

Abstracts of the ASHS Southern Region 69th Annual Meeting

Atlanta, Georgia

31 January–2 February 2009

J.B. Edmond Undergraduate Student Paper Competition

Amending Pine Bark Supplies with *WholeTree* and Clean Chip Residual

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This study evaluated the growth of five container-grown crops in nine different substrates with varying ratios of Pine Bark (PB), Clean Chip Residual (CCR) and *WholeTree* substrate (WT) in each. Treatments consisted of 100% each of PB, WT, and CCR, and 75:25 PB:CCR and PB:WT, 50:50 PB:CCR and PB:WT, and 25:75 PB:CCR and PB:WT. CCR and WT used in this study were processed through a swinging hammer mill to pass through a 0.95 cm (3/8 inch) screen. pH and electrical conductivity (EC) levels were measured using the pour through method at 7, 15, 30, 60, and 90 days after transplanting (DAT). At 30 DAT, pH of 100% PB (5.68) climbed with increasing levels of WT to 6.57 in 100% WT. Increasing volumes of CCR at 60 DAT exhibited the same trend with pH climbing from 6.26 (100% PB) to 6.59 (100% CCR). Addition of CCR and WT tended to raise pH at all testing dates, although levels did not exceed the recommended range, possibly indicating that lime may not be needed with higher levels of CCR and WT. EC levels were high at 7 DAT, but began to stabilize around 30 DAT, although 75:25 PB:CCR tended to maintain the highest levels throughout the study (1.60 dS/m at 7 DAT to 0.72 dS/m at 60 DAT). Growth indices [(height + width1 + width2)/3] (cm) were measured at 90 DAT. There were no statistical differences in growth indices of azalea in any substrate. For spiraea and ligustrum, all treatments had growth indices that were either statistically the same or larger than 100% PB. Tea olive, however, tended to grow better in substrates with 50% PB or higher, as the 25:75 PB:CCR treatment was the only treatment to have growth indices statistically smaller than those of the 100% PB treatment. Overall, this study demonstrated that nursery producers could amend their PB supplies with up to 75% WT or CCR with limited to no impact on crop growth.

Can Honey Be Used as an Auxin Substitute for Rooting Cuttings?

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Synthetic auxins such as IBA and NAA are commonly applied to promote adventitious rooting in vegetative propagation protocols. However, health hazards are associated with their use including skin, eye and lung irritation, and mutagenesis with chronic exposure. With a growing interest in the use of organic, sustainable, and green products, the identification of a naturally-derived substitute for synthetic auxins is desirable. Honey has growth promoting and nutritional components, and has been implicated as possessing root promoting activities. The objectives of this study were to evaluate the effects of honey on adventitious rooting in chrysanthemum and to determine if honey can act as an alternative to synthetic auxins. The basal 1.5 cm of 'White Blush' Chrysanthemum cuttings were given a quick dip in either honey (100%, 50%, 25%, or 3%), 1500 ppm

KIBA, or water. Percentage rooting, root number, root length, and shoot height were destructively assessed at 1 and 2 weeks; root and shoot dry weights were taken at 2 weeks. Percent rooting was rapid with >80% rooting obtained in all treatments by 1 week except for the 100% honey treatment which had a significantly lower rooting percentage, i.e., 60%. At week 2, all treatments had 100% rooting; no statistical differences in rooting percentage, number or weight were observed between KIBA, water, or honey treatments suggesting that KIBA may not be necessary for rooting in this species. However, differences in shoot dry weight were observed. All honey treatments produced plants with greater shoot dry weights and higher shoot:root ratios, indicating that honey promoted shoot and leaf growth.

Interesting Edibles: Designing an Edible Ornamental Garden for the Cliffs Botanical Garden

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Clemson University horticulture faculty and students have been working with the Cliffs Communities, a development company with private residential golf course communities in the Carolinas, to design a botanical garden for the Cliffs at Mountain Park in Travelers Rest, SC. The garden will be open to the public as a place of recreation and education for the surrounding community. Following a design methodology including research, analysis, preliminary, and final design development, a class of 10 students collaborated to research information pertaining to existing potage gardens, site analysis, photo analysis, program development, sustainable practices, and base mapping. Students then worked individually to design selected theme gardens and develop master plans. The master plans, including plant lists, pricing, quantities, planting details, and elevation drawings were presented to a board of Cliffs Community employees. The focus of this presentation will be an "Edible Ornamental Garden" which will showcase plants whose fruits, leaves, or roots are edible. Sustainable concepts have been incorporated such as native plant usage, companion planting, crop rotations, green roofs, pervious paving, and recycling material from development construction. The "Edible Ornamental Garden" has been subdivided into four different areas featuring 1) "Edibles Gone Wild," 2) "The South Carolina Garden," 3) "The Chef's Garden," and 4) "The Beverage Garden." Each area will emphasize plants with showy blooms, delicious fruits, attractive foliage, and interesting forms along with interpretative signage. The Edible Ornamental Garden will reinforce the "from farm to table" connection and educate the public on the benefits of locally grown produce.

Norman F. Childers MS Graduate Student Paper Competition

Changes in Edible Quality and Aroma Profile of 'Arkin' Carambola During Ripening on the Tree

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Commercially produced 'Arkin' carambola was harvested at five ripeness stages (1/4 yellow, 1/2 yellow, 3/4 yellow, 1/4 orange, and 1/2

orange). The following day fruit were analyzed for firmness and prepared for analysis of composition and aroma profile. Firmness was measured as the maximum force recorded as an 8-mm-diameter convex probe was extended to 7-mm depth on a 10-mm-thick equatorial slice of fruit tissue. Firmness ranged from 30.5 (1/4 yellow fruit) to 14.0 N (1/2 orange fruit), decreasing during ripening on the tree. Soluble solids content increased as fruit ripened on the tree and ranged from 5.8 (1/4 yellow) to 7.2 °Brix (1/4 and 1/2 orange). Total titratable acidity decreased during ripening on the tree, ranging from 3.65% to 1.74% at 1/4 yellow and 1/2 orange stages respectively. Sugar-to-acid ratios, an important indicator of sweetness, increased at each progressive ripeness stage, ranging from 15.9 (1/4 yellow fruit) to 41.4 (1/2 orange fruit). Aroma analysis was performed by headspace solid phase microextraction (SPME) and gas chromatography-mass spectroscopy (GC/MS). Alkanes and ketones, which contribute to green and sweet aromas, decreased at each progressive ripeness stage. Fruit harvested at 1/4 yellow and 1/2 orange had higher total volatiles than fruit harvested at 1/2 yellow, 3/4 yellow, and 1/4 orange. Fruit harvested at 1/4 and 1/2 orange had norisoprenoid compounds which contribute to honey and sweet aromas, but also indicate carotenoid degradation. Only fruit harvested at the 1/2 orange stage had acetic acid, which contributes to pungent, stinging, and sour flavors, and ethanol, which indicates that the fruit were over-ripe.

Effect of Sowing Depth and Soil Type on Germination and Initial Growth of Three Native Wildflower Species

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Establishing native wildflower species in the landscape requires planting practices that ensure good seed germination and subsequent growth. Seeds of *Coreopsis tinctoria* Nutt. (golden tickseed), *Gaillardia pulchella* Foug. (Indian blanket), and *Rudbeckia hirta* L. (black-eyed Susan) were sown in three Alabama soil types at four sowing depths. Soil types included Marvyn loamy sand, Tallasse loamy clay, or Black Belt clay. In Aug. 2008, treatments were in a 3 soil type x 4 sowing depth factorial with three single-container replications per treatment in a completely randomized design. Twenty seeds of one species were sown in a 2.5-L (trade gal) container at one of four depths: surface (0 inch), 0.3 cm (0.125 inch), 0.6 cm (0.25 inch), and 1.3 cm (0.50 inch). Germination was recorded every other day for 2 weeks and then weekly until experiment termination on 14 Oct. 2008. For *R. hirta* and *C. tinctoria*, germination, leaf area (LA), shoot dry weight (SDW), and root dry weight (RDW) were highest when seeds were surface sown than when planted below the surface. For *G. pulchella*, germination, LA, SDW, and RDW were highest when seeds were sown below the surface, and this species had the most growth and highest germination rates of all species tested. For all species, most germination occurred within 2 weeks after sowing. Germination, LA, SDW, and RDW tended to be highest in the Tallasse soil. Although germination percentages tended to be lower than expected (21%–58%), results indicate that wildflowers can be established in various soil types throughout the state, but that care must be taken to ensure proper sowing depth for each species.

Effects of High Tunnels and Mowing on Growing Degree Unit Response and Requirement of Primocane-fruiting Blackberries

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A growing degree unit (GDU) model previously developed to predict bloom dates of floricane-fruiting blackberries was evaluated for primocane-fruiting (PF) blackberries in combination with harvest season manipulation treatments. Two experiments were conducted to determine the validity of the model and its accuracy in predicting bloom dates. One experiment used treatments of mowing canes to the ground one, two, and three times during the growing season on PF genotypes, APF-45 and APF-52. Treatments were replicated under high tunnels and ambient conditions. A second experiment used three genotypes, Prime-Jan[®], Prime-Jim[®], and APF-46, under high tunnels and ambient conditions with a single mowing treatment. Nodes were

counted weekly and bloom dates were recorded in both experiments. GDUs were calculated based on half-hourly temperature data. Results indicate that node formation is consistent with the response model proposed for floricane-fruiting blackberries and is unaffected by high tunnels or by cane-mowing. However, total GDU at bloom and total node formation were affected by cane treatment and by genotype.

Effects of Short Interval Cyclic Flooding on Growth and Physiology of Selected Native Shrubs

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Plant species adapted to wet conditions are likely candidates for rain gardens due to their ability to withstand alternating wet and dry periods. On 16 June 2008, 30 rooted stem cuttings [0.25 L (2.25 inches)] of *Viburnum nudum* L. ‘Winterthur’ (possumhaw), *Ilex glabra* (L.) A. Gray. ‘Shamrock’ (inkberry holly), and *Itea virginica* L. ‘Henry’s Garnet’ (sweetspire) were planted into 2.5 L (trade gal) pots and arranged in a randomized complete block design with 5 blocks in a greenhouse in Auburn, AL. Beginning on 21 July 2008, plants were flooded to substrate level for 0 (control), 3, or 7 days and then allowed to drain for one week before the same flood cycle was repeated. Photosynthesis (Ps) rates were measured for *V. nudum* ‘Winterthur’ and *I. virginica* ‘Henry’s Garnet’ during flooding and draining cycles in plants flooded for 3 and 7 days. At each measurement Ps of control plants was measured. On 10 Oct. 2008, the experiment was terminated. Non-flooded plants of *I. virginica* ‘Henry’s Garnet’ and *I. glabra* ‘Shamrock’ had higher growth index (GI) [(height + widest width + width perpendicular to widest width)/3] than plants flooded for 3 and 7 days. Shoot dry weight (SDW) of *I. glabra* ‘Shamrock’ was lower when plants were flooded for 7 days than when flooded for 0 or 3 days. SDW for *I. virginica* ‘Henry’s Garnet’ was higher in non-flooded plants than plants flooded for 3 and 7 days. *Itea virginica* ‘Henry’s Garnet’ root dry weight (RDW) was higher in non-flooded plants and plants flooded for 3 days, than in plants flooded for 7 days. RDW for *I. glabra* ‘Shamrock’ was highest in non-flooded plants, followed by plants flooded for 3 and 7 days. RDW, SDW, and GI for *V. nudum* ‘Winterthur’ were not different among treatments. *V. nudum* ‘Winterthur’ and *I. virginica* ‘Henry’s Garnet’ Ps rates were higher during flooding than draining in both flooding treatments, and Ps rates were higher in control plants than in flooded plants. Although growth and Ps was generally lower in flooded plants than control plants, all taxa maintained visual quality and continued to grow, which suggests they would be acceptable choices for use in rain gardens.

Evaluation of Fertility in Floricane- and Primocane-fruiting Blackberry (*Rubus L. spp.*) Genotypes

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High self-fertility is important in blackberries as this crop is often grown in solid-cultivar blocks. Variation in berry set and fruit size of the recently introduced primocane-fruiting cultivars has been observed however, particularly in varied climates. Therefore, there is a need to assess overall fertility of this new type of blackberry in comparison to industry-standard floricane-fruiting cultivars. Eight genotypes, including primo- and floricane-fruiting, were tested for fertility in a field setting using floricane flowers with four pollination treatments. Treatments included open-pollinated undisturbed, emasculated selfed, emasculated and pollinated with another pollen source within fruiting type, and emasculated and pollinated with pollen of the other fruiting type. The effects of genotype and pollination treatment were significant for the number of berries set, berry weight, and visual rating of drupelet set; however, the interaction of these effects was not significant for any variables. There were no differences between cross-pollination treatments and self-pollination. The open-pollinated undisturbed flowers had the highest berry set and emasculated selfed flowers had the lowest berry set. Berry set among pollination treatments ranged from 83% to 86%. Among genotypes, APF-59 and ‘Navaho’ had the highest set of berries (92% and 97%, respectively).

Selections APF-31 and APF-59 had significantly larger berries than the other six genotypes while APF-45, APF-31, and APF-77 had the highest average drupelet set rating. 'Prime Jim' had significantly lower berry set and drupelet set rating than the five other primocane-fruiting genotypes. Our results indicate that self-fruitfulness appears to be adequate in all primocane-fruiting genotypes evaluated and that the newer-generation genotypes show improvement in fertility over Prime-Jim®.

Identification of Tannins from Pecan Kernels by Liquid Chromatography–Mass Spectrometry

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Tannins have recently acquired an interest due to their antioxidant, antimutagenic, anticarcinogenic, and antihypertensive properties. These phenolic compounds are classified into condensed or hydrolyzable. The hydrophilic matrix of four pecan [*Carya illinoensis* (Wangenh.) K. Koch] cultivars (Choctaw, Desirable, GraCross, and Kiowa) was screened for total phenolic (TP) and condensed tannins (CT) content, and for antioxidant capacities by 2, 2-diphenyl-1-picrylhydrazyl (DPPH) and Oxygen Radical Absorbance Capacity (ORAC) techniques. 'GraCross' had the highest values for TP, CT, DPPH, and ORAC. Therefore, this cultivar was selected for the tannins identification by Liquid Chromatography–Mass Spectrometry (LC-MS). Condensed tannins up to tetramers of procyanidin were found. Thirteen ellagitannins were characterized: 2, 3 HHDP-glucose, galloyl pedunculagin, pedunculagin isomers, stenophyllanin A, casuarinin/casuarictin C, valoneic acid dilactone, glausrin C, glansrin A/rugosin C, ellagic acid pentose conjugate, ellagic acid, methyl ellagic acid pentose conjugate, ellagic acid galloyl pentose conjugate, ellagic acid minus a water molecule, methyl ellagic acid galloyl pentoside. Identification of compounds was done by retention times, photodiode array (PDA) spectra, and fragmentation patterns reported in the literature. Their masses were 289–1207 *m/z*. Having identified the responsible compounds for pecan's antioxidant activity will lead to further research involving the health benefits associated with the consumption of this nut.

Landscape Irrigation Scheduling for *Hydrangea quercifolia* 'Alice' and *Rhododendron austrinum*

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The effect of three irrigation scheduling treatments on root and shoot growth and photosynthesis of *Hydrangea quercifolia* Bart. 'Alice' ('Alice' oakleaf hydrangea) and *Rhododendron austrinum* Rehd. (florida flame azalea) were studied using Horhizotrons in a greenhouse in Auburn, AL. Fifteen plants each of *H. quercifolia* 'Alice' and *R. austrinum* were removed from 11.4-L (3 gal) containers, and each plant was placed in the center of one Horhizotron. *H. quercifolia* 'Alice' and *R. austrinum* were planted 14 Feb. 2008 and 9 June 2008, respectively; the experiment was repeated for each species on 28 May 2008 and 8 Oct. 2008, respectively. Horhizotron quadrants (representing soil backfill) were filled with sandy loam soil level with the root ball. Irrigation frequency treatments included: 1) backfill and root ball maintained at or above 20% moisture (well watered, WW); 2) backfill and root ball re-watered when root ball moisture reached 10% (10% RB); and 3) backfill and root ball re-watered when quadrant soil moisture reached 15% (15% S). Percent moisture (by volume) was measured using ECH₂O EC-5 soil moisture sensors, installed in the root ball and in backfill. The experimental design was a randomized complete block design with plants assigned to five blocks. Horizontal root length (HRL) was measured once every 2 weeks, and photosynthetic rates were measured for both species. For both species HRL increased linearly over time in all three irrigation treatments, and plants that were re-watered when the root ball reached 10% moisture exhibited the longest HRL followed by plants in WW and 15% S treatments. Growth indices [(widest width + perpendicular width + height)/3] and photosynthetic rates were similar among treatments for both species. Dry weight of roots in soil-filled quadrants was similar among all three

irrigation treatments for *H. quercifolia* 'Alice'. Results indicate that once roots grow into the backfill soil, monitoring both backfill soil and root ball moisture is important for scheduling and reducing post-transplant irrigation applications.

Organic Matter Type Affects Post-transplant Root Growth of Selected Native Shrubs in a Simulated Above-grade Planting Technique

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Utilizing an above-grade planting technique with organic matter can mimic the natural organic layer that supports root growth after transplanting. A simulated, above-grade planting technique used Horhizotrons™ to evaluate the effect of organic matter type on post-transplant root growth of *Chionanthus virginicus* L., *Rhododendron austrinum* Rehd., and *Hydrangea quercifolia* Bartr. 'Alice'. Five plants of each taxa were removed from 3-gal containers, positioned in the center of Horhizotrons, and grown in a greenhouse in Auburn, AL. The bottom half (10 cm) of each quadrant was filled with sandy loam soil. The top half (10 cm) of each quadrant was filled with one of four substrates: coconut coir (CC), ground pine substrate (PT), peat moss (PM), or pine bark (PB), assigned randomly. Experimental design was a randomized complete-block design with five blocks (Horhizotrons). Root balls and quadrants were irrigated separately when volumetric percent moisture dropped to 20%. Every two weeks, horizontal root length (HRL) was measured. At experiment termination, roots growing into each quadrant were cut from the original container root ball, divided into soil and substrate portions, and rinsed to remove soil and substrates from roots. HRL increased linearly over time among all substrate treatments for *H. quercifolia* 'Alice' and *R. austrinum*, while *C. virginicus* demonstrated quadratic trends. Experiments were terminated when roots reached 26 cm at 61, 117, and 130 days after planting for *H. quercifolia* 'Alice', *C. virginicus*, and *R. austrinum*, respectively. HRL and RDW for *H. quercifolia* 'Alice' were highest in CC and PT substrates, while HRL for *R. austrinum* was higher in CC and PM. HRL of *C. virginicus* was longest in CC and PB, however, RDW was highest in PM and PT. These results reiterate the importance of RDW data for accurate root growth studies. It may be possible that a low EC and pH combination contributed to reduced growth in PB, and that physical and chemical properties of substrates may influence the effectiveness of this technique. Comparison also suggests CC or PT substrates may be acceptable replacements for PM or PB when utilized in this planting technique, but responses to substrates vary by taxa.

