Center, 155 Research Rd., Quincy, FL 32351-5677

The use of grafted vegetable plants is not common in the United States because most growers can rotate their crops, thereby reducing the incidence of disease. Increased cost of grafted plants is another constraint to commercial adoption of the practice. In spite of these barriers, there is interest in commercial watermelon production using grafted plants because they can provide resistance to a number of diseases, increased drought and salinity tolerance, increased nutrient uptake efficiency, increased yield and improved fruit quality. The goal of this study was to reduce planting density without sacrificing yield, thus reducing propagule costs. We evaluated two rootstocks ['Emphasis' (*Lagenaria*) and 'Strongtosa' (interspecific *Cucurbita* hybrid)], two watermelon scions ('Tri-X-313' and 'Matrix') at four planting densities (12, 24, 36, and 48 ft² per plant) for their effects on yield and quality of watermelon. A nongrafted treatment of 'Tri-X-313' at a representative commercial planting density of 36 ft² was used as the comparison treatment. The tests were conducted at five locations—Kinston, NC; Charleston, SC; Blackville, SC; Tifton, GA; and Quincy, FL—in a randomized complete-block design with four replications. Plots contained six plants, and SP-4 was used as a pollinizer in quantities that provided sufficient viable pollen for pollination. Cultural manage-

ment practices were followed according to recommendations within each state. Four harvests were obtained in three of the five locations, three in another, and only one in North Carolina due to severe hail damage. Fruit quality measurements were taken during second harvest and included total soluble solids, average fruit weight, hard seed, and hollow heart incidence and severity. Yields were measured on a per area and per plant basis. Fruit traits such as total soluble solids, hollow heart, and hard seeds were not influenced by treatment. Yields, both fruit number and mass, increased as planting density increased for both root stocks, while yields were superior at the highest planting density compared with the nongrafted 'Tri-X-313' control treatment. Fruit size was reduced 1 lb with 'Emphasis' root stock and 1.5 lb for 'Strongtosa' root stock when planting densities were increased. On a per plant basis, low planting densities of grafted plants resulted in increased yields. Optimum planting density for yields on a per plant basis was 36 ft² for 'Emphasis' root stock and at least 48 ft² for 'Strongtosa'. Growers needing resistance to root diseases or environmental stress can use grafted plants at a density of 36 to 48 ft² for optimum crop production.

Plant Reservoirs of Squash Vein Yellowing Virus, Causal Agent of Viral Watermelon Vine Decline, and Other Whitefly-transmitted Cucurbit Viruses in Florida

Scott Adkins^{*1}, Chandrasekar S. Kousik², Susan E. Webb³, Carlye A. Baker⁴, and William W. Turechek¹, ¹USDA-ARS, U.S. Horticultural Research Laboratory, Fort Pierce, FL 34945; ²USDA-ARS, U.S. Vegetable Laboratory, Charleston, SC 29414; ³University of Florida, Department of Entomology and Nematology, Gainesville, FL 32611; ⁴Florida Department of Agriculture and Consumer Services, Division of Plant Industry, Gainesville, FL 32614

Squash vein yellowing virus (SqVYV) was identified in cucurbits in Florida in 2005 and shown to be sufficient to induce a watermelon vine decline and fruit rind necrosis that had been observed for several years previously. This novel virus species was shown to be whitefly-transmissible and has now been isolated from declining watermelons for the past six growing seasons in southwest and west-central Florida where it has caused significant economic impact to watermelon production. The virus disease situation in watermelon (and cucurbits in general) recently worsened in Florida with the detection of two additional whitefly-transmitted viruses. *Cucurbit leaf crumple virus* (CuLCrV) was found in squash in north-central Florida in the fall of 2006 and in watermelon in southwest Florida in Spring 2007. *Cucurbit yellow stunting disorder virus* (CYSDV) was found in watermelon in west-central Florida in Fall 2007. Prior to the discovery of CYSDV in Florida, cucurbit weeds were examined as potential reservoirs of SqVYV and CuLCrV. Balsam-apple (*Momordica charantia*), a common cucurbit weed in south Florida was collected and tested for SqVYV and CuLCrV. Over 40% of the 86 balsam-apple plants collected from watermelon growing areas with previously reported cases of vine decline were found to be infected with SqVYV. A single balsam-apple plant was found to be infected with CuLCrV. A second common cucurbit weed, creeping cucumber (*Melothria pendula*) was determined to be an experimental host for SqVYV. In addition, green bean (*Phaseolus vulgaris*) plants with virus-like symptoms in southwest Florida collected in Dec. 2007 were determined to be infected with CuLCrV. Collectively, these results show that in Florida cucurbit weeds can provide reservoirs for SqVYV and CuLCrV, and that green beans can also provide a reservoir for CuLCrV.

Patterns of Multi-virus Infections of Watermelon at the Plant and Field Levels in Florida

William W. Turechek^{*1}, Scott Adkins¹, Chandrasekar S. Kousik², Philip A. Stansly³, and Pamela D. Roberts³, ¹USDA-ARS, U.S. Horticultural Research Lab, Ft. Pierce, FL 34945; ²USDA-ARS, U.S. Vegetable Lab, Charleston, SC 29414; ³University of Florida, SWFERC, Immokalee, FL 34142

The whitefly-transmitted viruses squash vein yellowing virus (SqVYV) and *Cucurbit leaf crumple virus* (CuLCrV) have had serious

impact on watermelon production in west-central and southwest Florida in recent years. We collected plants randomly from a commercial watermelon field in southwest Florida showing symptoms of SqVYV and CuLCrV and cut cross-sections from each vine on every plant from the crown to the vine tip. The cross-sections were blotted onto nitrocellulose membranes and nucleic acid hybridization was used to test for the presence of SqVYV and CuLCrV. Results showed that SqVYV and CuLCrV were present in the field in approximately 38% and 45% of the plants collected in the field, respectively. In plants diagnosed with SqVYV, the presence of SqVYV in vine tissue decreased proportionately with increasing distance from the crown. In contrast, the growing tip was the single best tissue for detection of CuLCrV in plants diagnosed with CuLCrV. The results show that SqVYV and CuLCrV are spatially separated in watermelon plant tissue. In a separate study, we monitored the progress of SqVYV and CuLCrV in a 2.5-acre experimental field of 'Fiesta' located in Immokalee, FL. Symptoms of CuLCrV were present soon after planting. Symptoms of SqVYV first appeared 7 weeks after planting and by week 12 the field was fully collapsed from disease. Analyses indicated that the degree of association between the two diseases was not greater than what would be expected from random, and that SqVYV was distributed randomly at low incidences, but became progressively more aggregated as disease incidence increased. These results are an indication that the viruses are being introduced independently by whiteflies, although the whiteflies may be emigrating from the same source, with secondary spread being dominated by local or within-field populations of whiteflies. This is conceivable based on the spatial separation of the viruses in individual watermelon plants from the commercial field. Additional field surveys are in progress to verify and extend these findings.