Phytotoxicity of Deer Repellents on Landscape Plants

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Six commercial deer repellents were evaluated for their toxic properties on kale (*Brassica oleracea*), snapdragon (*Antirrhinum majus*), and dianthus (*Dianthus plumaris*). Organic and non-organic repellents were tested. Repellents were tested on annual landscape plants considered highly palatable to deer in order to determine their phytotoxicity levels. The six products tested were: Deer Off, Liquid Fence, Deer Stopper, Plantskydd, Deer Pharm (organic), Deer Stopper (organic). Each of these repellents was applied at 1x and 2x rates excluding the organic products, which were ready to use. An untreated control was included, resulting in a total of 11 treatments. These treatments were replicated a total of six times in a randomized complete block. Quality ratings were taken the day after treatment and then at 21 days after treatment (DAT). Growth index measurements were also taken 21 DAT. SPAD readings detecting leaf greenness was measured using a SPAD chlorophyll meter were taken at 28 DAT. Data were analyzed using the general linear model procedure in SAS, and Tukey's Multiple Range Test was used for separation of means. Results concluded that product or rate of product had no effect on growth or

leaf greenness for any species. However, the 2x rate of all products did reduce the quality of kale but not of dianthus or snapdragon. Through testing, we concluded that all products used in this experiment are safe to use on annual landscape species.

Reproductive Biology of *Elliottia racemosa*, a Rare Coastal Plain Endemic

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Georgia plume (*Elliottia racemosa*) is a rare, woody species restricted to the coastal plain of Georgia. Seed set can be low or nonexistent and recent sexual recruitment has not been observed in the wild. The objective of this study was to evaluate the floral biology of Georgia plume to elucidate factors contributing to its lack of reproductive success. Stages of floral development were defined and characterized, and pollen viability assessed. Light and scanning electron microscopy were used to examine anther and stigma development at seven distinct stages of flower development ranging from small, immature buds to flowers with abscised petals. Pollen germination and tube growth were examined using aniline blue staining and in vitro pollen germination assays. Anther dehiscence and pollen release occurred within immature buds. Stigmatic receptivity was associated with the formation of a raised, dome-shaped central region on the stigma, and the development of cleft-like openings leading into the stylar canal. Pollen adherence and tube growth were observed only in the later stages of flower development, i.e., when flowers had petals that were abscising or completely abscised. Pollen capture and germination were restricted to the localized central region of the stigma where secreted exudates accumulated. Germination assays of pollen collected from several populations showed low pollen viability.

Warren S. Barham PhD Graduate Student Paper Competition

A Microarray Approach to Identify Candidate Genes for Internal Heat Necrosis in Potato

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Internal heat necrosis (IHN) is a physiological disorder of potato tubers, resulting in unsightly brown patches of tissue in the parenchyma. Crop losses in the mid-Atlantic states due to IHN are significant, and it is a significant potato production constraint in this region. Heat stress is thought to be a major contributing factor towards the development of IHN. Using an 11,412 potato gene microarray developed by The Institute for Genome Research (TIGR), we undertook a DNA microarray analysis of tubers grown under normal and high temperature regimes in order to identify genes differentially expressed under heat stress, which could also be associated with IHN. Plants of the IHN-susceptible cultivar 'Atlantic' were raised in growth chambers at the NCSU Phytotron under normal (20/18 °C day/night) or high (28/18 °C) temperatures, and tubers were harvested every 2 weeks from 76 to 118 days after planting. Total RNA was extracted from tubers and sent to TIGR for hybridization and data generation. Although overall levels of IHN were not significantly different between temperature regimes, levels of IHN increased more rapidly under high temperature than under normal temperature. Mixed model analysis of microarray results identified 17 genes whose expression was significantly different between high and normal temperatures at 76 DAP and later harvest intervals. The expression patterns of two of these genes were tested via quantitative PCR (qPCR) using Sybr Green I. A gene encoding a formin-homology domain containing protein was validated when tested on the original Phytotron-grown material,

but not when tested with symptomatic and asymptomatic field-grown tubers. The expression of a second gene, phosphatase 2C, was confirmed via qPCR of both Phytotron and field-grown materials, and is now considered a putative candidate gene for IHN. Future research will include the testing of phosphatase 2C and any other validated candidates for polymorphism between IHN-resistant and susceptible genotypes.

Determination of the Optimal Ripeness Stage for Processing 'Kent' Mango into Fresh-cut Slices

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The optimal ripening stage for processing 'Kent' mango (*Mangifera indica* L.) into fresh-cut slices was determined. Initial ripeness stage selection was based on whole fruit firmness, which was more variable than flesh color or soluble solids content. Fruit were left to ripen at 20 °C until they reached 35 N (Stage A), 30 N (Stage B), or 25 N (Stage C) firmness. When a ripeness stage was achieved, the fruit were processed under sanitized conditions into fresh-cut slices. Visual and compositional quality, aroma volatiles, respiration, and electrolyte leakage was compared during storage at 5 °C for 10 days. The visual quality differed among the ripeness stages and deteriorated during storage. The shelf-life duration, based on the subjective visual evaluation, was 10, 7, and 5 days for ripeness stages A, B, and C, respectively, and was mainly limited by desiccation and the development of off-odor (A and B), or edge tissue damage and spoilage (C). Stage A slices remained firmer, had the lowest pH and SSC/TA ratio, and the highest content of ketones and esters. Stage C slices had the highest pH, SSC/TA ratio, ascorbic acid content, the lowest acidity, and also highest aldehydes and alcohol content. Stage B slices had an intermediate, pH, SSC/TA ratio, color, and ascorbic acid content. Also, the stage B slices had less alcohols and aldehydes than C, but had similar content of esters as A. An initial firmness of 30 N (ripeness stage B) is recommended to process 'Kent' mangos into fresh-cut slices, to assure an optimal shelf life based on texture, visual, and compositional attributes.

Development of a Protocol to Assess Heat Tolerance in a Segregating Population of Red Raspberry (*Rubus* L.)

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There are no major producers of raspberries (*Rubus idaeus*) in the southeastern U.S. due in part to the lack of cultivars adapted to warm summer temperatures. Breeding for heat tolerance in raspberries at North Carolina State University is a primary goal in order to achieve adequate plant vigor and production. Screening germplasm for heat tolerance thus far has been done only by visual assessment over a number of years in the field. Here, we describe the development of a method that measures heat tolerance using a chlorophyll fluorometer, and the application of such method onto a field-grown mapping population of raspberries for genetic and quantitative analysis. We established that diurnal effects occur after leaf temperature reaches 28 °C, the critical temperature of *Rubus* is 43.7 °C, dark adaptation minimum is 5 minutes, and heat shock duration is optimal at 30 minutes. The mapping population (n = 196) was screened using the above parameters to measure the Fv/Fm (defined as the ratio of variable fluorescence by the maximal fluorescence). A significant difference in Fv/Fm was found between heat tolerant and non-heat tolerant genotypes (averages of 0.632 and 0.363, respectively). We have established a method to measure heat tolerance that is non-dependent on visual assessment for *Rubus*. Although samples can be screened relatively quickly using this method, the screen is not practical for very large populations in a breeding program. Segregation for heat tolerance is normally distributed and will be used for quantitative trait loci analysis for mapping of the trait. Future work involves fine mapping of the QTL regions, and development of EST markers for screening heat tolerance in the greenhouse.

Pre-storage Conditioning of NMF Peaches Using Directed Heat Stress Combined with 1-MCP to Maintain Appealing Sensory Characteristics during Postharvest Handling —A Preliminary Study

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Limited postharvest life of traditional melting flesh (MF) peaches due to rapid softening is one of the main factors leading to losses during distribution and marketing. Non-melting flesh (NMF) peaches change texture more slowly than MF cultivars and, thus, are ideal for shipping and long-term storage. To further extend the postharvest life of NMF peaches, a directed heat stress combined with liquid formulated 1-MCP applied pre-storage was proposed. Heat treatment involves reversible stress that stimulates defense reactions in plants to protect them from subsequent stresses and can also inhibit ripening. 1-MCP is a competitive inhibitor of ethylene action; it appears to be more efficient in inhibiting ripening in aqueous form than gaseous form. Two preliminary experiments were designed to examine the effect of pre-storage hot water treatment and aqueous 1-MCP application on firmness retention of NMF 'Last Tango' peaches. In both studies, the treated peaches were stored at 20 °C for 3 days and then flesh firmness was measured. Peaches were treated with 20, 43, 46 or 50 °C water for 1, 5, 10, 20 or 30 min. Peaches treated with hot water for 30 min either did not soften (43 and 46 °C) or were slightly firmer (50 °C) than the initial fruit. The fruit exposed to 50 °C for 30 min may have been irreversibly injured, resulting in an abnormal ripening pattern. Exposure to hot water at 43 °C or 46 °C for 30 min might be an ideal pre-storage treatment for firmness retention despite minor surface injuries. 'Last Tango' fruit dipped in solutions of 100 to 1000 µg/L 1-MCP retained greater flesh firmness than the control. A 1-min dip in 1-MCP solution was sufficient to inhibit ripening since flesh firmness did not differ among treatment durations. The results from these preliminary experiments indicate that pre-storage conditioning using directed heat stress combined with 1-MCP may be an effective approach for improving the postharvest life of NMF peaches.

Education Section

Challenges, Stratagems, and Gratification of Teaching a Study Abroad Course in Horticulture to Non-major Students

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Teaching horticulture to non-major students can be a challenging task when learning is confined to the classroom, but it can become a much easier undertaking in a study abroad setting where students can observe, touch, and taste many of the horticultural products discussed in class. In Summer 2008, a study abroad course (International Horticulture) was taught to a group of 24 Texas A&M University students, out of whom only one was horticulture major and a total of six were from the College of Agriculture and Life Sciences. The course was based at the Santa Chiara Study Center located in central Italy and included many excursions to destinations such as Florence, Rome, Venice, Perugia, and Herculaneum. Despite the fact that most students had little or no previous exposure to plant science, all students greatly enjoyed taking the course and all received excellent final grades. One of the secrets in making the course successful was to link the topics taught in class to the horticultural elements to which the students were exposed during the daily routine and the many field visits: the food, the drinks, the art masterpieces, the historical gardens, the archeological sites, etc. Many more or less familiar fruits and vegetables, such as artichokes, olive trees, fig trees, and caper plants were shown to the students during the numerous walking tours. A visit to a local organic winery enlightened the students about the complex and fascinating processes of wine and oil processing and how to do proper tasting. Visits to museums showed the students how plants were a source of inspiration for many of the Renaissance masters, from Giotto to Botticelli, who included in their paintings many flowers and plants still recognizable today. Overall, teaching in this unconventional setting

proved to be very effective in stimulating the students' interest toward horticulture and plant science in general.

Study Abroad in the College of Agricultural and Life Sciences: What Do the Students Say?

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Study abroad participation by college students has increased 4-fold since the 1980s. However, students in agriculture and related sciences account for only 1% to 2% of the approximately 250,000 students who study abroad annually in the USA. A survey was conducted during the Fall 2007 semester to assess student attitudes and motivation concerning study abroad in the College of Agricultural and Life Sciences at the University of Florida. Five large-enrollment classes, representing a range of disciplines in the college, were selected for participation in the survey yielding about 600 responses (about 15% of the undergraduate student body). Overall, students were very positive about study abroad as a component of their education and responses agreed with national trends. Large majorities indicated that programs less than 10 weeks in duration and under \$3000 were most attractive. The most attractive destinations were western Europe, the Caribbean, and Australia/New Zealand, and only the Middle East was considered unattractive. Over 80% of students indicated that they would prefer to visit more than one place while abroad, and would rather engage in hands-on activities than classroom instruction at a foreign university. Significant barriers to studying abroad were 1) program cost and 2) problems with courses taken abroad counting toward degree requirements. The results explained why short-term (<6 weeks), low cost, low credit-hour programs that include multiple destinations tend to be favored by students in the College of Agricultural and Life Sciences.

Transfer Planning Guides to Facilitate Articulation between Junior-college and Baccalaureate-level Horticulture Programs

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Recruitment resources need to be effectively targeted. In Fall 2008, transfers accounted for 36% of all new students within the College of Agricultural Sciences and Natural Resources (CASNR) at Oklahoma State University (OSU). Campus-wide, 7 of the top 10 in-state feeder institutions for new transfers in Fall 2008 were junior colleges. We first developed transfer guides in 1993 to show how courses from three Oklahoma junior college A.A.S. Horticulture programs could substitute in our OSU B.S. Horticulture programs. The guides have been updated yearly and have evolved over time. The guides directly contributed to development of A.S. Horticulture programs (designed for transfer) at some Oklahoma junior colleges. In Fall 2008, a CASNR-wide committee was formed to create a standard transfer planning guide template, and our guides served as a key model. The new one-page guides show side-by-side comparisons of junior college curricula and OSU course requirements met by these junior college courses, as well as a listing of courses remaining to be taken at OSU after completion of the Associate's degree. The guides are valuable communication tools, both for recruitment and to facilitate conversations among administrators and between students and advisors.

General Education and General Interest Courses as Recruiting Tools for the Horticulture Undergraduate Programs

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General Education courses in the sciences are offered to non-science majors with the goal of teaching entry level physical and biological sciences to undergraduates. At the University of Florida, non-science students need 9 credits of General Education science courses. General interest courses are also offered to non-majors but they are usually 1-credit introductory courses and do not satisfy the General Education requirement. The Horticultural Sciences undergraduate program at the University of Florida offers both a General Education and a general interest course for non-majors. VEC2100—World

Herbs and Vegetables—is a 3-credit General Education science course offered fall and summer semesters; FRC1010 is a 1-credit general interest course offered in spring. Both these courses have experienced rapid enrollment increases, with enrollment in the most current semesters reaching 79 students in VEC2100 and 439 students in FRC1010. Most students in these courses are non-majors and, based on student feedback, both courses are well liked. VEC2100 includes active learning strategies such as in-class and outside the classroom activities, mini-field trips, show and tell in the lectures and the use of popular books and multimedia sources. FRC1010 utilizes a series of guest speakers and for each lecture, students are given samples of the fruits that are being discussed. Student records of 47 current majors show that six of them attended VEC2100 (13%) and eight FRC1010 (17%) prior to their decision to major in Horticultural Sciences, suggesting a possible role these courses may play in attracting students to our major.

Turning Over a New Leaf: Creative Tools for Student Engagement and Recruitment in a Large-size Introductory Horticulture Class

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One problem facing many land-grant university horticulture programs is declining enrollment. At the University of Georgia, an introductory horticulture course helps increase student contact hours and is a tool for recruiting. The course is a freshman-sophomore level course offering three semester credit hours with no lab. To compensate for the lack of a true laboratory experience, students are required to participate in several out-of-class experiences including: field trips to farmer's markets, attendance at green industry trade shows, caring for an "unknown" houseplant, working alongside a local horticulturist for 4 hours, and interviewing a professional horticulturist. Originally begun as a small single class of 40 students, the class now has two sections of more than 300 students each. Since most of the students are not horticulture majors, or even from the College of Agricultural and Environmental Sciences, it is important to understand the contributing factors to increased enrollment. A recent survey of 590 students supports previous anecdotal evidence regarding student criteria for selecting an elective course. Results show time is a critical factor, with a strong preference for the midday course times. Results also indicate that, though they do not want the course to be too difficult, students appreciate a professor who challenges them and a course that teaches them valuable information. Location of the classroom on a large campus such as the University of Georgia is also an important consideration. Results show students listen to their friends more than other sources when it comes to selecting an elective and that they frequently make their decision after the term has officially begun, during the initial period to make schedule adjustments. The success of this course can be measured not only in overall contact hours, but in the 15% of graduating seniors who indicate this course was a major factor in their decision to select horticulture as a major.

A Preliminary Analysis of a Novel Horticulture Bachelor of Arts Degree Program

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Curricula in many horticulture departments have evolved from ones requiring depth in the fundamental sciences (physiology, genetics, organic chemistry, etc.) to include programs supporting a broader training including business, floral and landscape design, and people-plant relations. This evolution has been driven by the explosive growth in job opportunities in the service sectors of horticulture and the demand for graduates created by the "green" sector of horticultural business. Faculties are presented with a dilemma concerning how "broad" a curriculum can be defined to meet the needs of the students interested in non-science, non-production careers while still being considered a Bachelor of Science degree. Our faculty chose to define a new degree, the Bachelor of Arts in Horticulture, rather than to expand the definition and expectations of the Bachelor of Science

degree by removing the depth in science courses that would be necessary for our students. Our department received permission from the Texas Higher Education Coordinating Board to offer a Bachelor of Arts in Horticulture degree in 2006. The BA differs from the BS in that it requires the student to have a minor, requires more foreign language credit, and offers a different palette of horticultural specialization courses. Nearly half of our majors (47%) currently are enrolled in the BA, and students transferring within the university into our BA program increased between 2006 and 2008. More students transfer from general studies, architecture, and liberal arts into the BA program than into the BS. We believe the opportunity to obtain a Bachelor of Arts degree will be a compelling recruiting tool for our program, but more importantly the curricula that define it represent our best assessment of how to prepare students for careers in the expanding green and people-oriented industries of horticulture.

Impact of a Non-thesis Distance Graduate Program on Horticulture Enrollment: A Three-year Study

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During the past three years, the M.S. in horticulture non-thesis degree program at Texas Tech University has undergone sustained growth. As a direct result, the number of MS programs has grown as well as the number of courses that support these programs. In addition, graduate certificates have been incorporated in the distance education offerings. This investment of time and effort has more than doubled the number of distance students enrolling in the Department. Specifically, the number of MS non-thesis students comprises just fewer than 50% of the graduate enrollment. This sustained growth has required the addition of support staff, redistribution of advising responsibilities and the expectation that most faculty members in the participating programs will participate in at least one distance course.

Extension Section

Solving the Puzzle: Dealing With A New Pest

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In Aug. 2007, the University of Florida/IFAS Miami-Dade County Extension office began receiving numerous phone calls about heavy leaf loss in weeping fig (*Ficus benjamina*) hedges and plant death, which was a new problem. The cause was identified as the fig whitefly *Singhiella simplex* (Singh) in Oct. 2007. This was a first report of this insect in the western hemisphere. By Nov. 2007, a management protocol was developed, which included the use of a soil drench with a neonicotinoid insecticide to help preserve natural enemies. An educational outreach campaign was started including holding several industry oriented workshops, town hall meetings, developing fact sheets, and conducting a "media blitz" to raise awareness on how to manage this serious new pest. We estimated media contacts at over 300 million from print, television, and radio. The web-based fig whitefly fact sheet was the most viewed publication on the Miami-Dade County Extension website with well over 10,000 page views. As the result of many questions about application techniques from industry professionals, reports of misapplications and concerns about environmental impacts, the Miami-Dade County Extension horticultural staff decided that the best way to educate all possible clients was through a bilingual video demonstration of proper application techniques. The video was produced in-house and it includes information for both homeowners and professionals on the methods that should be used to apply a soil drench. It has been cut into segments and adapted for downloading via either a dial-up or a DSL connection and is posted on the Miami-Dade County Extension website. It has also been used in several workshops, including some by Miami-Dade Public Works Department.

Responding to Growers' Needs for Worker Protection Standards Training

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Fruit, vegetable, greenhouse and nursery crop growers are required to comply with the federal Worker Protection Standard (WPS), which is administered by the US Environmental Protection Agency (EPA), and in some cases, by state regulatory programs that have received delegated authority from the EPA. Basic requirements include: (a) protecting agricultural workers and pesticide handlers, (b) providing information, and (c) mitigation. In 2004, the Florida Department of Agriculture and Consumer Services (FDACS) adopted, by rule, the EPA's WPS regulations. Since that time, the number of inspections in Florida has risen dramatically. In 2007, Florida accounted for over 20% of all WPS inspections nationwide, 23% of warnings and 48% of fines. According to FDACS, the primary areas of violation within Florida are central location posting (38% of violations) and safety training (36%). In 2008, the Miami-Dade County Extension was asked to provide WPS safety training, by a local grower who believed that FDACS inspectors had higher levels of confidence in extension sponsored training than training provided by growers. A training DVD was developed starting with the EPA-approved WPS Handler video. Questions from *Protect Yourself from Pesticides – Guide for Pesticide Handlers* (WPS Handler Training Manual) were incorporated into PowerPoint presentations since asking questions is a required component of training. Camtasia 6 was used to make the video-DVD conversion and to insert the PowerPoint presentations. Two-hour training sessions are conducted from 12 noon till 2 p.m. Trainees eat a provided lunch while watching the training DVD, as this maximizes training time efficiency. The DVD is stopped at the end of each chapter so the instructor can ask questions of the trainees. In 2008, there were 3 workshops in Spanish and 1 in English. A total of 82 people attended WPS Handler training, 75 in Spanish and 7 in English. All 82 received FDACS-approved WPS Handler training cards and the WPS Handler Training Manual in the appropriate language. The 23 employers received a certificate listing each trained employee and a copy of the sign-in sheet. Growers have expressed strong appreciation for this service since it saves them time and assures their employees have received quality training.

Web-based Student Evaluation of the Oklahoma Grape Management Short Course

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A short course program designed to prepare potential grape growers for advanced topics in viticulture has been taught by Oklahoma State University (OSU) Cooperative Extension since 2001. The OSU Grape Management Short Course (GMSC) is taught for 7 class periods, once per month for 4 hours leading to a total of 28 contact hours. In Dec. 2007, a post-course evaluation was sent to participants of the GMSC. Former students were contacted by email and asked to complete the evaluation in the internet-based tool SurveyMonkey via an embedded link. A total of 306 participants who attended the course from 2001 to 2007 were asked 10 questions pertaining to their course experience. The evaluation revealed the course was effective in satisfying the educational needs of students, with more than 80% highly recommending the course. Also revealed from this evaluation was a large, positive financial impact to grape producers within Oklahoma, estimated between \$120,032 and \$490,000. High recommendation levels indicate the course is meeting the needs of beginning grape growers; however, many growers are unaware of other OSU Cooperative Extension grape-related programmatic materials such as a website, newsletter, fact sheets, research publications, and workshops. Therefore, a more directed effort must be made to heighten the awareness of new and established grape

producers to the grape-related educational provided by OSU Cooperative Extension.

Helping New Growers Gear-up for Production of Fresh Produce

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Production of fruit, nuts, and vegetables in Oklahoma currently consists of crops for processing and fresh market. Fresh producers include smaller operations that may have less than 10 up to several hundred acres. During the past few years, demands for extension programs related to fresh production has grown with requests coming from the Oklahoma Department of Agriculture, Forestry and Conservation (ODAFC), SARE, county extension educators and from producers. New producers vary in age and background, have a keen interest in farming, but little or no experience in farming. Recent publications for new producers include Oklahoman's guide to growing fruits, nuts, and vegetables (E-995), IPM pocket guide for grapes, and IPM pocket guide for pecans. During 2007 and 2008 two field days were completed that introduced new and potential growers to soil preparation, plasticulture, tillage equipment, and food safety concepts. Coursework for new growers has been developed as an 8-week short-course titled Oklahoma Market Gardening School. This course is a cooperative effort between OSU, Noble Foundation and ODAFF and includes 14 different lectures ranging from site selection and business planning to food safety and marketing. The first course was completed in Fall 2008 in Oklahoma County with the second underway in Tulsa County during Spring 2009. The course includes 14 PowerPoint lectures developed by the 11 original presenters and printed curriculum consisting of E-995 and a course syllabus comprised of PowerPoint notes, extension fact sheets, and additional lecture notes and publications. The concept of the course was to develop a "packaged" short-course that could be taught easily by subject matter specialists and county extension educators. Currently, plans are being made to make the course available to different areas of the state through involvement of multiple county extension educators.

Finding the Forest in the Trees: Using GPS Technology to Train Master Gardeners for Urban Tree Inventories

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Geographic information systems (GIS) and global positioning systems (GPS) technologies have become increasingly available in terms of price and ease of use. Current technology permits easy data entry using hand-held computers with embedded GPS. To increase the participation of small communities in a statewide effort to conduct tree surveys, an educational effort provided training to Master Gardeners and other community volunteers in the use of GPS for tree inventories. After several small trials, a grant from the Georgia Forestry Commission provided funding to pilot a more complete program in four counties. An easy-to-use data entry form using tree inventory categories from the Urban Forest Effects (UFORE) Model and tree condition ratings from the Council of Tree and Landscape Appraisers was developed. Using this form, and any PDA or GPS unit equipped with Windows Mobile software, Master Gardeners are able to conduct accurate tree surveys. Handouts and online PowerPoint presentations supplement training workshops. The tree surveys conducted by the Master Gardeners provide valuable information to planners and city officials and serve as an integral component of a community forestry education and management program.

Landscape Technician Certification for Prison Inmates in Florida

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Prison inmates are frequently an underserved extension audience. Inmate populations are often easier to quantify behavior change in because of the intensive monitoring by the state department of

corrections. In Florida, vocational training has been shown to decrease recidivism by 14.6%. This offers \$3.2 million in cost savings to the state, or about \$2000 per inmate trained. A training program is being developed by UF/IFAS Extension that will lead to the certification of state inmates as Florida Certified Landscape Technicians. This certification is one of five offered by the Florida Nursery Growers and Landscape Association. Inmates will be trained on 12 topics including: Plant ID, Plan Layout, Tree Planting, Tree Staking & Guying, Palm Banding & Propping, Grading & Drainage, Instrument Use, Irrigation Operation & Repair, Pruning, Job Evaluation, Equipment Operation, and Retaining Wall Construction. Training modules and curricula are being developed with feedback from the initial training class of female inmates.

Volunteer Management in Extension: Necessary Evil or Blessing in Disguise?

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Cooperative Extension relies on volunteers to assist in the education and outreach efforts of faculty and staff. Benefits of a volunteer program include cost-effective delivery of services, access to additional expertise, and better contact with the community. Volunteers, especially those in an educational setting dealing with an adult population, must have ongoing motivation and situated support based on their needs and the needs of their audiences (Belzer, 2006; Moskal and Blachowicz, 2006). Formal training and management is necessary to adequately prepare them for their roles. Attrition and lack of participation of volunteers is common, no matter how successfully managed the program, but mentoring programs may significantly counteract this trend. The average attrition rate between 2000 and 2005 for Master Gardener volunteers in Florida counties with active programs was 27%. An evaluation of five Florida counties that implemented a Master Gardener mentoring program during that same time period indicated an average attrition of only 7% (D'Abreau, 2007). In the southeastern United States in 2007, Master Gardeners donated more than 1.7 million hours of volunteer service – an equivalent of 600 full-time employees and \$31.2 million dollars. It is important to address the significance of volunteers as a resource, not only for Extension clients, but also for staff and faculty. As funding opportunities shrink and positions are eliminated, the need to better manage and utilize volunteers is critical.

An IPM Scouting Program for Small Mixed Vegetable Farms: Providing Service to Amish and Mennonite Communities in KY *Timothy W. Coolong* and Lucas Hanks, N-318 Ag. Sciences North, Department of Horticulture, University of Kentucky, Lexington, KY 40546*

Amish and Old Order Mennonites constitute a significant portion of commercial vegetable production in Kentucky. Most Amish and Mennonite vegetable growers operate small (5-20 acres) diverse (5 or more crops) farms. Previously, much of the produce grown on these farms was sold through wholesale contracts. However, in recent years several Amish and Mennonite groups have created produce auctions as a market outlet for their product. Produce auctions generally offer farmers a better return than wholesale markets. Due to the diverse needs of buyers, the auctions generally offer smaller selections of a wide variety of products. The farms that supply these auctions are typically small and diverse, growing a large number of vegetables on a limited acreage. Produce auctions have become a profitable market outlet for their suppliers. To capitalize on this earning opportunity many individuals in the Amish and Old Order Mennonite communities who had not previously farmed are now turning to vegetable farming as a way to earn a living. Many of these farmers are not familiar with integrated pest management practices. To address this need a student intern was hired and trained to scout for pests. The scout made weekly visits to Amish and Mennonite farms in central Kentucky. Pheromone traps were used for common insect pests such as squash vine borer, european corn borer, corn earworm, and fall armyworm. Individual crops were also scouted for insect pests and diseases. The participating

farmers scouted alongside the student intern and were presented with a weekly report detailing the findings and any problems that were evident. This scouting program was very useful in demonstrating IPM principles to new vegetable farmers. In addition, it allowed for the training of a student who wanted to pursue a career in farming, and data was gathered on the seasonal populations of several important insect pests of vegetable production in Kentucky.

Floriculture, Ornamentals, and Turf Section

National EarthKind Rose Cultivar Trial in Louisiana: Blackspot Observations from 2007 and 2008

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A landscape evaluation of cultivars in the national EarthKind rose trial was planted at the LSU AgCenter's Burden Center in Baton Rouge, LA in Spring 2007. A total of 31 cultivars growing in 1-gal containers were planted in raised rows of native Olivier silt loam soil in a randomized complete-block design with four replications. The trial was located in full sun. Plants received irrigation to aid in initial establishment. Plants were fertilized with StaGreen Nursery Special 12-6-6 in late Winter 2007 but were not fertilized thereafter. The trial area was mulched with 3 inches of baled pine straw at planting and refreshed twice annually to the starting depth. No fungicide was applied to the plants during the evaluation period. Blackspot ratings using a scale from 1 to 6 (1 = 0% defoliation or foliage with blackspot; 6 = 75% to 100% defoliation or foliage with blackspot) were taken in Fall 2007, Summer 2008 and Fall 2008. Cultivars with resistance to blackspot were Blushing Knock Out, Pink Knock Out, Knock Out, Princess Verona and The Fairy. Cultivars showing slight susceptibility to blackspot in 2007 and 2008 were Amiga Mia, April Moon, Barn Dance, Belinda's Dream, Carefree Beauty, Chuckles, Earth Song, Folksinger, Polonaise, Prairie Breeze, Prairie Princess, Sea Foam, Seminole Wind, and Winter Sunset. Moderately susceptible cultivars were Carefree Wonder, Country Dancer, Dublin Bay, Flora Dora, Nearly Wild, Pearlie Mae, Penelope, Prairie Harvest, and Square Dancer. Highly susceptible cultivars were Quietness and Summer Wind. Insufficient data were obtained for Climbing New Dawn.

New Liriope Cultivar Evaluations in the Landscape

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A landscape evaluation of new *Liriope* and *Ophiopogon* cultivars was initiated at the LSU AgCenter's Hammond Research Station in Fall 2007. New *Liriope* cultivars and standard cultivars available in Louisiana being evaluated were Cleopatra, New Blue, Marc Anthony, Emerald Goddess, Super Blue, Odom's Big Blue, Evergreen Giant, Jeanerette, and Doug Young Nursery Big Blue. A new *Ophiopogon* included was Crystal Falls. One-gallon containers of these cultivars were planted in a randomized complete-block design with two replications of five plants each. Spacing was 18 inches between plant centers. Beds were located in full sun and were a Cahaba fine sandy loam soil amended with incorporations of fine pine bark. Plants were fertilized with StaGreen Nursery Special 12-6-6 at the recommended rate in early Spring and mid-Summer 2008. Twice monthly visual quality ratings were taken on plants Jan. through Dec. 2008. Height measurements were also taken. The best performing *Liriope* cultivar in 2008 trials was Super Blue. Cleopatra, New Blue, Marc Anthony, Emerald Goddess were above average performers. Odom's Big Blue, Doug Young Nursery Big Blue and Jeanerette did not perform as well as the other cultivars listed. Evergreen Giant had unacceptable performance due to root rot presence through most of the year. Crystal Falls *Ophiopogon* had good quality ratings in winter, spring, and fall

but quality ratings in the summer were low due to sun scorch damage to the foliage. Super Blue was the tallest cultivar.

Reproductive Biology of *Elliottia racemosa*, a Rare Coastal Plain Endemic

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Georgia plume (*Elliottia racemosa*) is a rare, woody species restricted to the coastal plain of Georgia. Seed set can be low or nonexistent and recent sexual recruitment has not been observed in the wild. The objective of this study was to evaluate the floral biology of Georgia plume to elucidate factors contributing to its lack of reproductive success. Stages of floral development were defined and characterized, and pollen viability assessed. Light and scanning electron microscopy were used to examine anther and stigma development at seven distinct stages of flower development ranging from small, immature buds to flowers with abscised petals. Pollen germination and tube growth were examined using aniline blue staining and in vitro pollen germination assays. Anther dehiscence and pollen release occurred within immature buds. Stigmatic receptivity was associated with the formation of a raised, dome-shaped central region on the stigma, and the development of cleft-like openings leading into the stylar canal. Pollen adherence and tube growth were observed only in the later stages of flower development, i.e., when flowers had petals that were abscising or completely abscised. Pollen capture and germination were restricted to the localized central region of the stigma where secreted exudates accumulated. Germination assays of pollen collected from several populations showed low pollen viability.

An Overview of the Significant Woody Ornamental Collections in the SFA Gardens

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The SFA Gardens are a 60-acre on-campus resource at Stephen F. Austin State University, Nacogdoches, TX. The 10-acre SFA Mast Arboretum was initiated in 1985. The 8-acre Ruby M. Mize Azalea Garden was initiated in 1999, and the 42-acre Pineywoods Native Plant Center was dedicated in Apr. 2000. This paper briefly outlines some of the significant woody ornamental collections. In Cupressaceae, the genus *Taxodium* is represented in the SFA Mast Arboretum by a wide range of varieties, genotypes, and hybrid selections, the latter from the breeding program of the Nanjing Botanical Garden. In Fagaceae, the collection includes a dozen species of Mexico genotypes, including *Quercus risophylla*, *Q. canbyi*, *Q. polymorpha*, and *Q. grisea*. In Magnoliaceae, the section *Michelia* is particularly well represented, including specimens of *M. maudiae*, *M. foveolata*, *M. platypetala*, *M. skinneriana*, *M. yunnanensis*, *M. wilsoni*, *M. martini*, *M. tsoi*, *M. maclurei*, *M. chapensis*, *M. compressa*, and *M. figo*. The Ruby M. Mize Azalea Garden includes over 7000 azaleas and 553 varieties representing 55 hybrid groups. In Aceraceae, the collections include over 200 varieties of *Acer palmatum* and *A. japonicum*, and includes several rare species, including three evergreen Chinese maples, *A. fabri*, *A. oblongum*, and *A. cinnamomifolium*. Hydrangeaceae includes over 250 taxa, *Buxus* with over 40, and *Cephalotaxus* over 30. The SFA Gardens are also home to a many rarely encountered woody ornamentals acquired through international expeditions and exchanges with specialty nurseries. The collections are AutoCAD™ mapped and a plant acquisition list is managed through an Excel spreadsheet.

Anti-cancer Activity of Phenolic Compounds in Several Medicinal Herbs

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Many herbs have been used medicinally for thousands of years. Recently, more and more research has supported the potential health benefits of herbs with plant extracts displaying antioxidant, anti-inflammatory, antibacterial, analgesic, and antitumor activities. Co-

lorectal cancer is the second leading cause of cancer death in North America. The objectives of this study were to evaluate the anti-cancer activities of five culinary/medicinal herbs: thyme (*Thymus vulgaris*), sage (*Salvia officinalis*), rosemary (*Rosmarinus officinalis*), peppermint (*Mentha piperita*), and spearmint (*Mentha spicata*). Bioactivities were compared, and potential interactive/synergistic effects of different herb combinations were studied. Herbal leaf tissues were homogenized in liquid nitrogen, and phenolic compounds were extracted in 80% methanol. Different concentrations of extracts were applied to SW-480 colon cancer cells. Results showed that all of these five extracts caused significant inhibition to cancer cell growth in a dose-dependent pattern. Sage extract exhibited the strongest anti-cancer activities among the five species, and thyme extract showed the lowest. Total polyphenol content alone did not explain the different bioactivities among different species. Combinations of peppermint and sage extract showed significantly higher inhibition than combinations of rosemary and sage, indicating the existence of interactive effects.

Urban Landscape Restoration In Post-Katrina New Orleans

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On 29 Aug. 2005 Hurricane Katrina devastated New Orleans neighborhoods with fresh, brackish, and salt water from rainfall, levee breaks, and surge from the Gulf of Mexico. Prior to the storm, plant inventories were documented in several sections of New Orleans. The objective of this experiment was to document the survival of landscape species subjected to natural and simulated soil saturation and flooding. Bermudagrass tolerated both fresh and saltwater, becoming the dominant grass species in New Orleans. Prior to Katrina, St. Augustinegrass was the dominant grass species. Live oak trees survived salt and fresh water inundation. Southern magnolia trees did not survive inundation. The majority of flooded magnolia trees resulted in immediate or delayed tree mortality. Major wind damage occurred to bald cypress and water oaks. Root and bulb crops survived flooding, with growth occurring the next spring. Windmill and date palms survived the floodwaters. Groundcover species were affected by floodwater; however liriop and monkeygrass performed the best after 4 weeks of inundation. The results of this experiment indicated that survival was dependent on salinity, flooding duration, and plant species.

Evaluation of Seven *Stewartia* L. Species for use in Southern Landscapes

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Seven *Stewartia* L. species, including *S. gemmata*, *S. malocodendron*, *S. monadelpha*, *S. pseudocamellia*, *S. rostrata*, *S. serrata* and *S. sinensis*, were evaluated in a completely randomized design in each of three studies for nursery production and landscape establishment in southern growing conditions. Two field studies, one in Starville, MS (USDA Zone 7b, Oktibbeha soil) and the second in Crystal Springs, MS (USDA Zone 8a, Providence silt loam) were evaluated in 2007 and 2008 to determine growth and establishment of *Stewartia* species. An additional container study was conducted in Starkville, MS to simulate the growth of the seven *Stewartia* species in a container nursery. Twenty-two 1-year bareroot seedlings of each *Stewartia* species were planted in one gallon containers under full sun exposure with drip irrigation in late Feb. 2007. Data were collected on survival, plant growth, plant health and flowering at three intervals per year. In the Starkville field trial, only *S. pseudocamellia* had greater than 59% survival in 2007 and in 2008 only 32% of *S. pseudocamellia* remained alive and actively growing. All other species had poor establishment. At the Crystal Springs site in 2007, *S. malocodendron*, *S. pseudocamellia*, *S. serrata* and *S. sinensis* had greater than 59% survival with both *S. malocodendron* and *S. pseudocamellia* exceeding 82%. In 2008 at Crystal Springs, all of the *S. pseudocamellia* survived with increased height up to 75%, whereas 59% of *S. malocodendron* and *S. serrata*

survived with greater than 76% height growth. In the container study, all species except *S. monadelpha* had greater than 50% survival in 2007. After the plants were over-wintered in the cold-frame, *S. malocodendron* and *S. pseudocamellia* both had greater than 75% survival and positive growth percentages the following year. *Stewartia pseudocamellia* was the only species to flower in our trials during the 2-year evaluation. Our studies indicate that *S. pseudocamellia* followed by *S. malocodendron* is the most tolerant plants in the *Stewartia* trial in Mississippi. Future research will evaluate the species under shaded conditions.