Effects of Silver Plastic Mulch and Chemical Treatments on Development of Whitefly-transmitted Viral Watermelon Vine Decline in Florida

C.S. Kousik¹, S. Adkins², W.W. Turechek², and P.D. Roberts³, ¹US Vegetable Laboratory, USDA-ARS, Charleston, SC 29414; ²USHRL, USDA-ARS, Ft. Pierce, FL 34945; ³University of Florida/IFAS SWFREC, Immokalee, FL 34142

Watermelon vine decline (WVD) in Florida is caused by the whitefly (*Bemisia tabaci*) transmitted virus called squash vein yellowing virus (SqVYV, family: Potyviridae). WVD has been a major limiting factor in watermelon (*Citrullus lanatus*) production in southwest and west-central Florida for the past several years and losses of more than \$60 to 70 million dollars due to this disease have been estimated. Symptoms of WVD typically manifest as sudden decline of vines at harvest time or 1–2 weeks prior to harvest and can also affect fruit quality. Fruits from declined plants are generally unmarketable and exhibit symptoms of rind necrosis and fruit decay. We evaluated the effect of reflective plastic mulch combined with chemical treatments for management of whitefly on WVD development during fall growing periods of 2006 and 2007. The chemical treatment consisted of drenching the plants with Admire (Imidacloprid) at transplanting followed by two sprays of Oberon (Spiromesifen). Virus inoculum was introduced by planting SqVYV infected squash plants at ends of each plot. No significant interactions between plastic mulches and chemical treatments to manage whitefly were observed on WVD development in either year. However, in 2006, the chemically treated plots had significantly ($P = 0.038$) less fruits with WVD symptoms compared to the untreated plots. In 2007 the areas under disease progress curves (AUDPC) for WVD was significantly lower for the plots chemically treated ($P = 0.0038$) for managing whitefly and the reflective plastic mulch plots ($P = 0.0214$) compared to the untreated and non-reflective mulch plots respectively. Similarly in 2007, the treated plots had significantly less fruits with WVD symptoms compared to the non-treated plots ($P = 0.0124$). Our results suggest that management of whitefly can help in managing WVD in Florida.

Watermelon Enhances Arginine Availability in an Animal Model of Type-II Diabetes

Penelope Perkins-Weazie¹, Guoyao Wu², Mark Arney³, Julie K. Collins⁴, Muhammad Siddiq⁵, and Kirk D. Dolan⁵, ¹USDA-ARS, South Central Agricultural Research Laboratory, Lane, OK 74555; ²Faculty of Nutrition and Department of Animal Science, Texas A&M University, College Station, TX 77843; ³National Watermelon Promotion Board, Orlando, FL; ⁴Eastern Oklahoma State College, Wilburton, OK; ⁵Department of Food Science Human Nutrition, Michigan State University, East Lansing, MI 48824

Watermelon fruit contains lycopene, a red pigment known for its ability to scavenge free hydroxyl radicals. L-Citrulline, an amino acid that is a precursor of L-arginine, is found in all cucurbits but is most plentiful in watermelon. Humans and animals have a high capacity for converting L-citrulline into L-arginine, which is the physiological nitrogenous substrate for the synthesis of nitric oxide (a major vasodilator). In a study with Zucker diabetic fatty rats (an animal model of type-II diabetes mellitus), watermelon pomace (residual tissue following juice removal), synthetic arginine/citrulline, lycopene, or pectin were added to diets and the effectiveness of these substances on the function of cardiovascular biomarkers was tested. Diabetic rats fed the pomace or arginine/citrulline had a greater concentration of circulating arginine, a lower concentration of blood glucose, a reduced accretion of body fat, and a better relaxation of the aortic blood vessel, when compared with the other treatments. The results indicate that watermelon could improve cardiovascular health and glycemic control in diabetic animals, with effects most likely due to the citrulline/arginine component of watermelon. These novel data add to the growing body of scientific evidence demonstrating a measurable dietary value of fruits and vegetables, and also raises the possibility that watermelon may be useful in human clinical trials with populations at risk for some types of cardiovascular disease.

Poster Section

Viruses Affecting Blackberries in Alabama

Elina Coneva¹, John Murphy², Bobby Boozer³, Gary Gray³, James Miles³, William East³, and Lloyd Chapman³, ¹101 Funchess Hall, Department of Horticulture, Auburn University, Auburn, AL 36849; ²212 Life Sciences Building, Department of Entomology and Plant Pathology, Auburn University, Auburn, AL 36849; ³ACES, Auburn University, 120 County Road 756, Clanton, AL 35045

A survey to study the incidence and distribution of Tobacco ringspot virus (TRSV), Tomato rindspot virus (ToRSV), Raspberry bushy dwarf virus (RBDV), and *Impatiens necrotic spot virus* (INSV) in commercial blackberry plantations in Alabama was conducted in 2007. Blackberry plantings established at 13 growers' sites and two research stations throughout different locations were tested. A total number of 239 tissue samples from symptomatic and asymptomatic plants representing 14 blackberry cultivars were collected during mid July. Enzyme-Linked Immunosorbent Assay (ELISA) kits, (Agdia), were used to detect TRSV, ToRSV, RBDV, and INSV in blackberry samples. The results from our study suggest that 188 out of 239 samples tested positive for virus infection. Eighty-five samples tested positive for infection by a single virus, 85 tested positive for the presence of two viruses, 29 samples had three viruses, and two samples tested positive for all four viruses. Of the 239 blackberry samples tested, ToRSV was detected in 107 (45%), INSV was detected in 84 (35%), TRSV and RBDV were detected in 75 (31%) and 61 (26%) respectively. TRSV was detected in 13 of 15 sites tested, ToRSV was detected in 14 of 15 sites, while RBDV and INSV were detected in all of the 15 sites. Of the 14 blackberry cultivars tested, all four viruses were detected in 8 cultivars. More than 50% of infected plants consisted of more than one virus in the following blackberry cultivars: Navaho (60%), Apache (52%), and Ouachita (52%). Of the 180 asymptomatic tissue samples collected, 138 tested positive for at least one virus. Symptoms observed in plants that tested positive include chlorotic spots on leaves, leaf veinal chlorosis, stunting and combinations thereof. No particular

symptom type correlated with a specific virus. These initial findings illustrate the extent of viral diseases in Alabama-grown blackberry plants. Further study is needed to determine the occurrence of other viruses known to threaten blackberry production. Knowledge gained will help to develop management strategies to reduce or possibly eliminate losses caused by virus infection.