Fruit Section

Row Covers Do Not Increase Yield or Advance Season of Ripening of Primocane Fruiting Blackberry Genotypes in the North Carolina Mountains

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Primocane fruiting blackberries grown in high elevation sites in western North Carolina have the potential to extend blackberry harvest season on the east coast from late August until early November. However, primocane fruiting blackberries do not come into production until September and fruit is damaged in early October by fall frost/freezing events. These two events combined diminish the full potential of the primocane fruiting blackberry crop. To determine if we could advance harvest dates, and therefore bridge the gap between summer and fall crop and also harvest the crop before they were damaged, we applied rowcovers to plots in the spring at the Upper Mountain Research Station in Laurel Springs, NC (elevation 2800 ft). Rowcovers (1.5 oz/yd³) were applied to split plots nine primocane fruiting blackberry genotypes, including 3 from the University of Arkansas and 6 from North Carolina State University. Rowcovers remained on the plots for 8 weeks in 2007 and 6 weeks in 2008. Plants were tipped in each plot when the majority of the canes in each plot reached 3.5 ft. Harvest commenced on 13 Sept. in 2007 and on 28 Aug. in 2008. Rowcover treatments did not have a significant effect on either total or marketable yield in either year. Total and marketable yields were significantly different only among the genotypes and years. Rowcovers advanced the date of harvest slightly in 2007 or 2008, but not both years for the genotypes we tested. Based on these studies, we determined that rowcovers are not a viable option for advancing harvest season of primocane fruiting blackberries.

Blackberry Cultivar Performance in Central Alabama, 2008

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Named blackberry cultivars and selections were planted in central Alabama in 2006 to evaluate plant performance and fruit yields. Named cultivars included 'Kiowa', 'Chickasaw', 'Navaho', 'Ouachita', 'Natchez' (A2241T, 2007 release), and 'Prime-Jan'®. A total of seven selections, three primocane fruiting genotypes and four thornless floricanes fruiting genotypes; APF-27, APF-41, APF-46 and A1937T, A2195T, A2215T, and A2315T respectively, were also included. The production systems utilized were two-wire vertical trellis (TPUPS, Trellis Production Using Primocane Suppression, Dr. Arlie Powell, unpublished) and supported hedge. Plants were harvested every 3 to 4 days beginning 27 May and continued until 22 Oct. for primocane fruiting types. Highest marketable yields per plant were produced by 'Kiowa', 'Chickasaw', and 'Natchez' under both production systems. Primocane fruit production was highest for selection APF-46 for both systems. Individual fruit weight ranged from approximately 4.2 to 9.5 grams per berry with 'Kiowa', 'Chickasaw', and APF-41 having the largest fruit. Smallest fruit was produced on A1937T. Incidence of white drupelets on two-wire trellis and supported hedge ranged from 3.0% to 9.0%, and 1.0% to 13%, respectively, within genotypes with 'Prime-Jan'® having the highest percent and APF-27 the lowest percent

fruit affected in both systems. 'Natchez' was numerically lower but, not significantly different than 'Prime-Jan'® under either system in regard to white drupelets. The newest release, 'Natchez' performed as well or better than 'Navaho' and 'Ouachita', the other named thornless releases in this evaluation.

Blueberry Fruit Quality and Antioxidant Capacity as Affected by Fruit Ripeness

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Rabbiteye blueberry fruit are sometimes commercially harvested at onset of ripening as determined visually in order to concentrate harvest, minimize picking times, and increase storage life. These fruit may not be fully ripe at picking, thus fruit quality and antioxidants levels may not have completely developed. This study was initiated to determine how fruit quality and antioxidant factors in rabbiteye blueberries develop at various stages of ripeness (as determined visually and by firmness measurements). Three rabbiteye blueberry varieties were harvested at barely ripe, ripe and overripe stages. All varieties exhibited significantly lower soluble solids content and higher titratable acidity at the barely ripe stage compared to fruit at the other stages of ripeness. The ratio of soluble solids to titratable acidity increased linearly in all varieties as stages of ripeness increased. No differences were evident between ripe and overripe fruit maturity levels. Fruit phenolic levels did not differ between stages of fruit ripeness. The anthocyanin content was significantly less in barely ripe fruit compared to the other ripeness stages. Relationships between fruit maturity and antioxidant levels in rabbiteye blueberries are discussed.

Status of the Developing Blueberry Industry in South China in 2008

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This paper reflects on blueberry research efforts and development of new plantings in the four main blueberry growing regions of China. In northeastern China, blueberries are hindered primarily by suitable soils, water quality issues, and very low temperatures and dry soil conditions during the winter. Professor Li Yadong is the research scientist at Jilin Agricultural University and has a long history in blueberry field developments in Jilin and Liaoning provinces. Shandong province is further south and rests as a peninsula that juts out of the southern side of the Bohai Sea, a geography that buffers mid winter temperature extremes. While there are successful blueberry plantings in this region, many fields observed are under stress. Soil pH, water quality and alkalinity issues are concerns. Further south, Professors He Shanan and Yu Hong of the Nanjing Botanical Garden have been strong blueberry advocates and leading researchers in the region, with projects in Jiangsu, Zhejiang, Hubei, Anhui, and Jiangxi Provinces. Most work is with rabbiteye and southern high bush varieties. In the far southwest, the fourth region is mainly comprised of Sichuan, Quizhou and Yunnan provinces. In some locations, sandy soils and predictable summer rains have led to excellent plant growth. At lower latitudes and tropical conditions, many plants exhibit chilling requirement problems with sporadic and often out-of-season bloom. In some studies, bushes have been made to flower in late summer by hand defoliation which resulted in fruit in October and November. Total area under production in China is estimated at 1300 ha and 400 metric tons harvested in 2007. As in previous years, the number of nursery plants remains astounding. New plantings, coupled with the existing acreage of young plants, suggest that production will skyrocket in the next decade.

Effect of Aminoethoxyvinylglycine on Fruit Size and Quality of 'Loring' Peaches

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The effect of various aminoethoxyvinylglycine (AVG) rates and timings of application was studied over a 2-year period in experimental

peach orchard at the Chilton Research and Extension Center located in Central Alabama. Three rates of AVG (0, 100, and 200 mg·L⁻¹ AVG) were applied at 14 days before the anticipated first harvest date (14 DBH) and at 7 days before harvest (7 DBH) to mature 'Loring' peach trees. Each experimental tree was harvested according to the commercial standard maturation criteria based on background color and fruit size and fruit were graded into five size categories. Treatment effect on fruit maturity, delay in harvest, fruit size, fruit size distribution, total yield, and fruit quality characteristics at harvest as well as at 10 days following cold storage were evaluated. The results of our study suggest no difference in 'Loring' fruit maturation caused by AVG rate or timing of application. AVG rate of 100 mg·L⁻¹ resulted in firmer fruit 10 days following cold storage in the first year of our study. Treatment rate or timing of AVG application did not provide additional increase in fruit size or total yield of 'Loring' peaches. No differences in fruit size distribution and soluble solids content were detected following AVG application. However, AVG treatment resulted in an improved fruit color characteristics such as brightness and chromaticity, especially following 'Loring' fruit cold storage. Further research is needed to determine the effect of AVG on a variety of peach cultivars grown in Alabama.

Learning from Model Species: A Case Study of Comparative Genomics in *Arabidopsis*, *Populus*, Peach, and Apricot

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Comparative genomics explores the similarities and divergence between genome structures of different species. Comparative genomics facilitates the process of gene discovery and annotation, helps in the process of inference of function and provides important data on evolution of genes and genomes. We performed gene arrangement comparisons and phylogenetic analysis to study the recently mapped and sequenced in wild-type peach [*Prunus persica* (L.) Batsch] EVERGROWING (EVG) locus. The *evergrowing* mutant of peach has a deletion in the EVG locus and fails to cease growth and enter dormancy under dormancy-inducing conditions. Six dormancy associated MADS-box (DAM) genes have been found in this locus and proposed as candidates for the regulation of growth cessation and terminal bud formation in peach in response to dormancy-inducing conditions. To study the duplication history of the DAM genes, we identified two BACs corresponding to the EVG locus in apricot (*P. armeniaca* L.), and sequenced a region that contains five predicted DAM genes in apricot. We compared the peach EVG locus by global and local pair-wise alignment with the apricot sequence, and the *Arabidopsis* [*Arabidopsis thaliana* (L.) Heynh.] and poplar (*Populus trichocarpa* Torr. & A. Gray) sequenced genomes. There was a strong similarity between peach and apricot genomic sequence with a conserved order and orientation of orthologous genes facilitating the annotation process of the apricot EVG locus. Greater conserved synteny between the peach EVG locus and the poplar loci was found, than between peach and *Arabidopsis*. The peach EVG locus had sequence similarity regions to five poplar loci, with the presence of several inversions, reflecting a different duplication history. DAM gene phylogeny and locus distribution in the respective genomes indicates that duplication of the DAM genes occurred after *Prunus* and poplar divergence. Our data suggest that poplar genome sequence should be preferentially used for predicting gene presence and order in *Prunus* than *Arabidopsis*.

Mississippi Muscadines: Performance and Characteristics

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Studies were conducted at the Mississippi State University Agricultural and Forestry Experiment Station (MAFES) McNeil Unit in southern Mississippi to evaluate the performance of selected bronze and black-skinned fresh-market muscadine grape cultivars and at the USDA-ARS Thad Cochran Southern Horticulture Laboratory to

evaluate their fruit quality and storage properties. Plants were established in replicated plantings in 1992 and 1994 on a Ruston silt loam utilizing a "Geneva" double curtain trellis, and maintained with recommended fertilizers and drip irrigation without the use of fungicides. Bronze skinned cultivars included Darlene, Fry, Summit, Sweet Jenny, Tara, and Triumph; and black skinned cultivars included Black Beauty, Eudora, Ison, Jumbo, and Pollyanna. Observations on field performance were made in 2001, 2002, and 2006 and included vigor, resistance to leaf diseases and fruit rots, yield, cluster size, berry weight, percent dry picking scars, and laboratory evaluations of quality factors including firmness, pH, and soluble solids content. Observations on storage quality of these same cultivars were made in 2007 and included percent shrinkage, percent shriveled berries, firmness, soluble solids content, pH, and titratable acidity, at intervals from 14 to 30 days on samples held in storage at 1 °C. Results demonstrated differences among cultivars for the field performance parameters studied. Fruit quality diminished over time for all cultivars with those having the lowest percentage of dry stem scars showing the most rapid deterioration. Results demonstrated that current cultivars are not well suited for storage when berries are harvested individually and future storage studies should include evaluations of cluster harvested fruit.

Comparison of Field-grown Grapevine Stomatal Conductance Measurements Using Differing Porometers

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Measurement of leaf stomatal conductance (Gs) is critical for numerous aspects of viticulture research. When taking Gs measurements, a balance must be made between the number of measurements taken and the amount of time between measurements. Therefore, researchers desire to make the greatest number of Gs measurements in the shortest time period. To achieve this goal, it is often desirable to use more than one porometer. Concerns have arisen when comparing Gs measurements taken with porometers manufactured by different companies. The LI-1600 Steady State Porometer has long been used by plant physiologists when measuring Gs. Recently, Decagon introduced the SC-1 Leaf Porometer and it is thought to be a reliable alternative to the LI-1600. The objective of this research was to compare Gs collected from field-grown grapevines collected with these two porometers. Research took place at the Texas AgriLife Research and Extension Center experimental vineyard in Lubbock, TX. In early Summer 2008 Gs of *Vitis vinifera* cv. Chardonnay vines planted in 2006 were measured on six occasions. Mid-day Gs was measured simultaneously on each leaf with each porometer. Conductance measurements were made near the terminal tip of the leaf. Four leaves from three plants within four blocks were measured each day (96 daily measurements). Daily and overall mean conductance data were exposed to analysis of variance appropriate for a randomized complete-block design. If significant differences were found means were separated by Fisher's least significance difference procedure ($P \leq 0.05$). Daily and overall mean Gs data indicate porometer differences. Mean daily Gs measurements ranged from a high near 300 mmol·m⁻²·s⁻¹ (LI-1600) to a low of approximately 36 mmol·m⁻²·s⁻¹ (SC-1). On days data were collected there were no occasions in which Gs measured with the SC-1 was similar to Gs measured with the LI-1600. Conductance measured with the SC-1 ranged from one-third to two-thirds less when compared to Gs measured with the LI-1600. However, Gs measurements between porometers followed similar daily trends. Results suggest further research should be taken to investigate if Gs taken with the LI-1600 and the SC-1 are compatible.

Crop Load Affects Crown Gall Expression in 'Cabernet Sauvignon' after the 2007 Spring Freeze

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The 7 Apr. 2007 freeze event caused significant damage to grapevines throughout the mid-central United States, including

Oklahoma. Vine damage, vine death, and manifestation of crown gall were common consequences of the event. Victory Vineyards in Quinton, Okla. was the site of an experiment to determine if crop removal in 2nd leaf vines affected yield and growth of vines in the 3rd leaf and beyond on 'Cabernet Sauvignon' vines. Four treatments were implemented, flower removal before bloom (T1), early cluster removal (T2), cluster removal at veraison (T3), and no removal (T5). The 2007 freeze altered the experiment because of the damage to vines; however, crown gall expression was found to be related to the number of clusters on the vine after the freeze event. Vines with no crown gall expression averaged 6.4 clusters per vine, which was significantly different from vines with crown gall that averaged 11.0 clusters per vine. Treatments appeared to have little effect on the manifestation of crown gall the following year, but T1 had the most gall-free vines. These results suggest crop removal on vines in 2nd leaf may be beneficial to overall vine health and that crop removal after a significant freeze event may be warranted to reduce manifestation of crown gall symptoms in young vines.

Postharvest Section

Use of Enose to Determine Mango Maturity

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Three cultivars of Mango (*Mangifera indica* L.), ('Cogshall', 'Kent' and 'Keitt') were harvested at different maturities (61–115 days past flowering for 'Cogshall') and at different sizes (364–1563 and 276–894 average gram fresh weight for 'Keitt' and 'Kent', respectively) in Renion Island ('Cogshall') and Florida ('Kent' and 'Keitt'). Immediately after harvest or after one week of ripening at room temperature, fruit were homogenized or left intact and evaluated by gas chromatography (GC) or electronic nose (e-nose) for aroma and for solids and acids. Multivariate statistics was used to analyze volatile data from the different harvest maturities and ripening stages (Discriminant Factor Analysis). Both the e-nose and GC were able, in most cases, to separate fruit from different harvest maturities, especially for 'Cogshall' mangoes, at both the green and ripe stages as well as discriminate green from ripe fruit and fruit from the different varieties. Later-harvested fruit had lower acids, higher solids and generally higher levels of total volatiles. Mango fruit volatiles may be useful as maturity markers to determine optimal harvest maturity for mango fruit that results in full quality upon ripening.

Quality of Four Basil Types after Storage at 3 to 10 °C

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Sweet basil (*Ocimum basilicum*) has global culinary use as a fresh herb. Basil can also be dried and extracted for its essential oils and grows extremely well in the warm climate of Oklahoma. Several cultivars of sweet basil are known to be chill sensitive when stored below 7 °C. In this study, four cultivars/types were grown organically at Lane, OK, in 2008, harvested at bloom stage, and held at 3, 5, or 10 °C for 7 days in vented plastic bags. 'Mrs. Burns Lemon' and 'Ethiopian' were most sensitive to low temperature storage, although all types showed chilling injury (leaf browning, flower discoloration, and chlorophyll loss) at 3 °C. 'Nufar' had much less chill injury than 'Genovese'. All varieties except 'Nufar' had high leaf abscission at 10 °C (7% to 15%), probably because relative humidity was low, ranging from 70 to 85%. Off odors were detected in basil held at 3 °C or at 10 °C. Holding basil below 7 °C for less than 4 days may help preserve quality if availability of dryer space is limited.

Quality of Organically Grown Cherry Tomatoes for the Oklahoma Farm to School Program

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Cherry and grape tomatoes offer local growers the opportunity to take advantage of the state farm-to-school program. In this program, locally grown fresh produce can be marketed through local sales or through food distributors for use in school and colleges. We determined that the ideal size of small tomatoes was 10 to 30 g. We selected two cherry fruited tomato cultivars, 'Baxters Early Bush' and 'Washington Cherry', that produced well in a conventional production system, for testing in an organic system at Lane, OK. Fruit were harvested fully ripe from plants, and stored at 5 °C for 1 week, followed by 2 days at 20 °C. 'Washington Cherry' fruit had significantly more decay (48 vs. 12%) and weight loss (3% vs. 7%) than 'Baxters Early Bush'. Part of the decay was from early blight, which was not visible on fruit at harvest, but was prevalent on foliage, especially on 'Washington Cherry.' The lycopene content increased about 20% for both cultivars after storage, (80 to 100 mg/kg). Our results indicate that careful selection of disease tolerant cherry tomato cultivars is important to preserve fruit quality following harvest.

Effects of Foliar Potassium Fertilization on Muskmelon Fruit Quality and Yield

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Consumer preference of many fruits and vegetables such as muskmelon [*Cucumis melo* L. (Reticulatus Group)] is determined by a few key quality traits such as sugar content, aroma and texture. These quality traits are directly related to adequate potassium (K) content in plant tissues. However, soil-derived K alone is seldom adequate to satisfy these fruit quality processes. Controlled environment studies have shown that supplemental foliar K applications can mitigate this apparent deficiency. However, the suitability of potential K salts as foliar sources is still uncertain. We evaluated six foliar K sources (potassium chloride - KCl, potassium nitrate - KNO₃, monopotassium phosphate - Peak, potassium sulfate - K₂SO₄, potassium thiosulfate - KTS, and a glycine amino acid-complexed K- Potassium Metalosate, KM) for effects on fruit quality parameters of field-grown muskmelon (cv 'Cruiser') over two growing seasons, 2006 and 2007 in Weslaco, south Texas. Weekly foliar K applications were initiated at fruit set and continued to fruit maturity. Although soil K concentrations were very high, supplemental foliar K treatments resulted in higher K concentrations in plant tissues, suggesting that plant K uptake from the soil solution was not sufficient to saturate tissue K accumulation. In 2006, fruit yields were not affected by supplemental foliar K spray but in 2007, yields differed significantly among the foliar K sources with treated plots generally having higher yields than the control plots. Fruit from plots receiving supplemental foliar K had higher external and internal fruit tissue firmness than control fruit and this was associated with generally higher soluble solids concentrations (SSC) in both years. All the foliar K sources studied had positive effects on fruit quality parameters except for KNO₃ which tended to result in less firm fruit with lower SSC values. These results demonstrate that the apparent K deficiency caused by inadequate uptake can be alleviated by supplemental foliar K applications and that the effectiveness of foliar K fertilization will depend, not only on the source of fertilizer K, but also on environmental conditions affecting soil K availability and overall plant growth and development.

This material is based upon work supported in part by the Cooperative State Research, Education, and Extension Service, U.S.D.A. under Agreement No. 2006-34402-17121, "Designing Foods for Health" through the Vegetable & Fruit Improvement Center, Texas A&M University.

Response of the Ascorbate-glutathione Cycle and Lipoxigenase Pathway to Chilling and Heating Treatments in Tomatoes

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Ripe 'Sanibel' tomatoes were chilled (5 °C for 5 days), heated (hot water, 52 °C for 15 min, then cooled with tap water to 25 °C), or untreated. Fruit samples were taken after treatment or after 4 days storage at 20 °C. These consisted of pericarp from 2-4 fruit, pulverized in liquid N₂, and stored at -80 °C. For enzymatic activity analyses, samples were extracted using Tris buffer, and for substrate/product analyses, 6% TCA. For headspace volatile analysis, samples were homogenized with saturated CaCl₂ (2.5:1). Both treatments decreased cis-3-hexanal, trans-2-hexenal and other volatile aldehydes, as well as the related alcohol, cis-3-hexenol, important contributors to tomato aroma. Volatiles, however, recovered after 4 days storage. Lipoxigenase (LOX) activity increased due to heat treatment even after 4 days storage. The incompatible trends between the C-6 aldehyde concentrations and LOX activity indicate that the LOX isozyme measured included 9-LOX, rather than only 13-LOX, which leads to tomato aroma production. Activity of hydroperoxide lyase (HPL) was suppressed by both treatments and somewhat recovered after 4 days. The results indicate that the production of tomato aroma may be regulated by controlling HPL activity. Alcohol dehydrogenase (ADH) activity was suppressed immediately after both treatments, however recovered after 4 days storage. ADH activity increased in chilled compared to controls after 4 days storage. Despite strong LOX activity, indicating free radical production, the heat treatment did not increase H₂O₂ level, but did reduce ascorbic and dehydroascorbic acid levels. Possibly, heating induced the activities of peroxidase (POD), catalase (CAT), dehydroascorbate and glutathione reductase, which would quench free radicals. The activities of POD, ascorbate peroxidase (APX), monodehydroascorbate reductase (MDHAR) were lower in chilled fruit than in controls. This may explain why chilled fruit had high H₂O₂ levels after 4 days storage.

Evaluation of Fruit Quality Characteristics of 'Early Pride', a New Seedless Mandarin from the USDA-ARS

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Mandarins (*Citrus reticulata*) are citrus fruit grown for the fresh market. The value of the US mandarin crop was approximately \$200 million in 2008 with production divided approximately equally between California and Florida. 'Fallglo' is an early season mandarin hybrid that was released by the USDA in 1987 and currently represents a significant portion of the mandarin crop in Florida. 'Fallglo' fruit typically contain 20-40 seeds. An essentially seedless version of 'Fallglo' was produced by irradiation of budwood and the proposed name for this selection is 'Early Pride'. Horticultural characteristics of 'Early Pride' suggest that it is equivalent to 'Fallglo' in terms of productivity as well as pest and cold tolerance. 'Early Pride' averages less than 2 seeds per fruit and many fruit have no seeds. Our objective in this work was to compare fruit quality characteristics of 'Fallglo' with 'Early Pride'. Soluble solids, titratable acidity, flavor volatiles as well as rind and juice color did not differ significantly between 'Fallglo' and 'Early Pride'. Consumer preference tests revealed a slight, but non-significant preference for 'Early Pride' compared to 'Fallglo'. Our results indicate that fruit quality of 'Early Pride' is at least equivalent to 'Fallglo' and the absence of seeds should provide marketing advantage.

Quality Evaluation of Newly Released Florida Strawberries by Sensory Analysis

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Florida produces most of the strawberries available on the eastern U.S. market during the winter months. 'Strawberry Festival' is the main commercial cultivar producing fruit from January to March, but with fruit getting smaller towards the end of the season. 'Treasure' is another

commercial cultivar and occupies about 15% of the acreage. This study was to compare a newly released University of Florida cultivar, Winter Dawn and two promising selections, FL 00-51 and FL 01-116 with the standard commercial cultivars. Fruit were harvested from a commercial farm in Plant City (FL) on 21 Dec. 2007, 31 Jan., 28 Feb., and 2 Apr. 2008 and were tasted on the same or next day by the Gulf-Coast Research and Education Center staff and visitors (consumer panel), or by a trained panel at the USDA/ARS Citrus and Subtropical Products lab. The consumer panel consistently preferred the flavor of FL 00-51, and that of 'Treasure' every month except in April. FL 01-116 was preferred in January only, and 'Winter Dawn' was found to be an attractive fruit, but bland. 'Festival' was always rated with the lowest flavor, and comments were that it was too sour most of the time. High correlations were found between flavor liking and sweetness or tartness (negative correlation). Similar results were found by the trained panel: FL 00-51 was sweet with high strawberry flavor except in January; FL 01-116 was described with a green flavor and some bitterness, except in January when it was sweet and fruity; 'Treasure' tended to be on the "fermented/overripe" side except in December; 'Winter Dawn' was "fermented/overripe" in December, and "sour" in January; and 'Festival' was described as sour or "woody/musty/stale". 'Festival', FL 01-116 and FL 00-51 had the best storage potential in December, January and April, respectively, and 'Winter Dawn' was highly susceptible to decay in January. Data show a large effect of climate and possibly harvest maturity on flavor and decay in storage.

Cultivar Variability in the Response of Tomato Fruit Lycopene Synthesis to a Brief Postharvest Heat Stress

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The overall objective of this project is to utilize directed post-harvest stress and optimization of the postharvest environment to maximize the genetic potential of tomato fruit to produce more nutritionally important secondary compounds while maintaining or improving appealing flavor and aroma characteristics. We hypothesize that brief, directed applications of non-injurious heat stress followed by maintenance of conducive handling temperatures can be used to redirect the secondary metabolism of tomatoes to stimulate tissue antioxidant and aroma volatile systems during ripening. Mature green (MG), breaker (Br), turning and pink 'Crown Jewel' and 'Security 23' tomato fruit were exposed to 25, 50, 52 or 54 °C water for 2.5, 5 or 15 min; followed by ripening in air at 20 °C until the CIE 'a' value at the fruit blossom end reached a plateau (equals full red ripeness stage; MG fruit were first exposed to 100 ppm ethylene in air for 2 days at 20 °C). Response to heat treatment in terms of red color development was greatest for MG and Br and fruit. Subsequently, MG 'Crown Jewel', 'Biltmore', 'Security 28', 'HMX 5828', 'FL-47', and 'Tasti-Lee' fruit were exposed to 25 or 52 °C water for 5 min or 54 °C water for 2.5 min. Lycopene content and antioxidant activity at the full red ripeness stage was increased by 10 to more than 50% in all varieties except FL-47, which decreased, when exposed to 52 or 54 °C water compared to the 25 °C water control treatment and varied by ≈50% among the different cultivars and harvest seasons.

Vegetable Crops Section

Tomato Yield and Quality for Commercial Production in Tennessee and Kentucky

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In 2008, field trials were conducted in Crossville, TN and Lexington, KY to compare yield and quality of fresh-market, slicing

tomatoes. Twenty-four and 23 varieties were planted in TN and KY, respectively. Eighteen varieties were tested in both locations in a RCBD with 4 replications per variety. Transplants were set on 12 May (TN) and 6 May 6 (KY) on raised beds with plastic mulch (18 inches between plants, 6 ft between centers), with 8 (KY) and 10 (TN) plants/plot. Tomatoes were harvested 7 (TN) and 13 (KY) times from July through September, and sized and graded according to USDA standards. Varieties performed differently by location. Yields were generally higher in KY versus TN, which was partially attributed to the larger number of harvests in KY. In KY, Mt. Fresh Plus and Mr. Ugly had the greatest marketable yields, with 61,376 and 60,716 lb/A, respectively. These varieties outyielded all but four (NC 07245, BHN 602, NC 086 and Nico) out of the other 21 varieties evaluated. In TN, Nico (53,075 lb/acre), Sunsation (51,920 lb/acre), Red Defender (51,350 lb/acre) and Solar Fire (50,587 lb/acre) yielded significantly more marketable fruit than Crista, Amelia, NC0694, BHN 640 and Applause. BHN 602, Nico, Red Defender and Mt. Crest yielded among the top 10 in both locations. Applause (24,914 lb/acre (TN) and 26,355 lb/acre (KY)) and Amelia [36,230 lb/acre (TN) and 43,326 lb/acre (KY)] were among the lowest yielding varieties in both locations. Applause was also among the varieties with the highest percentage of culls in both locations, with 54% (KY) and 42% (TN). Average fruit weight ranged from 8.5 oz (Solar Fire) to 12.1 oz (NC 0821) in KY, and 7.1 oz (BHN 640) to 11.6 oz (Quincy) in TN. Soluble solids (%) ranged from 3.8 (Nico) to 4.5 (Crista) in KY and 3.8 (BHN 640) to 5.0 (Mt. Crest and Phoenix) in TN. While many varieties performed variably by location, BHN 602, Nico, Red Defender and Mt. Crest performed consistently well in both KY and TN with high yields and good quality.

The Best of Both Worlds: Bicolor Sweet Corn Varieties for the Grower and Consumer

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Synergistic sweet corn varieties appeal to growers and consumers alike due to their high sugar content, slow rate of starch conversion, creamy texture, and ease of production. In this study, production traits and eating quality of 16 varieties of bicolor, synergistic sweet corn were compared at the Plateau AgResearch and Education Center in Crossville, TN in both 2007 and 2008. Sweet corn was planted on 15 May 2007 and 20 May 2008, with 4 replications per variety. Plant spacing was 30 inches between rows and 10 inches between plants. Corn was harvested 6 times in 2007 between 24 July and 6 Aug. and 5 times in 2008 between 25 July and 4 Aug. There was an interaction between year and variety for days to harvest (DTH). In 2007, DTH ranged from 70-83 days, and 66-75 days in 2008. Sweet Rhythm and Reflection were the earliest maturing varieties in 2007 and Sweet Chorus, Reflection, Temptation and Vitality were the earliest in 2008. Providence and BC0805 were the latest maturing varieties in 2007, while Kristine was the latest in 2008. Marketable yield differed by year, with higher yields in 2007. Yield also differed by variety in 2007. Montauk, Sweet Rhythm and Charisma yielded significantly more crates/A compared to BC0805, Reflection and Renaissance. In 2008, Montauk and Sweet Rhythm also were among the highest yielding varieties. Plant height, stem diameter and height to collar differed by year (2007 > 2008) and variety. Ear lengths were slightly longer in 2007, while ear diameter and number of ears/plant did not differ by year. Husk color was lighter in 2007 versus 2008, though tip fill and cover were better in 2008 versus 2007. While brix (%) was higher in 2008 (16.7%) than 2007 (15.9%), there was no difference by variety in either year. BC0805 and Providence tended to have the highest percentages (over 18%) in 2007 and Serendipity and SSM#950BC (over 19%) in 2008. Montauk, Sweet Rhythm, Cameo, Providence and SSM#950BC performed well in both years for yield and quality.

Transplant Cell Volume Affects Transplant Size and Subsequent Broccoli Yield

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The objectives were to determine the effects of transplant cell volume and number of plants per cell (one or two) on the growth of broccoli transplants and the subsequent floret yield of after transplanting to the field. Cell volumes evaluated were 35.0 mL (162 cell/tray), 31.3 mL (200 cell/tray), 23.7 mL (242 cell/tray), 20.4 mL (338 cell/tray), and 7.8 mL (338L cell per tray). Individual broccoli seedling biomass was larger in trays with one plant per cell compared to trays with two plants per cell, however, the opposite occurred when expressing seedling biomass on a per cell basis. Regardless of the number of plants per cell, seedling leaf area per cell, stem dry weight per cell, and root dry weight per cell increased with increasing tray cell volume. The number of florets either increased (2 plants/cell) or was unaffected (1 plant/cell) with increasing tray cell volume, while individual floret weight either increased (1 plant/cell) or was unaffected (2 plants/cell) with increasing cell volume. Marketable yield increased with increasing cell volume. In conclusion, transplant biomass increased with increasing tray cell volume, and broccoli yields increased with increasing transplant biomass.

Melon Grafting Improves Fruit Quality and Marketable Yields

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The goal of this study was to determine the effect of grafted melons on fruit internal quality and overall marketable yields. Grafted plants were evaluated in the field, both spring and fall, at the Coastal Research and Education Center of Clemson University located in Charleston, SC. Rootstocks used were: Dinero (wild melon hybrid), Storm Tosa (inter-specific squash hybrid), and Kazako (interspecific squash hybrid). The scion material consisted only of cultivar Athena (a cantaloupe hybrid). All plots were 40 ft long, 2 ft between plants, with 9 ft between rows, replicated four times. Fruit was harvested at full slip and categorized as marketable if they weighed above 4 lb. Fruit were graded according to the U.S. Department of Agriculture (USDA) grading standards for all melon fruit. Overall grafting increased the average fruit size, and decreases the size of the internal cavity. Grafting affected the fruit shape by making is more circular rather than oval. Sugars were unaffected. Yields were not affected; however, the first harvest was delayed by an average of 3 days. Further studies in the coming year will be done to confirm this information.

Distribution of Tomato Fruit Sizes by Variety as Affected by Various Treatment Conditions Grown in the Greenhouse at Tifton, GA

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Tomatoes were grown in greenhouse on two occasions: Jan.–Mar. 1979 (49 days) and Aug.–Nov. 1979 (70 days). Up to 10 tomato varieties were transplanted at 4 weeks. Growing practices were those recommended by UGA Extension Service. Early: Plants were randomly selected to be placed in spacing study (15, 30, 45 cm × 60 cm) while all other tomato plants were at 45 cm × 60 cm. Late: Two sets of plants were randomly selected where first was divided into two groups (blossoms vibrated or not vibrated) and second was transplants were cold treated before transplanting or not cold treated. All plants were at 45 cm × 60 cm spacing. Ripe tomatoes were picked every 2 to 9 days with the plant ID, cluster, fruit sized, and weighed and recorded. Results of spacing study were as follows: 15 cm, 36 g/fruit; 30 cm, 90 g/fruit; and 45 cm, 100 g/fruit. There was no significant difference among the three spacings. Results of cold treated transplant study are as follows: cold, 45.3 g/fruit; not cold, 41.8 g/fruit. There was a significant difference between cold treated transplants compared with transplants not cold treated. Results of blossom vibration study are as follows: VIB, 167 g/fruit; and No VIB, 169 g/fruit. There was

no significant difference the two vibrator treatments. Cluster 7 yielded the heaviest fruit, 96 g/fruit; while Cluster 1 the lightest, 68 g/fruit; and mean fruit weight was 82 g/fruit. 'Monte Carlo', 'W-Villamarie', and 'Bigset' yielded the heaviest fruit, 169, 160, and 154 g/fruit, respectively. 'Petra' and 'Stella' yielded the lightest fruit, 57 and 62 g/fruit, respectively. Almost 1305 kg of fruit were harvested, consisting of 15,909 marketable fruit. About 52 kg of fruit were not marketable.

Practical Method for Irrigation Chlorination: Field Experiences with Lettuce and Tomato

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Microbial contamination of fresh fruits and vegetables has been recognized as an increasing cause of foodborne illness. The food safety risk of this produce is increased as they are often consumed with minimal or no processing or cooking. Through the use of Good Agricultural Practices, growers are able to identify important transfer points of pathogens to fresh produce. These include workers hands, animals and the water used on the farm. Irrigation water quality can be particularly difficult to manage if the producer is limited to surface water sources. In an effort to address this potential source of contamination, growers are looking for practical and cost effective solutions to treat irrigation water prior to application. This study explored the use of a tablet based chlorination system for the disinfection of surface irrigation water prior to delivery to lettuce and tomatoes grown in North Carolina. Two irrigation methods, either drip or sprinkler irrigation, were used in each crop. Water testing demonstrated positive fecal coliforms in the surface water being used and that as the season progresses these coliform counts increase in both cropping systems. In addition, the use of the chlorination system appears to effectively treat agricultural water to reduce its risk as a possible source of contamination.

The Effects of Pulsing Drip Irrigation on Tomato Fruit and Quality

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Fresh market tomatoes grown on black plastic mulch with drip irrigation require large quantities of water to be productive and profitable. Improving drip irrigation water use efficiency could reduce production costs and minimize negative environmental impacts resulting from excessive irrigation and subsequent nutrient leaching. To improve irrigation efficiency of drip irrigated fresh market tomatoes a tensiometer-based pulsed irrigation system was developed. Irrigation treatments consisted of a manual "farmer" based control, an automated tensiometer controlled treatment that initiated irrigation at 30 cb and stopped irrigation at 10 cb, and three pulsed treatments that delivered 100%, 80%, and 60% of the water of the automated system. Tomato yields were not affected by irrigation treatment. Tomato quality, measured by average fruit size, yield of jumbo and extra large tomatoes, and soluble solids was not affected by the irrigation treatments. Tomato leaflet pre-dawn and mid-day water potentials were also measured using a pressure bomb. There were no differences between treatments for leaf water potential at both measurement times throughout the study, although pre-dawn water potentials were significantly lower than mid-day potentials at all sampling dates. This indicated that there were no differences in plant water status among the treatments when sampled. This research suggests that drip irrigation management in tomato can be improved

significantly, thus reducing water use and improving the sustainability of tomato production.

Effects of Colored Shade Cloth on Yield and Grade of Bell Pepper Grown in a High Tunnel

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The objective of this study was to determine the effects of various colored shade cloth on yield and grade of colored bell peppers grown in a high tunnel production system. Red, blue, gray, or pearl ChromatiNet [Polysack Plastic Industries, Ltd. (Nir-Yitzhak, Sufa, Israel)], black shade cloth, or no shade cloth were applied over *Capsicum annum* 'Magno' and 'Permit'. Bell peppers transplants were planted in raised beds covered with white plastic 4 June 2008. Harvests began 19 Aug. 2008 and ended 15 Jan. 2009 and occurred approximately once a week. Bell peppers were harvested when full color was reached, orange for 'Magno' and red for 'Permit'. Fruit was graded and counted as marketable (close to U.S. Fancy grade) or unmarketable (marketable fruit, but not of as high a grade as marketable). All fruit in each grade were weighed as a whole for each plot. The most marketable fruit were harvested during the hottest part of the season in August and September. Red and black shade cloths consistently produced the highest numbers of marketable fruit. Marketable fruit weights followed the same trends. The highest numbers of unmarketable fruit were harvested during the hottest part of the season, August to October and towards the end of the season in January. Plots with no shade cloth consistently produced the highest number of unmarketable fruit. Unmarketable fruit weights followed the same trends. Temperatures were freezing or below 29 times during the growing season. However, fruit were harvestable in the high tunnel late into the production period (15 Jan. 2009), though in lower numbers and grade, showing how effective the high tunnel was in extending the growing season.