Extending Peak Harvest of Primocane-fruiting Blackberries under High Tunnel Production

Christopher Vincent, Heather Friedrich, and M. Elena García, Department of Horticulture, University of Arkansas, Fayetteville, AR 72701

Harvesting blackberries for fresh consumption outside the traditional harvest season can bring important economic benefits to growers. Primocane-fruiting blackberries have the potential to produce peak yields in late August and September, well after the typical harvest season. However, high temperatures during flower bud formation, anthesis, and fruit ripening cause low yield and poor quality fruit in Arkansas. Delaying harvest by 1 month could bring a significant improvement of fruit quality and yields. This study combined high tunnel and outdoor comparisons with three pruning treatments applied to primocane-fruiting cultivars Prime Jan[®] and Prime Jim[®] and unreleased genotype APF 46. Pruning treatments were 1) mowing canes to the ground in late July and tipping the re-emergent canes at 75 cm; 2) tipping canes at 100 cm; 3) tipping canes at 50 cm. Yields were measured and analyzed in terms of yield rate (g/row m/day). High tunnels extended the period of peak harvest. Mowing primocanes delayed harvest, although the mowing was too late to allow canes to grow and produce a viable harvest. Tipping did not delay harvest and there were no significant differences in harvest rates between 50- and 100-cm tipping heights. Results of this study are compatible with similar studies of primocane-fruiting raspberries and of primocane-fruiting blackberries in other locations.

Aerial Root Development on Winegrape Cultivars following a Spring Freeze

J. Andrew Puckette, Eric T. Stafne, and Becky L. Carroll, 360 Agricultural Hall, Department of Horticulture and Landscape Architecture, Oklahoma State University, Stillwater, OK 74078

Aerial rooting in grapes has been described as an indication of cold injury. This study was conducted in Summer 2007 to determine if there is a difference in the amount of aerial root formation between cultivars, rootstock type (1103P vs. own root), location the vine (distal and basal for cordons and trunk), and planting year. Budbreak date and prior visual winter injury ratings were also analyzed for correlation with the number of aerial roots produced. Aerial roots were counted separately on basal and distal portions of the trunk, and basal and distal portions of the north and south cordons. Mean number of aerial roots was significantly different between 11 cultivars. Different sections of the vine also produced a significantly different number of roots. The distal regions of both cordons produced the highest mean number of aerial roots, followed by the basal regions of the cordons, and lastly the basal and distal regions of the trunk. There was no significant difference between the north and south cordons, but the pooled cordon data revealed a significantly greater amount of aerial roots (mean = 11.35) when compared to the pooled trunk data (mean = 0.36). No significant difference in aerial rooting was found between rootstock type or year of planting. Aerial root production appears to differ based on the cultivar, as well as location on the vine. Budbreak date and injury ratings appear to have no relationship with the number of aerial roots produced.

Ornamental Plant Evaluation at the SFA Mast Arboretum – Two Decades of Trials

Dawn Stover and David Creech, SFA Mast Arboretum, P.O. Box 13000, Stephen F. Austin State University, Nacogdoches, TX 75962

The SFA Horticultural Gardens have grown from a small project of a landscape plant materials class in 1985 to 60 acres of diverse plant

materials evaluated and promoted throughout the southeastern United States. The gardens now include the SFA Mast Arboretum, Ruby M. Mize Azalea Garden, and the Pineywoods Native Plant Center. In 1985, the original plantings consisted of common landscape shrubs and annual color and have grown to include 7500 different plant taxa, including a strong representation of eastern Texas natives. While the original intent of the gardens was to provide a living laboratory for SFA horticulture, biology, and forestry students, the collections evolved to become a testing ground for new, rare, and unusual plants with potential in commerce. The collections are mapped and recorded in an accessions database. By far the most significant contribution to the living plant collection comes via trade with other interested professionals, botanical gardens, and individuals who often possess a specific plant interest. Specialty mail order nurseries provide a steady supply of new plant materials for testing. Over the years, partnerships have been formed within the connoisseur plant community. Finally, plant hunting expeditions to China and Mexico have also contributed to the diversity of the garden. Special collections include Aceraceae (300 taxa), Hydrangeaceae (250 taxa), rhododendrons (600 taxa), camellias (200 taxa), Styracaceae (20 taxa), oaks (50 taxa), and others.

Soil Respiration and Root Growth of Sweetgum (*Liquidambar styraciflua*) Trees as Affected by Pavement Types

Bhavana Viswanathan¹, Astrid Volder^{1,2} and W. Todd Watson³, ¹Department of Horticultural Sciences, Texas A&M University, College Station, TX 77843; ²Interdisciplinary Program in Molecular and Environmental Plant Sciences (MEPS), Texas A&M University, College Station, TX 77843; ³Department of Ecosystem Science and Management, Texas A&M University, College Station, TX 77843

Impermeable pavement around trees in parking lots and other places can cause severe deterioration of tree growth. Porous concrete with better water infiltration, soil aeration, and moderating effects on soil temperature could be a good alternative for paving around trees. The purpose of our study is to test soil respiration, root respiration and root growth of American sweetgum (*Liquidambar styraciflua*) as affected by both pavement types and a control treatment. The experimental set up consists of 25 American sweetgum trees, the root zones of which have been covered with standard concrete, porous concrete, or left uncovered (control). Each of the plots was outfitted with six capped chambers for taking measurements. The first set of soil respiration measurements along with soil temperature and soil moisture indicate higher respiration rates in the control plots which could be attributed to the higher input of above ground litter. Temperature or soil moisture did not have any effect on the respiration rates possibly due to the high soil water content (>40%) and small range in observed temperature (9 to 10 °C). Future measurements will include measurements of soil respiration, seasonally and after rainfall periods, root respiration, and root productivity. Overall we expect that seasonal variations in temperature, moisture, rhizosphere activity, and root growth patterns would be strongly affected by different pavement types and would consequently affect root and overall tree health.

Soil Moisture, Gas Exchange, and Growth Characteristics of Mature Sweetgum (*Liquidambar styraciflua*) Trees as Affected by Different Pavement Options

Astrid Volder^{1,2} and W. Todd Watson³, ¹Department of Horticulture, Texas A&M University, College Station, TX 77843; ²Interdisciplinary Program in Molecular and Environmental Plant Sciences (MEPS), Texas A&M University, College Station, TX 77843; ³Department of Ecosystem Science and Management, Texas A&M University, College Station, TX 77843

Dense, impervious pavements poured around mature trees generally result in a rapid decline of tree health and premature tree death. In situations where traffic is light, such as parking lots, porous pavement options can be a good alternative. Porous pavements may greatly improve soil hydrology and aeration, while moderating high summer soil temperatures. This will improve rooting habitat and ultimately overall tree health. To test this, root zones (3 m x 3 m) of 25 sweetgum (*Liquidambar styraciflua*) trees (20 cm dbh), were covered with three

pavement combinations (concrete, porous concrete, no concrete) in Summer 2006. In addition, a water and root impermeable barrier to 1-m depth was installed at the edge of the concrete slabs and control plots to prevent root growth outside the experimental zone or lateral inflow of soil water into the experimental zone. Soil water and temperature sensors were installed at two depths under each slab. As expected, soil water fluctuations after a rainfall event mimicked the control treatment for the porous plots, while the impermeable plots exhibited little response to individual rainfall events. During Summer 2007, trees in the porous treatment exhibited higher diameter growth rates than the other treatments, suggesting better growth conditions in the porous plots. Light saturated photosynthetic rates were highest in the control plots and lowest in the impermeable plots for both sun and shade leaves. Fluorescence measurements indicated little difference in light harvesting efficiency between the treatments. Due to excessive summer rainfall in 2007, we were not able to evaluate the pavement effects under real drought conditions. Future measurements will include continued monitoring of plant growth and physiology, as well as a detailed comparison of water infiltration rates and water quality. These data will help develop a model that will contrast the effects of these pavements on urban stream water quality.