The Effects of Colored Plastic Mulches and Row Cover on the Growth and Production of Sweet Potato

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The effects of colored plastic mulches and row cover on the performance of sweet potato production were evaluated. This study was conducted at E.V. Smith Research Center, Shorter, AL. The experiment consisted of 12 treatments including: 1) black plastic mulch (BPM) + spun-bonded row cover (RC), 2) BPM alone, 3) white plastic mulch (WPM) + RC, 4) WPM alone, 5) red plastic mulch (RPM) + RC, 6) RPM alone, 7) bare soil (BS) + RC, 8) BS alone, 9) silver plastic mulch (SPM) + RC, 10) SPM alone, 11) blue plastic mulch (BLUPM) + RC, and 12) BLUPM alone. Eighty-three days after planting, SPM + RC, SPM alone, and RPM alone, produced the highest marketable and total yields while other treatments exhibited similar yields. Following 104 days after planting, results of the study showed no difference in marketable or total yield among colored plastic mulch treatments except for the BPM + RC and RPM + RC which produced the lowest yield. BPM + RC and SPM alone produced the lowest vine lengths when compared to other treatments. WPM + RC, BS + RC and BPM + RC had the lowest vine weights while there were no differences in vine weights among other treatments. Increased soil and air temperatures did not always correspond with sweet potato yield.

Influence of Plastic Mulch Color on Carotenoid Content and Antioxidant Properties in Sweet Potato

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The present study was conducted at Auburn University's E.V. Smith Research Station in Shorter, AL, during Summer 2008 in order to determine the influence of agricultural practice (plasticulture, i.e., mulch color) on sweetpotato [*Ipomoea batatas* (L.) Lam. cv.

'Beauregard'] nutritional value. Five mulch treatments (black, red, silver, white, and blue plastic) were compared to bare ground on their influence on sweetpotato nutritional value. The antioxidant properties determined were assessed by four different means, antioxidant radical scavenging activity [2,2-diphenyl-1-picrylhydrazyl (DPPH)], ferric reducing antioxidant power (FRAP) assay, total phenolics (TP), and total carotenoid content (TC). Our findings indicate the following: (1) bare ground and blue mulch were highest, in antioxidant capacity (DPPH) with white, silver and red mulch intermediate and black mulch lowest capacities respectively; (2) bare ground exhibited the highest (FRAP) values, with intermediate values found in blue and silver, while lowest values were found in white, black and red respectively; (3) TPC were highest in bare soil and blue with intermediate concentrations in white and red, while lowest values were found in silver and black mulch treatments respectively; (4) highest TC content was noted in blue and reduced in decreasing order of white, silver, bare soil, red with black exhibiting the lowest total carotenoid content; and (5) soil temperature appeared to influence antioxidant capacities DPPH (AEAC, Trolox), FRAP (AEAC, Trolox) and TP content. Results from this study indicate that the use of plasticulture (i.e., various mulch colors) on sweetpotato has potential benefits in altering growth and nutritional status of sweetpotato under Alabama growing conditions. Further investigations are required to determine the exact mechanisms involved in order to fully exploit this technology (plasticulture) intended to enhance early market season, quality and nutrition of sweetpotato.

Two-year Evaluation of Pepper Herbicides

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A 2-year study was conducted at the University of Kentucky Research and Education Center, Princeton, KY, to evaluate the performance and safety of clomazone and trifluralin applied under plastic mulch in bell pepper. Treatments were applied after beds were made and before plastic was laid, which was followed by transplanting peppers within hours of herbicide application. Clomazone was applied alone at 1.7, and 3.4 kg ai/ha or in combination with trifluralin 1.25 or 2 kg ai/ha. Trifluralin was also applied alone at 1.25 or 2 kg ai/ha. Handweeded and untreated checks were part of the experimental design in the 2 years of study. In both years, initial bleaching of lower bell pepper leaves was observed but was not consistent in all treatments or replications. Weed pressure in the planting holes was minimal in both years with honeyvine milkweed and large crabgrass as the majority of the weeds present. Honeyvine milkweed, growing in the planting hole, exhibited significant bleaching and stunting with all clomazone treatments. Both clomazone and trifluralin resulted in a season-long weed control in both years of the study. Total number and fresh weight of harvested bell peppers was not significantly different from the handweeded control due to herbicide application. Although not statistically significant, all herbicide treatments averaged double the yields of the untreated control in both years. This study strongly supports the safety and effectiveness of clomazone and trifluralin applied under plastic mulch in bell pepper production.

Two-year Evaluation of Sweet Sorghum Herbicides

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A 2-year study supported by Syngenta was conducted at the University of Kentucky Research and Education Center, Princeton, KY, to evaluate the performance of mesotrione and s-metolachlor as preemergence herbicides in sweet sorghum. Treatments were applied at 14 days before seeding (Pre-Plant) and a second time immediately before seeding (PRE). Mesotrione was applied alone at 0.105, 0.21, and 0.42 kg ai/ha or in combination with s-metolachlor 1.39 kg ai/ha. S-metolachlor was also applied alone at 1.39 kg ai/ha. Handweeded and untreated checks were part of the experimental design in the two

years of study. In both years of the study, no stunting of sweet sorghum was observed with any herbicide treatment. Some leaf bleaching was observed with PRE application of mesotrione 0.42 kg ai/ha alone or tank-mixed with s-metolachlor at 1.39 kg ai/ha. Bleaching injury ranged from 15% to 22% and had no effect on harvestable yield. In general, more bleaching was observed with PRE than with Pre-Plant. A severe drought in 2007 resulted in minimal weed pressure in all plots, including the untreated control plots. In 2008, effective season-long weed control was obtained with all treatments, with few large crabgrass observed in the PRE treatments. However, total plant fresh weight was not significantly reduced due to any herbicide treatment or to weed competition. This study strongly supports the safety and effectiveness of mesotrione and s-metolachlor for sweet sorghum production.

Organic Production of Vidalia Onions

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These studies were to evaluate different organic fertilizer sources and rates on production of Vidalia onions. Vidalia onions are short-day onions produced in a region of southeastern Georgia known for mild winters, abundant water, and low sulfur soils, conditions that favor mild onion production. In experiments on production of onion transplants, rates of fresh poultry litter from 0-10 tons/acre were evaluated in a randomized complete block design (RCBD) of 4 replications. Four rows of onions were sown on beds formed on 6-ft centers with 60 seed per linear foot of row. Transplants were evaluated for plant length, plant width at the base, and weight of 20 plants. In addition, onion transplant production was evaluated with 4-2-3 organic fertilizer at 0 and 130 lb/acre N with compost at 0, 5, and 10 tons/acre in a RCBD with a factorial arrangement of 4 replications. Poultry litter at 0-10 tons/acre was also evaluated for dry bulb onion production after transplanting in a RCBD of 4 replications. Finally, organic fertilizer 4-2-3, 9-0-9, and 13-0-0 were evaluated at 150, 200, and 250 lb/acre N rates. Plants were transplanted on beds formed with 6-ft centers with an in-row spacing of 5.5 inches and between-row spacing of 12 inches. Transplants of comparable size to conventional production could be produced with 4-6 ton/acre poultry litter. In addition, there was a synergistic effect between 4-2-3 organic fertilizer and compost with the heaviest transplants produced with 4-2-3 at 130 lb/acre N with either 5 or 10 tons/acre compost. There was a linear increase in total onion yield with increasing rates of poultry litter from 0-10 tons/acre. Finally, there were no differences between organic fertilizer sources or rates for total or jumbo (≥ 3 inches) yields.

Specialty Eggplants (*Solanum melongena* L.) yield well in Mississippi Using Organic or Inorganic Production Methods

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Six cultivars of specialty eggplants were evaluated for yield and ornamental value in organic and non-organic management systems in central Mississippi in 2008. The systems were evaluated as two separate experiments. Greenhouse-grown seedlings of cvs. Millionaire, Casper, Fairy Tale, Bride, Lavender Touch, and Slim Jim were transplanted in Apr. 2008 only raised beds with black plastic mulch and drip irrigation. Both studies received pre-plant and side-dress fertilizer, with the organic plot receiving composted chicken litter and fish emulsion, and the non-organic plot receiving salt-based granular N, P, and K fertilizers. There were significant differences in total and

marketable fruit yield among cultivars in each system. Generally, larger fruited types yielded more than smaller fruited types. Marketable yields in the organic system ranged from 2.0 to 3.7 kg/plant, with the statistically highest marketable yields seen in cvs. Bride, Lavender Touch, Millionaire, and Fairy Tale. Marketable yields in the non-organic system ranged from 2.3 to 3.7 kg/plant, with the statistically highest marketable yields seen in cvs. Fairy Tale, Lavender Touch, and Slim Jim. 'Slim Jim', a small fruited, purple-leased eggplant, was named a 2009 Mississippi Medallion Award winner for its ornamental value and overall performance this and other trials. Similarities in yield and crop performance in the two systems indicate that specialty eggplant can be grown by farmers or gardeners using organic or non-organic management in the Gulf States.

Dimethyl Disulfide use for Bacterial Wilt Management and Weed Control in Virginia Tomatoes

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Field studies were performed to compare several methyl bromide alternatives for the management of bacterial wilt (*Ralstonia solanacearum*), yellow nutsedge (*Cyperus esculentus*), and other problematic weeds in fresh market tomato production. Experiments were conducted during Spring 2008 comparing multiple application rates of dimethyl disulfide/chloropicrin (DMDSC) to a single rate of methyl bromide/chloropicrin (MBC). In Fall 2008, multiple rates of DMDSC and dimethyl disulfide (DMDS) were compared to a single rate of MBC. In the spring, all fumigants significantly reduced bacterial wilt incidence as well as plant densities of yellow nutsedge and common purslane (*Portulaca oleraceae*). Tomato yields were similar between fumigation treatments and all plots receiving fumigation yielded greater than non-fumigated plots. In Fall 2008 there was no incidence of bacterial wilt in experimental plots. There were no significant differences in nutsedge densities between fumigated and non-fumigated plots however; non-fumigated plots had significantly greater densities of common purslane compared to fumigated plots. There were no significant differences in purslane densities within fumigation treatments in the fall. There were also no significant differences in yield between fumigation treatments and fumigated plots yielded similar to non-fumigated plots. Without the yield-limiting factor of bacterial wilt in the fall, fumigation treatments did not significantly improve yield. Dimethyl disulfide performed similarly to DMDSC across all measured variables. Dimethyl disulfide appears to be a suitable alternative to MBC for the management of bacterial wilt and problematic weeds in Virginia tomato production.

Does Granular Preplant Nitrogen Source Influence a Staked Tomato (*Lycopersicon esculentum* Mill.) Crop?

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Due to security concerns, ammonium nitrate (AN) has become less available to many vegetable growers in recent years. Urea ammonium sulfate (UAS) has become a widely available substitute for AN, but it is one of the most highly acidifying nitrogen sources. In an effort to compare sources and determine if growers should alter their management practices as they shift away from AN, we established replicated a fresh market tomato study comparing equal rates, on a nitrogen basis, of pre-plant UAS, AN, urea (U) or calcium nitrate (CN). All plots received 60 lbs/acre N pre-plant, and two sidedress applications of 30 lb N/acre as CN applied through drip irrigation. Tomato cv. Crista was raised using common local practices at 0.6 m in-row and 1.9 m between rows. Fruit were harvested twice weekly, graded and weighed. Mean soil pH in early June, 56 days after planting ranged from 5.6 to 6.2 and varied by treatment. Soils receiving pre-plant CN fell within the highest pH mean grouping, those receiving pre-plant UAS in the lowest grouping, and those receiving pre-plant AN or U intermediate to the soils receiving pre-plant CN or UAS. All four pre-plant N treatments produced vigorous tomato shoot growth. Nitrogen source did not alter total fruit yield, but did alter fruit number

somewhat. Nitrogen source did not affect mean marketable fruit weight. Additional field trials will be needed before firm conclusions and recommended practices can be made from this work.

An Economic Analysis of Nutrient Management Programs for Fresh Market Tomatoes Grown with Plasticulture in the BMP Era

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In fresh market tomato production, fertilizer as a crop input has been relatively cheap, representing >5% of the total production cost. Consequently, growers tend to apply fertilizer in excess of UF/IFAS recommended rates to prevent nutrient shortages and maintain productivity. Moreover, because of low water holding capacity of the sandy soils, growers apply excess irrigation. With the adoption of the Federal Clean Water Act, states are required to assess the impact of non point sources of pollution on surface and ground waters, and establish programs to minimize them. Further, with the adoption of BMPs to implement the Total Maximum Daily Loads, growers are encouraged to follow UF/IFAS irrigation-fertilizer recommendations. Therefore, the objective of this study was to determine the economic impact of irrigation-nutrient management programs on fresh market tomato returns using partial budget analysis. A 2-year experiment was conducted in Live Oak, FL, during 2005 and 2006 with irrigation-nutrient programs created by a combination of fertilizer rate (100% (UF/IFAS rate), 200%), and irrigation rate (100% (UF/IFAS rate), 300%). In 2005 and 2006, cost of irrigation-nutrient management programs ranged from \$403/acre-\$656/acre. In both 2005 and 2006, the high fertigation (200% Fertigation-100% Irrigation) program resulted in net positive effects relative to the UF/IFAS program (\$55/acre, \$561/acre, respectively). However, these results did not differ statistically. Moreover, the high fertigation program resulted in higher total-N load than the UF/IFAS program. With the adoption of legislation to establish a monetary value on increased nutrient pollution in northern Florida, there is an added negative impact to high fertilizer application. Therefore, there is no economic benefit in applying fertilizer rates in excess of the UF/IFAS rates. In 2005 and 2006, relative to the UF/IFAS program, the high irrigation alone program (100% Fertigation-300% Irrigation) not only increased the cost of the program (\$17/acre), but also lowered net returns by \$1,701/acre-\$4,112/acre. We can conclude that growers should not use higher irrigation rates to ensure adequate soil moisture levels in the crop root zone as it results in net losses. Instead, they should better manage irrigation water application.

Effect of Ion Interferences on Nitrate Measurement in Plant Sap, Soil and Fertigation Solutions using Portable Ion-selective Electrodes

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Ion-selective electrodes (ISE) are simple tools used for rapid measurement of nitrate (NO₃-N) in plant sap. With the development of Best Management Practices (BMPs), interest exists in using them for soil leachate, soil and fertilizer solutions. Nitrate-nitrogen concentrations in the 0 to 10,000 mg·L⁻¹ ISE working range were measured in dilute solutions of common salts to assess ionic interference of K⁺, Ca²⁺, NH₄⁺, Cl⁻ and SO₄²⁻. The effects of meter (replication) were unexpectedly significant in one of out of three ranges (p-values of 0.50,

0.72, and 0.01, for the 0 to 100, 100 to 1,000 and 1,000 to 10,000 mg·L⁻¹ ranges, respectively) of NO₃-N concentration. The responses of calculated NO₃-N concentrations to measured NO₃-N concentrations were linear, but slope ranged from 0.85 to 1.54, 0.24 to 2.72, and 0.93 to 5.48 for the 0-100, 100-1,000 and 1,000-10,000 mg·L⁻¹ measuring ranges, respectively. All slopes were significantly different from zero and several were significantly different from each other, and 1:1 line. Pairwise slope comparisons conducted with covariance analysis showed that NO₃-N measurements were affected by SO₄²⁻ alone at low, medium and high concentrations ranges and by the presence in combination of K⁺, NH₄⁺, Ca²⁺ and Cl⁻ within the medium and high concentration range. These results highlight the importance of using quality assurance/quality control samples in the set of unknown samples to detect unacceptable departure from linearity in routine analysis. The increase in measurement variability from one range to the next showed the importance of keeping measurements within a set of a single concentration range by using dilutions. Hence, ISE may be used for field measurements of NO₃-N concentrations in soil leachate, soil and nutrient solutions, thereby being a practical BMP tool. However, ISE should not be used as substitute for the laboratory methods when official measurements are needed.

Advantages and Limits of Integrating Forecasts of El Niño Southern Oscillation (ENSO) on Nutrient Management for Tomato

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ENSO is a natural phenomenon based on changes in sea surface temperature from the long-term average temperature and is the strongest driver of inter-annual climate variability in South Florida. ENSO primarily affects rainfall amount and distribution, and air temperature. Current N recommendations for tomato consist of a base rate and a supplemental application allowed after leaching rainfall events (defined as 25.4 mm in 1 day, 72.2 mm in 3 days or 101.6 mm in 7 days). Using historical weather data from weather stations, we wanted to assess the effect of ENSO phases on total rainfall distribution and the occurrence of leaching rainfalls for simulated tomato crops planted in the fall, winter and Spring. Winter and Spring average rainfall amounts during La Niña and neutral years were lower than during El Niño years. During El Niño years, at least one leaching rainfall of 25.4 mm in 1 day occurred at all four weather stations and all planting seasons, and 2 of these events occurred more than 9 out of 10 years. During the Fall growing season of El Niño years, 3 to 4 25.4 mm in 1 day leaching rainfalls may be expected at least 4 years out of 5 at all four weather stations. The probability of exceedence of having at least one larger leaching rainfall event was mostly <0.80. These results suggest that fertilization applications could be adjusted to ENSO phase, but the risk taken in linking fertilization practices to ENSO phases depends on the quality of the ENSO phase prediction, spatial rainfall variability, and the applicability of long-term probabilities to each single year.

Determining Optimum Nitrogen Rates for Sweet Corn in Georgia

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According to the 2007 Georgia Farm Gate Vegetable Report published by the University of Georgia Center for Agribusiness and Economic Development, sweet corn in Georgia was valued at over 93 million dollars and occupied 15.3% of all vegetable land, being Georgia's largest crop by acreage. The objective of this study was to establish plant tissue and sweet corn yield response curves for nitrogen (N) on Georgia soils. A Bt sweet corn variety was planted at 3 ft. row centers on a Tifton sandy loam soil. Increasing rates of nitrogen, from 0 lbs. N/acre to 400 lbs. N/acre, were applied at different crop growth stages including pre-plant, V4, V8, VT, and R1. Plant tissue samples were collected at both V8 and VT stages to compare foliar N among

treatments. Corn was harvested and number of ears/acre and marketable yield (lb/acre) data were collected and analyzed by Duncan's Multiple Range Test using SAS. Regression curves were made using Microsoft Excel to compare yields to nitrogen rate and foliar N. All data parameters were significant ($P \leq 0.05$) across N treatments. The 300 lb N/acre resulted in the best number of ears/acre counts (28,677 ears/acre) and 300-350 lb N rates gave the best marketable yields (17,845 lb/acre and 17,569 lb/acre, respectively). Leaf tissue analysis overlapped for V8 and VT stages indicating that 3.0% to 3.9% N at either of those stages corresponded with highest crop yields. This study will be repeated Spring 2009 on this same soil type, as well as a loamy sand soil with a deep clay subsoil in Mitchell County, GA. As input costs rise, farmers and scientists alike must revisit plant nutrition issues and calibrate fertility programs to better make increasingly complex economic decisions in the future with regards to fertilizer management.