Can Salt Stress in Greenhouse Roses Be Ameliorated by Supplemental Calcium Applications?

Alma R. Solís-Pérez and Raul I. Cabrera, Department of Horticultural Sciences, Texas A&M University Research and Extension Center, 17360 Coit Rd., Dallas, TX 75252-6599

'Happy Hour' roses budded on *R. manetti* and *R. 'Natal Briar'* were grown in 12-L containers filled with a peat-based substrate. A modified Hoagland solution salinized with 12 mM NaCl and supplemented with 0, 2.5, 5.0, 7.5, and 10.0 mM Ca (supplied as CaSO₄) was used to irrigate the plants over five flushes of growth and flowering. A control treatment (no salinity, no supplemental Ca) was also included. Rootstock selection (RS) significantly affected harvested dry weight (DW; higher in *R. manetti* plants). In salinized plants there were no effects of supplemental Ca over any of the flower and DW yield-quality variables over the five flower harvests. Control plants had higher DW and harvested flowers than salt-stressed plants receiving supplemental Ca. Destructive harvest of whole plants at the end of the experiment showed no differences in DW due to RS or supplemental Ca additions in the salinized plants. Compared to the (non-salinized) control, the salinized plants had higher tissue Cl and Na concentrations, and in these latter plants there was a pattern of Cl and Na accumulation in leaves from flower shoots from one harvest to the next. However, RS and supplemental Ca treatments did not produce differential concentrations of leaf Cl and neither in the various plant organs at the end of the experiment. The results were similar for tissue Na accumulation, except the roots, where *R. manetti* plants showed higher concentrations. The salinity, RS and supplemental Ca treatments did not affect Ca concentrations in the different organs. Salt burn damage was more severe in leaves of salinized *R. manetti* plants than in *R. x 'Natal Briar'*. Average salt burn ratings increased as the level of Ca increased, this being more noticeable in *R. 'Natal Briar'* plants. The overall results indicate that supplemental Ca does not ameliorate the negative effects of what was considered a moderate NaCl salt stress (12 mM) on yield and quality of 'Happy Hour' roses. In fact, drainage water data suggest that supplemental Ca applications may have exacerbated the severity of salt stress.

Evaluating the Landscape Performance of Miniature and Dwarf Crape Myrtle (*Lagerstroemia* spp.) Cultivars in North Texas

Jennifer McCormick and Raul I. Cabrera, Dept. of Horticultural Sciences, Texas A&M University Research and Extension Center, 17360 Coit Rd., Dallas, TX 75252-6599

A collection of 47 dwarf and miniature (<5 ft and 5–10 ft in mature height, respectively) *Lagerstroemia* cultivars was established in the fall of 2003. The cultivars were arranged in a mowed grass-cover field, at appropriate spacing, in a complete randomized block design with five replications. With the exception of a single fertigation event in Summer

2006, the plants have not received fertilizer nor pesticide applications. Weeds have been controlled mechanically, and occasionally with spot applications of glyphosate. Formal observations and ratings for this collection have been made only in 2006 and 2007, and include date to first flower, flower density, winter die-back, growth index, rabbit herbivory damage, foliage quality and chlorophyll (SPAD) readings. To obtain an overall landscape plant performance index (LPI), the ratings or units of each individual parameter (six categories, except plant growth index), were normalized on a 1 to 5 scale (1 = poor, 5 = best) and then added to generate the LPI for each plant and the average for each cultivar. Interestingly, the results to date indicate that eight of the best 10 overall performers were *L. indica* cultivars, with the top five being 'Pink Ruffles', 'Petite Pinkie Monkie', 'Petite Embers', 'Delta Blush' and 'Snow'. 'Hopi' and 'Zuni' were the only *L. indica* *L. fauriei* interspecific hybrids among the top 10 performers in our study. Our observations and data suggest that winter weather conditions and rabbit herbivory damage may have been among the most significant factors affecting overall cultivar performance.

Digital Image Analysis of Pecans

Eric T. Stafne¹, Douglas E. Karcher², Becky L. Carroll¹, and J. Andrew Puckette¹, ¹Department of Horticulture and Landscape Architecture, Oklahoma State University, Stillwater, OK 74078; ²Department of Horticulture, University of Arkansas, Fayetteville, AR 72701

Pecans come in various shapes and sizes, some of which are preferred over others for reasons of aesthetics as well as ease of cracking. Manual measurement of nut samples is labor intensive and subject to human error, as is subjective analysis of nut color. Quantification of pecan traits through digital image analysis with SigmaScan could be useful in a variety of areas including plant breeding and cultivar identification. In this study of uncracked nuts from eight pecan cultivars ('Cheyenne', 'Choctaw', 'Maramec', 'Mohawk', 'Pawnee', 'Stuart', 'Wichita', and 'Williamson'), significant differences were observed for all variables, thus differentiating the cultivars based on size and shape parameters. 'Mohawk' had the largest volume, whereas 'Cheyenne', 'Wichita', and 'Williamson' had the least. For shape, 'Williamson' was the least round and 'Cheyenne', 'Choctaw', and 'Stuart' were the roundest. Color analysis may also be useful, but more likely for nutmeats rather than shell. Digital image analysis can be used to objectively quantify pecan shape with great accuracy and precision.

Effect of Elevated CO₂ and Harvest Schedule on *Allium* Biomass and Sensory Quality of *Allium fistulosum*

Amanda Broome¹, Ellen B. Peffley¹, Leslie D. Thompson², and David Wester³, ¹Department of Plant and Soil Science; ²Animal and Food Sciences; ³Natural Resources Management, Texas Tech University, Lubbock, TX 79409

Plants of three *Alliums* were grown at 400 and 1200 ppm CO₂ in growth chambers. Shoots of these plants were harvested weekly, bi-monthly, or at 70 days after planting (DAP). Shoots were removed at 50-mm from media surface and weight (g) recorded. Results varied by species, harvest, and CO₂. Overall, Japanese bunching onion (JBO) and bulbing onion had the greatest shoot biomass. Plants harvested one time at 70 DAP weighed more than those harvested weekly and bi-monthly. The effect of CO₂ on shoot weight depended upon harvest schedule. Shoots from plants grown under 400 ppm weighed more than those grown under 1200 ppm CO₂ when left undisturbed and harvested once at 70 DAP. Consumer panelists (n = 25) ranked sensory quality of JBO grown under 1200 and 2000 ppm CO₂ as more visually appealing at 28 DAP; JBO grown under 400 ppm CO₂ as the most visually appealing at 70 DAP.

Variation in Organic Matter and Macronutrient Availability in Landscape Soils under Landscape Fabric

Derald A. Harp, David Colbert, and Hanan Gopffarth, Department of Agricultural Sciences, Texas A&M University-Commerce, P.O. Box 3011, Commerce, TX 75429

Landscape fabrics are frequently used in landscapes as weed barriers and to reduce soil moisture loss. Unfortunately, these fabrics

also prevent soil contact with organic mulches, potentially reducing the benefits these mulches can provide. Landscape beds were prepared to evaluate the effect of landscape fabric on soil organic matter, pH, and macronutrient availability. The native soil was excavated to a depth of 25 cm and replaced with 25 to 50 cm of loamy sand. The soil was amended with 10 cm of a commercially available compost mix and tilled to a depth of 25 cm. One half of each bed was covered with 1-m-wide swaths of landscape fabric and 7.5 cm of cedar mulch. The remaining portion of each bed was covered in 7 cm of cedar mulch only. Each fall, an additional 2.5 cm of mulch was added to all beds. No fertilizer was added throughout the duration of the study. In Spring 2007, all landscape fabric was removed and four soil samples were taken from eight different locations in the beds, four from locations under landscape fabric, four from mulch-only locations. Soil samples were oven dried and tested in the Texas A&M–Commerce soil testing laboratory. Landscape fabric locations were lower in all variables analyzed except for phosphorus. Organic matter decreased from 4.7% under mulch to 2.76% under fabric. NO₃-N levels decreased from 1.97 to 0.73 ppm N. Potassium levels dropped considerably from 29.8 to 6.6 ppm K. Soil pH was slightly higher in the mulch only soils. Further study is warranted, as this study only evaluated one form of landscape fabric, but their use may negatively affect soil fertility and long-term soil till.

Effects of Varying Nitrogen Levels on Greenhouse Growth and Quality of Ornamental White Clover

Derald A. Harp and Steven Pulatje, Department of Agriculture Sciences, Texas A&M University–Commerce, P.O. Box 3011, Commerce, TX 75429

Several new ornamental varieties of white clover (*Trifolium repens* L.) have been released in recent years. Unfortunately, greenhouse production information is currently only anecdotal in nature, and recommendations range from no fertilizer to 200 ppm N. This study was conducted to analyze performance at various fertilizer levels. Two ornamental varieties of white clover, ‘Salsa Dancer’ and ‘Dark Dancer’ were grown at four fertilizer levels, 0, 100, 200, and 300 ppm N during Spring 2007 in 15.24-cm (6 inch) azalea pots using a commercially available mix, Berger BM-7 35. Plants were fertilized twice weekly, and additional water was given as needed. Plant size and shoot dry weight increased ($P < 0.05$) with increasing N level. However, N level negatively impacted root growth, with root dry weights being significantly lower at higher N levels. Additionally, plant quality decreased with increasing N level ($P < 0.05$), as leaf color became more green and ornamental characters became more poorly defined. While plant shoot size increases with increased N levels, the decline in quality makes higher fertilization levels difficult to recommend.

Weed Control in Blackberries using Synthetic Ground Covers

D.J. Makus, USDA-ARS Subtropical Research Center, Weslaco, TX 78596

Weed control in blackberries (*Rubus* spp.) is a serious problem for organic producers and those who wish to reduce their reliance on herbicides. Three landscape fabrics (Dewitt, Texel, and a white polyester weave) and one industrial grade white on black plastic were used in conjunction with newly planted ‘Kiowa’ root cuttings in Feb. 2006. In the no-fabric treatment, weeds were controlled by hand. The reflectant white plastic and weave weed barriers reduced mid-summer soil temperatures at 10 cm and reduced the magnitude in soil temperature fluctuation. None of the weed barriers had an effect on soil water content measured at 0 to 20 cm. Plant vigor and height were improved by use of weed barriers. White plastic improved the cumulative season yield by 30% in 2007 compared to other barriers or bare soil. Fruit from bare soil plants showed the greatest decline in average fruit size during the picking season. Fruit from plants grown in bare soil were lowest in soluble solids and sugar:acid ratio compared to fruit from weed barrier treatments. Fruit grown over white plastic had the highest mean soluble solids and sugar:acid ratios; both reflectant weed barriers improved berry anthocyanin levels.

Micropropagation and Tissue Culture of *Hydrangea macrophylla* for Mutagenesis, Ploidy Manipulation, and Possible Transformation

Stephen P. Greer¹, Sandra Reed², Jeff Adkins³, and Timothy Rinehart¹, ¹USDA-ARS, Southern Horticultural Laboratory, 810 Highway 26 West, Poplarville, MS 39470; ²USDA-ARS, National Arboretum, 472 Cadillac Lane, McMinnville, TN 37110; ³Stephen F. Austin State University, Department of Agriculture, P.O. Box 13000 - SFA Station, Nacogdoches, TX 75962

We have established parameters for efficient in vitro germination of open pollinated seeds from 17 *Hydrangea macrophylla* and two *Hydrangea paniculata* cultivars. All tested hydrangea seed had a confirmed light requirement for germination to occur, and contrary to some prior reports, we discovered that germination increased substantially subsequent to cold, wet stratification for one month or greater. In addition, germination was stimulated individually and additively by imbibition with KNO₃ and gibberellic acid, as well incubation under low level red light or low level full spectrum light (50–60 footcandles). In contrast, *H. macrophylla* germination was significantly inhibited by full spectrum light intensities higher than 100 footcandles, KNO₃ concentrations higher than 1000 ppm, all of our tested concentrations of thiourea, and 6-benzylamino purine (BAP). Using improved germination methods, we have mutagenized seeds from all cultivars using 0.5% to 5% EMS, assaying seed viability and dormancy of each cultivar with TTC staining before and after treatments. Separate experiments are in progress to develop effectual protocol for the sterile culture, callus and new shoot formation of *H. macrophylla* explants. Currently, our improved methods establishing sterile cultures from unopened buds have produced success rates approaching 50%; subsequent protocol used to produce regenerative callus and multiple shoots from these sterile cultures has a success rate approaching 10% after 1+ month. We are continuing to evaluate and develop these and additional methods with the goals of transforming and increasing ploidy levels of *H. macrophylla*.