Can Alternate N Sources and Additives Reduce Nutrient Costs in Vegetables?

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Increases in fuel costs, world fertilizer demand and production of non-food crops are a few of the forces pushing fertilizer costs higher. Additionally, nitrate fertilizers are becoming more difficult to obtain. This has caused exploration of the use of non-traditional fertilizers on vegetable crops. Urea is one potential alternative, but it can volatilize, leach or be lost to nitrification. Nutrisphere - N is a new product claiming to reduce losses of N. The objective here was to determine if alternative N sources in liquid fertilizers were feasible and whether Nutrisphere - N enhanced the efficiency of these materials. Two liquid fertilizers (KNO₃ + CN9 + MgNO₃ + AN21 and KNO₃ + 32% UAN), each in a 4-0-8 formulation, were tested with and without Nutrisphere - N mixed at 0.5% into the fertilizer. All four treatments were evaluated on cantaloupe, tomato and pepper in separate trials. Seedlings were produced in an experiment station greenhouse. Tomato ('Crista') was transplanted to the field 10 Apr. 2008, 'Athena' cantaloupe 11 Apr. 2008 and 'Aristotole' bell pepper 21 Apr. 2008 in Tifton, GA. All crops were planted on fumigated, drip irrigated, plastic mulched beds 6 ft from center to center. Tomatoes and cantaloupe were planted with one row per bed at 24 inches between plants and pepper with two rows per bed at 12 inches between plants. Plots were 20 ft in length and were replicated four times in a randomized complete-block design. Fertilizer was injected at equal amounts of N for each treatment on a weekly basis. Total N for pepper and tomato was 237 lb/acre and 196 lb/acre for cantaloupe. Crops were harvested at the appropriate maturity stage and yield and quality data taken at harvest. Normal cultural practices were used for each crop. Fruit size in cantaloupe was significantly greater when Nutrisphere was added to the UAN fertilizer. Boxes of jumbo pepper were affected in a similar fashion. Blossom end rot percentage was lower in tomato where Nutrisphere was used with the AN21 formulation. No other differences were detected. The use of Nutrisphere - N seems to have some advantages, but the value is of this product is still unclear.

Phosphorus Nutrition of Romaine Lettuce in North Carolina

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Due to recent increases in fuel costs, there is increasing interest in lettuce production in North Carolina. Along with increased transportation costs increases in fertilizer costs have forced producers to use more care when considering how much of a given element is needed by the plant to satisfy growth and development. Phosphorous management for lettuce in North Carolina suggests 44-52 lb of P per acre on soils testing high for phosphorus. In an attempt to refine this recommendation it was observed that Romaine lettuce has a linear growth response to phosphorus nutrition additions, even above

those regarded as best management application rates. As a side project, a study was carried out in field, to further explore the growth response of Romaine lettuce to very high rates of phosphorus nutrition. Transplants were planted on double row beds and fertilized with diammonium phosphate at rates from 0 to 100 lb of P per acre. Nitrogen was balanced across all treatments using calcium nitrate. Plant growth was measured two times during the production season. Ideal Cos showed significant increases in plant height as the P rate increased at the early harvest. Sunbelt, however, did not show significant increases in plant height until the later harvest. Ideal Cos showed significant increase in fresh weight at the early evaluation date, as P rate increased. These differences, however, were not evident at the later harvest date. Significant amounts of phytotoxicity were present as phosphorus rates increased in both cultivars. Though there were interesting growth responses to increased rates of P nutrition, increased yield loss due to phytotoxicity and the subsequent increased labor costs in trimming that material in the field would likely not justify increasing the rate of P above those currently recommended.

Differential Tolerance of Cowpea (*Vigna unguiculata*) to Sulfentrazone

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Cowpea is an important vegetable crop in the southern U.S. It is grown in large enough acres in commercial production such that herbicides are routinely used to control weeds. The combination of imazethapyr and metolachlor has been used for years because it provides excellent broadspectrum weed control without incurring injury to cowpea. Two major weed problems had evolved lately – hophornbeam copperleaf (*Acalypha ostryifolia*) and ALS-resistant Palmer amaranth (*Amaranthus palmeri*). The standard herbicide combination does not control hophornbeam copperleaf. Widespread use of ALS (acetolactate synthase) inhibitors in field crops led to the evolution of ALS-resistant amaranth. Thus, a search for alternative herbicides and efforts to diversify the weed management tools are necessary. Sulfentrazone has recently received a special use label for Arkansas and neighboring states because it has excellent activity on copperleaf and Palmer amaranth. Differential tolerance to sulfentrazone is documented in soybean and is also expected in cowpea. Tolerance of 12 cultivars and advanced breeding lines to the pre-emergence (PRE) application of sulfentrazone at 0, 0.1875 and 0.375 lb ai/acre was evaluated at Kibler, Arkansas in 2007 and 2008. The label rate for cowpea is 0.1875 lb ai/acre. Experiments were laid out in a split-plot design with cowpea cultivar as mainfactor and herbicide rate as subfactor, replicated three times. The whole experiment was kept weed-free by a blanket application of imazethapyr + metolachlor. Stand count, crop injury, flowering, pod maturation, and yield were recorded. Stand reduction was high at the high rate of sulfentrazone. Those that showed low stand reduction included 01-874, AR blackeye, CT Pinkeye and Coronet with <10% at the label rate and <15% at the high rate. Cowpea injury was higher in 2007, but yielded better than in 2008. At the label rate, injury ranged from 8% to 46% at 29 d after application (DAA). The label rate caused a delay in maturation of 01-243, 01-874, 92-551, AR blackeye, and Erect set. Delay in maturity increased with the high rate. All advanced lines yielded the same or better than the most widely planted cultivar, Early Scarlet. The label rate caused 2% to 42% yield loss. Negligible yield loss (2% to 13%) was observed in 00-855, 01-874, CT Pinkeye, and Coronet; these were classified as tolerant. There were the ones whose emergence was least affected by the label rate. CT Pinkeye, Coronet and 01-874 also incurred the lowest yield loss (37% to 39%) at the high sulfentrazone rate. Early Scarlet showed intermediate tolerance to sulfentrazone, incurring about 20% yield loss over two years. For cultivars with less tolerance to sulfentrazone, growers need to ensure correct application rate with respect to soil type and pH.

Vegetable Crops Section—Sweetpotato

Sweetpotato Foundation Seed Survey: Yield Performance of Multiple Generations of Sweetpotato Foundation Seed in 2007 and 2008

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Foundation sweetpotato seed has been provided by the LSU AgCenter since the mid 1930s. The current mission of the LSU AgCenter virus-tested foundation seed program is to produce virus-tested foundation seed stock of popular and potential commercial cultivars. Producers supplement their on-farm seed programs with virus-tested planting stock each year. Seed root age is designated by generation (G1, G2 and G3). G1 seed is seed that has been produced at the Sweet Potato Research Station directly from virus-tested tissue cultures. A foundation seed survey research trial was initiated in 2007 to examine the yield potential of several generations of foundation seed stock once it is incorporated into on-farm seed programs. Ten producers provided two 40-lb boxes of G2-G4 seed that was evaluated in the study in 2007 and 2008. Twenty-five and 23 treatments were included in the test in 2007 and 2008, respectively. The seed was collected in the spring following the bedding season and subsequently bedded in seed beds at the LSU AgCenter Burden Research Center in Baton Rouge, LA. In 2007, no significant differences were detected in any yield grade for U.S. No. 1, canner, jumbo or total marketable yield grade between generations. However, G1 (generation 1) seed did produce more U.S. No. 1s than older generations. Similarly in 2008, no significant differences were detected in U.S. No. 1 yield grade between the different generations evaluated however the G1 seed did produce more U.S. No. 1s than did older generations.

Field Propagation of Certified Sweetpotato Cuttings in Early Spring under Plasticulture

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Plastic mulch and spun-bonded rowcover were evaluated to enhance growth and increase production of certified sweetpotato propagation material in early spring. Certified plant material is propagated in greenhouses during the winter and cuttings are planted in the spring for seed-stock production. Over-winter propagation in screened and heated greenhouses is expensive, so growers reduce the cost of certified material by cutting out vines from the first planting to increase the production area. Sweetpotato is a warm climate crop that requires temperature above 15.5 °C (60 °F) for growth; therefore, plasticulture was used to increase soil and air temperature early in the spring. Beauregard B-14 slips from the Mississippi sweetpotato foundation stock were planted on April 16, 2008 under a combination of black plastic mulch and spun-bonded rowcover. All plots were drip irrigated and fertilized through irrigation. Bare ground without rowcover was considered control. Treatments lasted 1.5 month when rowcover was removed. Soil and air temperatures were monitored during the trial and plant growth (root and vines) was evaluated. Sweetpotato responded favorably to plasticulture in early spring planting. Plastic mulch increased soil temperature and rowcover increased both soil and air temperatures favoring fast growth of sweetpotato roots and vines. Average daily soil and air temperatures under mulch and rowcover in the first 6 days increased 4.7 °C and 6.7 °C, respectively. Root growth in the first 6 days increased under mulch and/or rowcover. After 45 days when rowcover was removed, vine fresh weight and length under rowcover was 5 and 6 fold higher than control, respectively. In conclusion, this technology enhances field propagation of certified planting material in early spring and may reduce planting costs for sweetpotato seed-stock production.

A Comparison of Ethephon and Conventional Vine Removal Systems for Mississippi Sweetpotato

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Sweetpotato is a perishable root crop that is exposed to mechanical damage during harvest and packaging. Much of the mechanical damage is the removal of small amounts of epidermal layers, "skinning." Skinning allows for transpiration weight loss during storage and lowers the overall appearance and consumer acceptance of the produce. Removal of the vines prior to harvest aids efficiency by minimizing interference with the harvest equipment. Another benefit to vine removal is an apparent increase in maturity of the sweetpotato roots. This is realized in the epidermal layers adhering to the sweetpotato root more tightly. Small plot research was conducted in 2007 and 2008 along with a replicated strip plot utilizing the same treatments to evaluate mechanical and chemical methods to reduce sweetpotato skinning injury in Mississippi. Treatments were: mechanical removal of the vine (mow), ethephon 6 lb ai/gal at 8, 16, 32, or 48 oz/acre rates, and a control mow day of harvest at three application timings 1, 3, or 7 days before harvest (DBH). Vines were mowed the day of harvest on all ethephon treatments. Ten medium sized roots from each plot were examined for skinning injuries immediately after harvest. In 2007, injury ratings for timing averaged across treatments ranged from 4.5 to 16.8 for 7 DBH and 1 DBH timings, respectively. The 7 DBH timing was greater than the 3 DBH which was also greater than the 1 DBH timing. In the 2008 small plot trial the 7 DBH timing, 6.6 injuries, was greater than the 1 or 3 DBH timings with 9.2 root injuries each. In the 2008 strip trial the 1 DBH timing had more injuries, 5.2, across treatments than the 3 or 7 DBH timings, 2.4 and 1.8, respectively. In all trials the longer the treatment was applied prior to harvest, either chemical or mechanical, the lower the incidence of root injury.

The Use of Soil Amendments and Foliar Nutrients to Improve Sweetpotato Yield

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A trial was established in 2008 to evaluate the effects of Hydra-Hume DG and several nutrient products on yield of sweetpotato at the Pontotoc Ridge-Flatwoods Branch Experiment Station. Treatments were Hydra-Hume DG @ 40 and 60 lb/acre applied for 2 and 3 years, Hydra-Hume DG @ 40 lb/acre plus Kayphol 0-0-33 @ 1 and 2 qt/acre at 60 DAT, Helena Acres System (Hydra-Hume @ 40 lb/acre followed- by Coron 10-0-10 + 5% B @ 1 qt/acre plus Ele-Max PhosCal-zinc @ 2 qt/acre plus Coron FullBor 12-0-0 + 5% B @ 8 oz/acre at 20 DAT, followed-by Coron 10-0-10 + 5% B @ 2 qt/acre plus Coron FullBor 12-0-0 + 5% B @ 8 oz/acre plus Ele-Max Phoscal LC 3-23-0 @ 8 oz/acre at 35 DAT, followed-by Coron 10-0-10 + 5% B @ 1 qt/acre plus Kayphol @ 2 qt/a at 55 DAT, followed-by Ele-Max PhosK-Mag LS @ 2 qt/acre at 75 DAT), and an untreated with no fertilizer. A standard fertilizer 50-50-200 lb was applied to the study area, except for the untreated plots. Plots were harvested using a one-row chain digger 103 and 117 DAT in 2007 and 2008, respectively, and graded. Analysis of variance was conducted and means were separated using Fisher's protected LSD ($\alpha = 0.10$). In 2007, US No. 1 grade yield was not different than the standard fertilizer program compared to any nutrient program tested. However, the Helena Acres program yielded at least 30 more boxes of No. 1 grade sweetpotatoes compared to all other treatments. In addition, Total Marketable grade yield with the Helena Acres program was greater compared to the standard fertilizer program. In 2008, US No. 1 grade yield for all treatments was greater than the untreated check, except the 2nd year application of 60 lb/acre Hydra Hume. Total marketable yield was not different for any treatment compared to the standard fertilizer program. The difference in yield between years could be a result of early verses late season rainfall in dry-land sweetpotato.

Observations of Adventitious Root initiation and Storage Root Formation Under Field Conditions

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Destructive sampling of plants was conducted starting at 3 days after transplanting (DAT) to observe the initiation of adventitious roots and the onset of secondary meristematic activity in the root stelar region. Under conditions of optimal soil moisture (50% of field capacity), initiation of adventitious roots were observed as early as 3 DAT. Under similar moisture conditions, secondary meristematic activity was observed as early as 13 DAT. Visible pigmented storage roots, defined as more than 0.5 cm at its widest section, were observed as early as 26 DAT. For some plots, soil moisture stress 20 DAT was simulated using a plastic canopy. The plastic canopy was removed 20 DAT and normal irrigation was resumed. Storage root formation was highly variable at 60 DAT from plots with simulated moisture stress. The implications of these observations for optimizing management inputs like transplant quality, irrigation, and nitrogen fertilization will be discussed.

Modeling and Inference Using a Bayesian Belief Network Learned from Empirical Yield Data

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Yield data from 2007 and 2008 were used for structural learning of candidate Bayesian belief networks (BBN) for US#1 yield. The following variables were used: growing degree days, air temperature (mean maximum and minimum), soil temperature (mean maximum and minimum), and mean solar radiation. Agroclimatic variables were measured in 10-day intervals within 30 days after transplanting. Several BN algorithms were used. A BN network that correctly classified 73% of instances in stratified cross validation will be used for demonstration of modeling and inference. This BN was learned using agroclimatic data from 10 to 20 DAT with the tree augmented naïve Bayesian classifier as implemented in Weka v. 3.5.8. Advantages and disadvantages of the Bayesian network approach will be outlined. The potential use of BNs for decision support, quantitative risk assessment, and for further understanding the sweetpotato production system will be demonstrated.

Evaluation of Crop Rotations and Nematicides for Management of Reniform Nematode in Sweetpotato

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Reniform nematode, (*Rotylenchulus reniformis* Linford and Oliveira) is a serious pest of sweetpotato in Louisiana. Reniform nematode is present to some degree in most sweetpotato production fields. Damage from this nematode is difficult to recognize and in most cases no distinct foliar symptoms can be detected. The nematode will result in underdevelopment of roots and in root cracking when high populations are present. The threshold for this pest in Louisiana is 1,000 per pint of soil. At present, no commercially available sweetpotato varieties express resistance to this nematode. Producers currently rely on crop rotation schemes and various chemical nematicides to manage this pest in commercial fields. A crop rotation study was initiated in 2005, to evaluate the effect of several agronomic crop rotations on reniform nematode populations. The study was designed as a randomized block design and plot size was 4 rows by 100 feet. The crops evaluated included: sweetpotato, cotton, grain sorghum, wheat, soybean, corn and fallow ground. Each of the crops was planted for 2 consecutive years followed by 2 years of sweetpotato in all plots. Nematode samples were collected in the fall of each year, following harvest. A separate study was initiated in 2007 to evaluate the efficacy of several labeled nematicides (Temik 15G[®], Telone II[®], KPAM[®] and Pic-chlor 60[®]) in sweetpotato, in a reniform nematode infested sweetpotato field. The study was arranged in a randomized block design and plot size

was 4 rows x 60 feet. Sweetpotatoes (Beauregard 2007, Evangeline 2008) were planted on 12-inch centers and were harvested approximately 110 days after transplanting. All nematicides were applied according to label directions. Yield data and nematode samples were collected at harvest. Cumulative analyses for all years, indicated that non-host crops for reniform nematode (grain sorghum, corn and fallow ground) resulted in the lowest populations of this pest in the crop rotation study. All nematicides evaluated resulted in increased yields compared to non-treated control plots and Telone II® evaluated at a 6-gal rate resulted in the highest yields of all treatments in 2007 and 2008.

Effect of KIH-485 on Weed Control and Sweetpotato Yield

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Research was conducted to determine crop tolerance, grass control, and broadleaf weed control for KIH-485 in sweetpotato. The study was conducted on a Falkner silt loam (Fine-silty, siliceous, thermic Aquic Paleudalfs) in 2008. The experimental design was a randomized complete block design with 4 replications. Field-grown 'Beauregard B-14' slips were transplanted on 3 July. Treatments include KIH-485 at 1.5, 2.0, 2.5, and 3.0 oz/acre applied post-transplant and flumioxazin at 2.5 oz/acre applied pre-transplant + clomazone at 2.66 pt/acre applied post-transplant. Visual observations of crop injury and weed control were made at 4, 7, 21, and 28 days after transplant (DAT). Sweetpotato roots were harvested at 102 DAT and graded into US No. 1, Canner, Cull, and Jumbo grade yields. Analysis of variance was conducted on weed control and yield using Fisher's protected LSD ($\alpha = 0.05$). At 4 DAT, sweetpotato injury was observed at 5% for all KIH-485 treatments, with no injury observed for the Valor + Command treatment. No other injury was observed after 4 DAT. Pigweed control was at least 90% for all treatments at 21 DAT. At 28 DAT, all KIH-485 treatments controlled pigweed at least 90%, which was higher than Valor + Command. Grass control was at least 90% at 7 DAT for all treatments except KIH-485 at 1.5 oz/acre. At 28 DAT, grass control ranged from 73% to 90% for KIH-485 at 1.5 oz/acre and Valor + Command, respectively. A rate effect was observed for grass control. US No. 1 yield ranged from 5 to 288 boxes/acre for the untreated and Valor + Command, respectively. Total marketable yield ranged from 23 to 441 boxes/acre for the untreated and Valor + Command, respectively. The highest yielding treatment of KIH-485 was the 3-oz rate, which yielded 273 and 390 boxes/acre for US No. 1 and Total marketable, respectively. This yield was comparable to the treatment of Valor + Command.