Nutrient Uptake Efficiency and Plant Growth Indicators of Grafted Tomatoes

Suzanne O’Connell and Mary M. Peet, 2721 Founders Drive, Kilgore Hall, Department of Horticultural Science, North Carolina State University, Raleigh, NC 27695-7609

Grafted herbaceous plants maybe more efficient at absorbing certain macro- and micro-nutrients (Ruiz, 1996; Leonardi, 2006) but these effects are not well-documented. A greenhouse study evaluating the tomato cultivars, Trust (*Solanum lycopersicum*) and German Johnson (*Solanum lycopersicum*), grafted onto the Maxifort rootstock (*Solanum lycopersicum* x *Solanum habrochaites*) was conducted in 2007 at the North Carolina State University Phytotron. Total nutrient uptake efficiency was calculated for both macro- and micro- nutrient content in the leaf tissue (leaf biomass leaf nutrient concentration) and plant growth indicators. The experiment was a completely randomized block design with 5 replications, consisting of 6 treatments: Maxifort-Trust grafts, self-grafted Trust, non-grafted Trust, Maxifort-German Johnson grafts, self-grafted German Johnson, and non-grafted German Johnson. Five successive weekly destructive harvests were conducted representing the period 4-8 weeks post-grafting. Shoot biomass, root biomass, and height of Maxifort-Trust and Maxifort-German Johnson grafts were significantly higher compared to the non-grafted treatments ($P < 0.05$). The shoot biomass and height of the self-grafted treatments were also significantly higher for than the non-grafted treatments. The total macro- and micro-nutrient content of the leaf tissue of the Maxifort-Trust and Maxifort-German Johnson grafts were significantly higher for: N, P, K, Ca, Mg, Fe, Mn, Zn, Cu, B than the non-grafted treatments ($P < 0.05$). The total macro- and micro-nutrient content of the leaf tissue of the self-grafted treatments were significantly higher for: N, P, K, Mg, Zn, Cu, and B than the non-grafted treatments ($P < 0.05$). Further understanding the nutrient requirements and growth habits of grafted tomatoes will aid in the development of best management practices for U.S. growers, including potentially more efficient use of fertilizers.

Combined Effects of Storage Time and Temperature on Sensory Characteristics of Plain Yogurt

Shweta Kumari¹, Patti C. Coggins¹, Julie C. Wilson¹, and Dennis Rowe², ¹Garrison Sensory Evaluation, Department of Food Science, Nutrition and Health Promotion, Mississippi State University, Starkville, MS 39762; ²Department of Plant and Soil Sciences, Mississippi State University, Starkville, MS 39762

Sensory characteristics of appearance, basic taste, aroma, texture and flavor are the parameters that ultimately decide the quality of plain yogurt. This research was designed to ascertain the effects of time (1, 7, 14, 21, 28, 35, 42, and 56 days) and temperature (4.4, 7, 10 °C) on the sensory characteristics of yogurt during refrigerated storage. A trained descriptive panel was used to measure the sensory categories of aroma, appearance, texture, basic taste, and flavor. All categories of the sensory attributes demonstrated significant ($P < 0.01$) changes over time and temperature, however the differences ($P < 0.01$) observed did not make the yogurt unpalatable for consumption. Overall flavor intensity and sourness were the most obvious effects of storage time and temperature. Results indicate the tested combined effects of time and temperature would not render the yogurt unpalatable. The sensory attributes which changed could be used as a guide in establishing sensory specifications for quality control.

Sensory and Quality Assessment of Grazing Standing Corn versus Commercially Feed Lot Finished Beef

Patti C. Coggins¹, James M. Martin², Husniye Imamoglu^{1*}, and Glover B. Triplett³, ¹Garrison Sensory Evaluation, Department of Food Science, Nutrition and Health Promotion; ²Animal and Dairy Science Department; ³Department of Plant and Soil Sciences, Mississippi State University, Starkville, MS 39762

This study compared feed lot finished beef and grazing standing corn beef from young steers for sensory acceptance, sensory quantitative descriptive analysis attributes palatability and shear force values. In comparing both feeding treatments results indicated no differences ($P > 0.05$) between feeding treatments for all attributes including appearance, aroma (with handheld) and (with sniff bottle), texture, flavor and basic taste. However, there was a difference ($P < 0.05$) in flavor, off-flavor for different feeding systems as determined by sensory panelists. Analysis of variance for shear force values revealed no differences ($P > 0.05$) between steaks from two treatments. Based on this research, the meat industry may wish to provide the consumer with the option of choosing beef that was traditionally feed-lot finished or beef finished by grazing standing corn. Thus, grazing standing corn beef producers could utilize a practicable alternative feeding system with niche market appeal to represent a viable production option.

Effects of Fruit Harvest Position on Eggplant Fruit Quality

Brian A. Kahn¹ and Mark E. Payton², ¹Departments of Horticulture and Landscape Architecture; and ²Statistics, Oklahoma State University, Stillwater, OK 74078

Eggplants (*Solanum melongena* L.) were grown from transplants in a field study at Bixby, OK in 2005 and 2006. Plants were harvested 14 times (twice a week for 7 weeks) in both years. Data were taken from 3 individual plants per plot \times 11 cultivars \times 3 replications in each year. Each fruit on each individual plant was charted upon harvest. Fruit harvest position no. 1 corresponded to the first fruit harvested on a given plant. Sequential positions (such as positions 2 and 3, the second and third fruits harvested on a given plant) may have been harvested on one date. Data analyses examined each harvest position up to the overall mean for number of harvested fruits per plant for a given cultivar and an aggregate term for any subsequent harvest positions. Chi square analysis was used to test the null hypothesis that fruit harvest position had no effect on marketability. Total fruit numbers observed decreased as the harvest season progressed. An effect of fruit harvest position on marketable fruit production was found in only two cases out of 22 total possibilities. Therefore, we conclude that within the harvest range tested, eggplant fruit harvest position affects the likelihood that a given fruit will be marketable only in rare events.

Response of Three Southern Highbush Blueberry Cultivars to CPPU

D. Scott NeSmith, Department of Horticulture, Georgia Station, Griffin, GA 30223

Several experiments have been conducted since 1999 to determine how the growth regulator CPPU [N-(2-chloro-4-pyridyl)-N'-phenyl-urea] affects fruit set, berry size, and yield of blueberries grown in the southern United States. Much of the early research was with rabbiteye blueberries (*Vaccinium ashei* Reade); however, recent tests have been conducted with southern highbush (*V. corymbosum*). This research examined the response of three southern highbush cultivars ('Millennia', 'O'Neal', and 'Bluecrisp') to two rates of CPPU (10 and 15 mg-L⁻¹) and the usage of a nonionic surfactant or not. Depending on rate, surfactant, and cultivar, as much as a 2-fold increase in fruit set was noted when using CPPU, and up to a 15% increase in berry weight was observed. However, when using CPPU, significant burning of leaves and berries was observed on several treatment/cultivar combinations. It appeared injury was worsened by the presence of the surfactant. Also, delays in ripening have been noted when using CPPU. These data suggest that CPPU usage on southern highbush blueberries needs to be carefully evaluated. Cultivars vary in sensitivity, thus, usage of the product should be contemplated only on a trial basis.

Paper Mulches for Weed Control in Summer Squash

Timothy W. Coolong, N-318 Ag Sciences North, Department of Horticulture, University of Kentucky, Lexington, KY 40546-0091

Several commercially available papers were tested for suitability as mulches for weed control in summer squash (*Cucurbita pepo*). Fifty-pound kraft paper, 50-lb polyethylene coated kraft paper, 40-lb butcher paper, and 30-lb waxed papers were tested for differences in weed control yield and quality in *C. pepo* 'Conqueror III'. The performance of the paper mulches was compared to black plastic mulch, hand-weeded bare ground and non-weeded bare ground treatments. Treatments were organized in a randomized complete block design with four blocks. The black plastic mulch treatment had the highest yields (30,879 kg-ha⁻¹) and number of fruit (56,628 fruit/ha) of the treatments tested. Though less than the black plastic treatment, the polyethylene coated kraft paper (26,088 kg-ha⁻¹), waxed paper (25,289 kg-ha⁻¹) and butcher paper (24,757 kg-ha⁻¹) treatments produced reasonable yields. The black plastic, butcher paper, waxed paper, and polyethylene coated kraft paper were not significantly different in terms of weed biomass. While the kraft, butcher, and waxed papers degraded during the study, a thin film of polyethylene remained from the polyethylene coated kraft paper, suggesting it would not be suitable for use as a biodegradable mulch. The 40-lb butcher paper had the best combination of yield, weed suppression, biodegradability, and ease of use when put out using a traditional plastic layer and may prove useful for farmers wishing to utilize inexpensive biodegradable mulches.

In Vitro Factors Affecting Galax Seed Germination

Guochen Yang* and Zhongge (Cindy) Lu, Department of Natural Resources and Environmental Design, North Carolina A&T State University, Greensboro, NC 27411

The research goal was to expedite Galax propagation through in vitro techniques. Galax seed germination was achieved under different in vitro conditions using the tiny rust-colored seeds collected from South Toe, Yancey County, NC at an elevation of about 1100 m. After surface sterilization, Galax seeds were transferred different in vitro factor conditions as treatments. These in vitro factors include culture medium pH conditions (4.2, 5.0, and 5.8), culture medium strengths (MS 0, 1/2, 1, or 1-1/2), or different plant growth regulators (BA or GA₃) at various concentrations. The tests were focused on individual factor treatment and the interactions of different factors. Seed germination was achieved under these in vitro conditions. Significant germination differences and interactions were observed among the culture medium pH, culture medium strengths, growth regulators, and concentration treatments.

Effect of Irrigation Frequency on Root Growth, Stem Water Potential, and Net Photosynthesis of *Kalmia latifolia*

Matthew F. Wilkin and Amy N. Wright, Department of Horticulture, Auburn University, Auburn, AL 36849

Knowledge of plant responses to soil moisture deficit can provide information concerning relative drought tolerance and irrigation requirements of native landscape shrub species. Plants of *Kalmia latifolia* 'Olympic Wedding' (mountain laurel) were removed from 11-L containers and planted into Horhizotrons on 21 Nov. 2006. Each Horhizotron contained eight glass panes arranged to form four quadrants extending away from the original container root ball. Quadrants were filled with a calcined clay substrate, and one of three different irrigation frequencies was assigned to all four quadrants of a Horhizotron. Irrigation frequencies included watered-daily (substrate about 20% moisture by volume) or irrigated once substrate percent moisture reached 15% or 10% by vol. Root balls of all plants received 600 mL water every other day. Once each substrate reached the target minimum percent moisture, stem water potential (SWP) and net photosynthesis (net Ps) were measured before and after irrigation. Biweekly horizontal root length (HRL) was recorded by measuring the five longest roots (measured parallel to the ground) visible on each glass pane of a quadrant, and root dry weight (RDW), shoot dry weight (SDW), and final growth indices (GI) were determined upon completion of the study (180 days after planting). HRL, RDW, SDW, and GI were highest in the watered-daily substrate. Stem water potential and net Ps decreased with decreasing soil moisture and were lower before irrigation than after. Over time, prolonged "mild" drought conditions produced similar effects on SWP and net Ps as more severe drought conditions. Also over time the difference between before and after watering, in terms of SWP and net Ps, decreased.

Bite-Sized Tomatoes: Cultivars and Quality for a Farm-to-School Lunch Program

Warren Roberts¹, Penny Perkins-Veazie², Merritt Taylor¹, and Jim Shrefler¹, ¹Wes Watkins Agricultural Research and Extension Center, Oklahoma State University, 911 Highway 3, Lane, Oklahoma 74555; ²USDA/SCARL, 911 Highway 3, Lane, Oklahoma, 74555

An epidemic is occurring in the United States. Adults and children are becoming increasingly obese, and the incidence of diabetes is becoming more common even among school children. The type of foods eaten by children is one of the causes for obesity and diabetes. Fresh fruits and vegetables would offer high levels of nutrients but low levels of fats and calories to children. A Farm-to-School program has been developed to facilitate interactions and sales directly between farmers and school cafeteria workers. Fresh fruits and vegetables are items that are currently being sold by farmers in this program. An ideal vegetable would be one that was easily harvested, easily cleaned, did not require special storage facilities, did not require cutting, slicing, peeling, coring, or cooking, did not produce waste within the school cafeteria, and tasted good. We selected small tomatoes as one crop that fit all of those categories. We grouped cherry tomatoes, plum tomatoes, pear tomatoes, and grape tomatoes into a category that we called 'bite-sized' tomatoes. During 2007, we grew 90 cultivars of bite-sized tomatoes, including representatives of all four shape designations previously listed. We included red, yellow, and green/brown cultivars within the test. Yields were about 0.5 to 2.0 lb per plant, which was less than anticipated. Prolonged periods of rainfall during the growing season probably limited pollination and yield. Lycopene of several cultivars was greater than 100 mg/kg. Soluble solids of many cultivars were greater than 7%. Brown tomatoes had a taste that was favorable to many consumers. Pear tomatoes tended to crack more than did the round or oblong cultivars.

Melon Types and Cultivars Grown with Organic and Synthetic Fertilizers

Warren Roberts¹, Benny Bruton², Wayne Fish², and Merritt Taylor¹, ¹Wes Watkins Agricultural Research and Extension Center, Oklahoma State University, 911 Highway 3, Lane, OK 74555; ²USDA/SCARL, 911 Highway 3, Lane, OK 74555

For 3 years, 12 melon cultivars were grown with either synthetic or organic (poultry litter) fertilizer. Both fertilizers were applied at 100 lb

N, 100 lb P₂O₅, and 100 lb K₂O per acre. In order to satisfy the requirements of the USDA National Organic Program, all fertilizer was applied at least 120 days prior to harvest. When yields were pooled across cultivars, average yields from synthetic fertilizer exceeded yields from organic poultry litter fertilizer in 2007, but not in 2005 or 2006. Neither synthetic nor organic fertilizer produced statistically greater yields than did the other fertilizer material in the first 2 years of the study. In 2007, prolonged rainfall occurred throughout the growing season. This may have affected treatment efficiencies and yields. Nutrients that may have leached from the root zone could not be re-applied because of the 120-day mandatory waiting period between application of poultry litter and melon harvest. Cultivar yield responses varied with year. Yields ranged from about 1 to about 15 tons per acre, depending on the cultivar and the year. Foliar disease ratings were taken in 2006, when disease losses from *Macrophomina phaseolina* were prevalent. Great variation existed in disease resistance among cultivars. Fertilizer had little effect on foliar disease ratings, but cultivar had a major effect on disease ratings. Honeydew melons were more resistant to disease development from *Macrophomina phaseolina* than were the other melon cultivars.

Crape Myrtle Growth and Phenology in South Mississippi

Christine Coker, Patricia R. Knight, John M. Anderson, and Wayne McLaurin, Mississippi State University, Coastal Research and Extension Center, 1815 Popps Ferry Road, Biloxi, MS 39532

Lagerstroemia indica fauriei 'Tonto' and 'Sioux' were planted in Mar. 1995. All other cultivars were planted in Oct. 1985. Plants were planted into a Ruston sandy loam on a 12 ft (3.7 m) spacing. Trees were pruned to develop multiple trunks. Trees are pruned annually in winter to remove any limbs smaller than 1/4 inch (0.6 cm) in diameter. Pruning cuts are made 6–8 inches (15.2–20.3 cm) above prior cuts. Severe pruning is performed every 5 years. Trees were evaluated at 2-week intervals during the flowering season to determine total length of flowering and duration of good to superior flowering. Growth indices (height + width + perpendicular width)/3 were recorded after plants were dormant. Total days of flowering and floral display (0–5 with 0 representing no flowers and 5 representing superior flowering) were rated. 'Muskogee' had the greatest growth index after the 2004 growing season. 'Seminole' had the least. However, 'Seminole' had the greatest number of flowering days. 'Biloxi' had the fewest flowering days. 'Tonto' had the most good to superior flowering days while 'Tuskegee' and 'Muskogee' had the fewest. In 2005, 'Muskogee' again had the greatest growth index while 'Sioux' had the least. 'Yuma' and 'Seminole' had the greatest number of flowering days, and 'Biloxi' again had the fewest. 'Tonto' again had the most good to superior flowering days while 'Biloxi' and 'Acoma' had the fewest.

Effect of Plant Growth Regulators and Nutrition on Morphology and Anatomy of Butterfly Plant *Christia subcordata* Moench

Paula Whiting and Bodie Pennisi, Horticulture Department, The University of Georgia CAES UGA Griffin Campus, 1109 Experiment St., Griffin, GA 30223

Butterfly plant, *Christia subcordata* Moench, is a new ornamental legume of potential interest to the industry. It is a tropical herbaceous perennial with slender elongated stems, trifoliate leaflets with green tint in juvenility, burgundy with darker burgundy stripes when mature. The species exhibits strong apical dominance leading to sprawling growth habit and less tidy appearance. Growth control is required to achieve more marketable plants with upright and compact habit. The use of natural height control such as selective pruning is time- and labor-intensive, and may result in increased production costs. *Christia subcordata* was grown under various nutritional regimes and PGRs to determine the most effective PGRs and rates for producing optimal growth while producing a compact, marketable plant. Ethephon was consistently more effective in reducing height, shortening internodes, and inducing lateral branches in *C. subcordata* when compared to dikegulac-sodium. The plants treated with ethephon had the lowest leaf area and shoot dry weight, but the highest leaf area ratio. Ethephon-treated plants were more compact than plants treated with dikegulac-sodium. Plants treated with 500 mg/L chlormequat chloride showed

a significant reduction in plant height, internode length leaf area and leaf area ratio, when compared with plants receiving 750, 1000, or 1250 mg·L⁻¹ chlormequat chloride. Benzyladenine (BA) had no statistically significant effect on growth parameters. From the four chemicals tested, ethephon was found to be most effective in controlling growth and producing marketable *C. subcordata*. Ethephon-treated plants had reduced cell length in internodal stem parenchyma tissue (cortex and pith), and reduced intercellular spaces and leaf thickness, and reduced palisade and spongy mesophyll cell length. With respect to nutrition, optimal plant growth of *C. subcordata* can be obtained with a rate of 100 to 175 mg·L⁻¹ nitrogen. Fertilizer rate (100, 175, 250 mg·L⁻¹) had no significant effect on lateral branching and leaf area ratio.

Evaluation of Natural Fertilizers for Greenhouse Crop Production

W.B. Evans and G. Bi, Mississippi State University, Truck Crops Branch, Crystal Springs, MS 39059-0231

We are investigating the suitability of several locally available agricultural and industrial by-products as fertilizers and/or substrate amendments for horticultural production. Within these trials, we ran two experiments to investigate the suitability of composted broiler litter (CBL) as a fertilizer in production of tomato and marigold plants in 6-inch (15 cm) pots. CBL rates of 0%, 2%, 4%, 6%, and 8% v/v in a custom blended substrate (CUST) were compared to a standard rate of slow release fertilizer (SRF) in CUST and a commercial potting substrate. Substrate pH and electroconductivity (EC) were similar in the two substrates when fertilized with equal amounts of SRF. CUST EC increased as concentration of CBL increased, exceeding that of the commercial substrate with SRF. Compared to the unfertilized control,

CBL increased tomato and marigold shoot dry weight, growth index, and root vigor, as well as marigold flower number. However, plants grown with CBL had lower values for these parameters, and SPAD chlorophyll meter readings at harvest, than those produced in the two treatments receiving SRF. Results of these studies are similar to findings from several of our other investigations: that many by-products have potential value in horticulture but their utility may be greatly improved by developing systematic blends of several by-products, rather than relying on a single one as a fertilizer or substrate amendment.

Harpin Protein Use to Improve Early Season Fruit Size of 'Queencrest' Peach

Robert T. Boozer and James A. Pitts, 120 County Road 756, Auburn University Chilton Research and Extension Center, Clanton, AL 35045

Adequate fruit size is often difficult to obtain from early season peach cultivars in many areas of the southeast. Bloom thinning increases fruit size but, increases grower risk associated with early spring freezes. In a non-irrigated orchard, Harpin protein, EBC-351B, was evaluated at two rates, 2 oz and 4 oz per acre at pit-hardening on 'Queencrest' peach to determine affect on fruit size. First year resulted in a 70% increase in number of 2.5-inch marketable fruit where 4 oz EBC-351B was used. Years 2 and 3 were not significantly different from untreated control. Positive trends were evident in year 2 but, not year 3. Rainfall totals during early season, March to May, were 17.9, 9.0, and 3.2 inches for years 1, 2, and 3, respectively. Climatic conditions that adversely affect early fruit development appear to greatly limit potential benefits of Harpin protein EBC-351B.