Effects of Meristem Culture on Yields of Heirloom Sweetpotatoes in the Field

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During 2005-2007, 23 heirloom sweetpotato varieties were taken through meristem shoot tip culture to generate virus-free plants. These cultivars were then grown in 12-plant plots that were replicated four times at the U.S. Vegetable Laboratory during the summer of 2008. These plots included the cleaned-up material ("clean") that had been taken through meristem culture and PCR-tested and the original plant introductions ("dirty") that had been re-infected with sweet potato leaf curl virus (SPLCV) through whitefly transmission by *Bemisia tabaci* (Gennadius) inside a greenhouse. Normal production practices were followed except that no insecticides were applied to these plots. Overall, there were highly significant differences in the weight of the clean vs. dirty plots. All of the varieties had numerically higher yields in the clean plots, and for 12 varieties these differences were statistically significant. The clean plots ranged 1.1 to 7.4 times more yield than the dirty plots. There were also significantly more roots in the clean plots of most of the heirloom varieties. PCR analysis of storage roots and leaf material confirmed that the yield increases were related to the elimination of viruses from these materials.

Sensory Evaluation of Baked and Microwaved Sweetpotato Cultivars and Lines

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Sweetpotatoes harvested in 2008 in the Pontotoc Branch experiment station from the Sweetpotato Collaborators trials were evaluated for sensory quality following the Collaborators guidelines. Hunter color values of the flesh were also measured. The sweetpotatoes were held at 18 °C for ~2 weeks prior to evaluation. They were sorted (size, defects), washed, wrapped in aluminum foil (baking) or Saran® wrap (microwave), and baked (BK) at 185 °C for 65 min or microwaved (MW) on high in a 900-W oven for 5 minutes. The cooked roots were allowed to equilibrate to room temperature (~25°C) before evaluation by an experienced panel. The cooked products were rated on a 10-point scale with 6 being the minimum for acceptability. The panelists rated the check ('Beauregard') as the baseline. 'Evangeline' scored highest on appearance, color intensity and uniformity. Hue and Hunter 'a' values for 'Evangeline' were closest to the orange color and chroma was the highest, confirming the deep orange color of this line, regardless of cooking method. 'Covington' scored the highest on flavor (mainly sweetness). Evangeline followed by 'NC99-573' had the highest total (overall) scores than other cultivars/lines, regardless of cooking method. Scores for all cultivars/lines evaluated were acceptable but the white-fleshed lines scored lower due mainly to lower mouthfeel scores (slightly dry).

Vegetable Crops Section—Watermelon

Georgia Watermelon Variety Trial and Pollenizer Evaluation

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Watermelon varieties were evaluated at the Vidalia Onion and Vegetable Research Center in Lyons, GA, in 2008. In addition, pollenizers were evaluated at this location in 2007 and 2008. For the variety trial and pollenizer study, seed were sown in a greenhouse by a local commercial grower on 10 Mar. 2008 and grown according to University of Georgia Cooperative Extension Service recommendations. Transplants were set on 10 Apr. 2008 in a randomized complete-block design (RCBD) of 4 replications with 10 plants per replication. Plants were grown according to University of Georgia Cooperative Extension Service recommendations. Plant spacing was 4 ft in-row with 6 ft between-row. All the entries were triploids so alternate rows were transplanted with diploid variety 'Jamboree', as the pollenizer. Fruit were harvested on 30 June and 1 July 2008. Two fruit from each plot were measured for length, width, rind thickness, soluble solids, and firmness. The pollenizer study was arranged with alternating plots of watermelon and cantaloupe to isolate adjacent watermelon plots and was arranged as a RCBD with 3 replications. Cultural practices and spacing were as in the variety trial. Plants were transplanted on 31 May and harvested on 9 Aug. in 2007 and transplanted on 14 Apr. and harvested on 2 Jul. in 2008. Pollenizer transplants were set every 2nd plant. The triploid variety used was 'Wrigley', which was also included in 2007 as a "pollenizer" treatment to validate the spacing. Other pollenizers evaluated included 'SP4', 'Companion', 'Ace', 'WSB108-6000', and 'Jamboree'. In the variety trial, there were no differences in yield between the entries, which averaged 48,279 lb/acre. All the entries were small Crimson Sweet types and the range of soluble solids was 10.0% to 12.2%. Trial conditions were very good with all CVs at or below 27%. In 2007, the pollenizer study had the lowest yields when 'Wrigley' was used as a pollenizer. The highest yields were with 'SP4' and 'Ace'. Using 'Jamboree' as the pollenizer resulted in low yields

comparable to 'Companion' and 'Wrigley'. In 2008 there were no differences between pollenizer sources.

Economics of Using Watermelon Juice as a No-cost Diluent and Supplemental Sugar Source for Fermentation of Molasses in Ethanol Production

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In Dec. 2007, Congress passed an energy bill that mandated a 5-fold increase in ethanol production by 2022 to decrease the nation's dependence on petroleum products. One of the readily available sources for ethanol production is molasses, which is a by-product of sugar production. This economic study was undertaken to determine the gross revenue potential of integrating a watermelon neutraceutical production facility with an ethanol production plant utilizing molasses as a primary feedstock. Watermelon has been found to contain several neutraceutical compounds that are beneficial for healthy living. Two of these chemicals are lycopene, which has been found to reduce incidence of male prostate disease, and citrulline, which is a vasodilator that can reduce blood pressure. During the chemical extraction process from fresh watermelons, a considerable volume of waste products is generated, which consists of sugar-loaded juice and carbohydrate-loaded rind. These by-products can be converted into ethanol, thereby reducing the amount of solid materials that would be placed into the waste stream while providing additional income to the neutraceutical facility. At assumed market prices of \$5/gm, \$50/kg, and \$1/gal for lycopene, citrulline, and ethanol, respectively, gross revenue of \$5161 could be expected from 50,000 lb of watermelons produced on 1 acre of land. This is comparable to the \$5000 expected gross revenue from 50,000 lb of watermelons sold at an average price of \$0.10/lb on the fresh market. Ethanol production from molasses requires that the 50% sugar-laden liquid be diluted to a maximum of 25% sugar for optimum fermentation of the sugars. If the molasses is diluted with potable water, a single run for a 40,000-gal fermenter would cost \$12,580. If the molasses was diluted with a zero cost 10% sugar waste watermelon juice from a neutraceutical process, the 40,000-gal mixture would cost \$9,375.20, or a cost savings of \$3,204.80 per 40,000-gal batch. Thus, integrating a small-scale ethanol-from-molasses facility with a watermelon processing neutraceutical facility would reduce waste by-product costs and reduce the total cost of ethanol production.

Markers Linked to the ZYMV-FL Resistance Gene and Their Use in Marker-assisted Selection in Watermelon

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Zucchini yellow mosaic virus (ZYMV) is a major pathogen that reduces yield in cucurbits. The best studied strains include ZYMV-FL and ZYMV-CH of which resistance is conferred by a single recessive gene in watermelon. Bulk segregant analysis was used for watermelon populations derived from PI 595203, a line with ZYMV-FL and ZYMV-CH resistance and NHM, a susceptible cultivar. A single marker, Zucchini Yellow Resistance Polymorphism (ZYRP), was identified that is linked to the ZYMV-FL resistance gene and a SCAR marker was generated. These markers were used for marker-assisted selection (MAS) to generate a BC₂F₂ population derived from the donor parent PI 595203 and the recurrent watermelon cultivar Charleston Gray. Progeny from the BC₂F₂ population exhibited resistance when in possession of homozygous allele from PI 595203. Loss of resistance was seen in resistant BC₂F₂ plants when compared to the resistance from PI 595203. These newly identified markers are linked to ZYMV-FL resistance and can be useful in a MAS breeding program not only in watermelon, but in other cucurbits.

New Flesh Colors in Watermelon?

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There are currently six published flesh colors in watermelon along with the associated genes for each of the designated flesh colors. Previous results have shown that segregation patterns did not fit with published results for canary yellow and red flesh. We believe that part of the problem has been that previous studies focused on the phenotype, and did not include carotenoid profiles to designate the phenotype. We used carotenoid profiles along with visual color ratings to designate phenotype, and have identified pale yellow as a distinct phenotype that was probably confused with white flesh in previous investigations. This pale yellow phenotype is controlled by a single recessive gene, has very low levels of carotenoids but is distinct from white flesh, which contains no carotenoids. Pale yellow is controlled by a single recessive gene (py) that is only expressed in the presence of a dominant C gene, which confers canary yellow flesh. We have also discovered a green flesh phenotype that contains significant amounts of chlorophyll. It is believed that green flesh is easily overshadowed by high levels of carotenoids so that it may not always be visible; therefore biochemical analysis may be necessary to identify the presence of chlorophyll in the flesh. These new flesh colors mean that there are now eight designated flesh colors in watermelon: White, Salmon Yellow, Orange, Crimson Red, Scarlet Red, Pale Yellow, Canary Yellow, and Green.

Grafting for Management of Root-knot Nematodes in Watermelon

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Five wild watermelon (*Citrullus lanatus* var. *citroides*) germplasm lines, four bottlegourd (*Lagenaria siceraria*) cultivars, one squash (*Cucurbita moschata* × *C. maxima*) hybrid, and one commercial wild watermelon (*C. lanatus* spp.) cultivar were evaluated as rootstocks for watermelon in a field infested with the southern root-knot nematode, *Meloidogyne incognita*, in Charleston, S.C. in 2007 and 2008. Rootstocks were grafted to the scion diploid watermelon (*C. lanatus* var. *lanatus*) 'Fiesta' in 2007 and to the scion triploid watermelon 'Tri-X 313' in 2008. In 2007, four *C. lanatus* var. *citroides* germplasm lines and the commercial wild watermelon rootstock had significantly less ($P < 0.05$) root galling than non-grafted 'Fiesta' watermelon, the *L. siceraria* rootstocks, and the *C. moschata* × *C. maxima* hybrid rootstock. In 2008, three *C. lanatus* var. *citroides* germplasm lines had significantly less root ($P < 0.05$) galling than non-grafted 'Tri-X 313' watermelon, the *L. siceraria* rootstocks, and the *C. moschata* × *C. maxima* hybrid rootstock. The *L. siceraria* rootstock and the *C. moschata* × *C. maxima* hybrid rootstock exhibited severe root galling in both years (80% to 96% in 2007, and 96% to 100% in 2008). Root galling was moderately severe for non-grafted 'Fiesta' (40%) and 'Tri-X 313' (56%) watermelon. The commercial wild watermelon rootstock had 24% and 39% root galling in 2007 and 2008, respectively. Root galling for germplasm lines derived from *C. lanatus* var. *citroides* ranged from 11% to 34%, and 32% to 42% in 2007 and 2008, respectively. *Citrullus lanatus* var. *citroides* germplasm lines may provide a source of resistance that will be useful in developing root-knot nematode resistant rootstocks for watermelon.

Planting Density and Its Effects on Yield and Quality of Grafted Triploid Watermelon, 2008

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There is interest in the use of grafted plants in commercial vegetable production in the United States. A primary reason is they

can confer increased disease resistance. Some diploid watermelon cultivars are resistant to fusarium wilt, race 1, but no cultivars are resistant to race 2. Nearly all triploid watermelon cultivars are susceptible to fusarium wilt, races 1 and 2. Because watermelons lack resistance to both races of fusarium wilt, and more soils are harboring this pathogen, this disease is a threat to the industry. Grafted plants are more expensive than nongrafted plants; however, certain rootstocks can confer resistance to watermelon. High cost of grafted plants is a barrier to adopting this technology. The goal of this study was to reduce planting density of grafted watermelon plants yet maintain acceptable yields. We evaluated rootstock 'Shintosa Camel' (interspecific *Cucurbita* hybrid) with scion 'Tri-x-313' triploid watermelon and compared with nongrafted 'Tri-x-313' watermelon at four planting densities (8, 24, 40 and 56 ft² per plant; 1, 3, 5, and 7 ft in-row spacing, respectively by 8 ft between rows). Treatment comparisons were made for yield (number and mass) and quality (fruit size, hollow heart occurrence and severity, soluble solids, hard seed). Tests were conducted at four locations; Kinston, NC, Charleston, 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 the pollenizer. Cultural management practices were followed according to recommendations within each state. Four harvests were made in all locations. The fruit traits total soluble solids, hollow heart, and hard seeds were not influenced by treatment. However, fruit size averaged 1 lb more across all harvests with 'Shintosa Camel' than with nongrafted 'Tri-x-313'. Yields for both the early (first) and total harvests were increased with 'Shintosa Camel' compared with the nongrafted plants. Yields, both fruit number and mass, increased as planting density increased for both grafted and nongrafted plants. Fruit size was significantly reduced at the lowest planting density compared with the three wider planting densities. Wider spacing (8 ft × 7 ft and 8 ft × 5 ft) had significantly higher fruit mass and fruit number per plant than the closer plant spacings. Yields of watermelons were similar with grafted 'Shintosa Camel' and nongrafted 'Tri-x-313' at comparable planting densities. Therefore, similar planting density should be used to optimize yields of grafted watermelon using rootstock 'Shintosa Camel'.

2007 and 2008 Watermelon Cultigen Yield and Quality Trial Results in North Carolina

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Forty-two and 40 advanced lines or cultivars (cultigens) were evaluated in 2007 and 2008, respectively, at the Central Crops Research Station in Clayton, NC, to compare watermelon yield and quality among cultigens grown in the southeastern United States. Over 20 of the same cultigens were included in both trials. A randomized complete design was utilized using four replications per treatment. Seeding was early April, while transplant in the field was early May. Recommended cultural practices for watermelon were used during the season including growing the plants on black polyethylene mulch with drip irrigation. Transplants were set in-row 2.5 ft apart while row centers were 10 ft. Four harvests were made every 7 to 10 days both years. Each fruit was harvested and weighed. Fruit were considered marketable when fruit were 8 or more pounds in 2007 and 10 or more pounds in 2008. Fruit number and mass were determined on a per acre basis. Some key fruit quality characteristics that were measured included average fruit weight, percentage and severity hollow heart, and firmness of the mesocarp. 'Crunchy Red', 'Vagabond', 'Firm N' Red' and 'Super Seedless 9651' had the firmest mesocarp both growing seasons. Nearly all fruit had minimal hollow heart in 2007, with more incidence and severity in 2008. The following cultigens had the most unmarketable fruit (25%) due to serious hollow heart; 'Sweet Slice Plus' and 'SW 2988' in 2007, while eight of the 40 cultigens had at least 25% serious hollow heart in 2008. The cultigens that consistently produced the largest average fruit size both years were 'Crunchy Red' and 'Matrix', while the smallest average fruit size was produced by 'Triple Threat' scion x 'Emphasis' root stock, 'CS 4804', 'SW 139', 'Amarillo' (yellow flesh type), and 'SW 3988' in 2007, and 'Consti-

tution', 'Verde Roo', 'Tri-x-Triple Threat' and 'Imagination' in 2008. Fruit yields were quite variable for a given cultigen from season to season. Fruit number per acre ranged from 2600 to 5000 in 2007 and 2100 to 5300 in 2008. Fruit mass per acre ranged from 36,000 to 69,000 lb per acre in 2007 and from 25,000 to 83,000 lb per acre in 2008. Results for mesocarp firmness seemed more consistent than yields over seasons. Increasingly, fruit quality such as hollow heart and mesocarp firmness are being evaluated, especially for the cut fruit, value added markets. Yields, however, must still be high for profitability each year.

Poster Section

Chemical Composition of the Medicinal Plant, *Marrubium vulgare* L., Grown Under Greenhouse Versus In Vitro Conditions

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Marrubium vulgare, white horehound, is known for medicinal properties that are attributed to antioxidants and the novel furanic labdane diterpene marrubiin. Biochemical production using in vitro cultures has been accomplished in other species and may be an approach applicable to this plant. However, work evaluating chemical production of plants grown under in vitro culture conditions is lacking. The objective of this study was to evaluate the chemical composition and leaf characteristics of *M. vulgare* grown under greenhouse and tissue culture conditions. Tissue cultured plants were grown on a Murashige and Skoog medium either with or without plant growth regulators (PGRs).

Total antioxidant capacity was evaluated using the Trolox equivalent antioxidant capacity (TEAC) assay, polyphenol content was measured with the Folin-Ciocalteu method, and furanic labdane diterpene concentration was determined by the 4-dimethylamino-benzaldehyde method. Leaves were examined using light and scanning electron microscopy. The leaf parameters: leaf dry matter content (LDMC), leaf thickness (LT), and specific leaf area (SLA) were contrasted. Tissue-cultured plants grown on media with PGRs had significantly higher TEAC values than greenhouse plants or those on basal media (39% and 37% greater, respectively). A positive linear relationship between TEAC values and total polyphenols was observed. LDMC of greenhouse plants was 2.7 times greater than those grown in vitro. LT of plants grown on media with and without PGRs were 38% and 44% greater, respectively, than greenhouse-grown plants. LDMC and LT were negatively correlated. No significant differences were observed in the other chemical and leaf traits examined. SEM revealed that awn-shaped hairs were more numerous on GH versus tissue-cultured plants, while awn shaped and glandular trichomes were larger in tissue culture plants.

Conserving our Botanical Heritage: Using GPS/GIS as a Conservation Management Tool for *Elliottia racemosa*

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Georgia plume, *Elliottia racemosa*, is a threatened small tree to shrub that is endemic to Georgia. Management of current populations is difficult due to disparate reports of the locations and conditions of populations. Through the use of Geographic Information Systems (GIS) and the Global Positioning System (GPS), efficiency in managing records of populations and locating sites can be greatly increased by allowing attribute data to be stored along with geographic data. Spatial analysis of data can also be performed quickly and easily in the digital environment. In this study, analyzed geographic information was integrated from the Georgia Department of Natural Resources, the Georgia Plant Conservation Alliance, the Georgia GIS Data Clearinghouse, several

Georgia Regional Development Centers, and the USDA Natural Resource Conservation Service Geospatial Data Gateway using ESRI ArcGIS software. Many of these data sources provide information at no cost. A data entry form was also created for use in later field work. This form will speed collection of data by standardizing information and simplifying data input. Site characteristics analyzed included geographic, climatic and anthropic variables. It was possible to show populations in relation to these variables. Performing basic comparative site analysis before going into the field is achievable. This work can be used to identify priorities for populations in need of conservation attention (i.e. those near cities and in danger of being destroyed by development). It is also hoped that using GIS and GPS technology with Georgia plume will serve as a model system for other endangered and threatened plants.

Effects of Salt Sources and Rates on Three *Taxodium* Genotypes

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Abbreviated as BC, MC, and T302, Baldcypress (*Taxodium distichum* L Rich var. *distichum*), Montezuma cypress (*Taxodium distichum* var. *mexicana* Gordon), and *Taxodium* x 'Nanjing Beauty' (a hybrid - BC x MC) were subjected to chronic salt applications for eight weeks in a container study. This short-term study tested the effects of NaCl and KCl/CaCl₂ on the leaf water potential and elemental concentrations in three genotypes of *Taxodium distichum*. This study was initiated 19 Oct. 2008, utilizing a randomized block design with three genotypes and 24 plants per genotype per block. Treatments were four 4 levels of salinity (0, 51, 102, 204 mole/m³) created by two sources of salt solutions (NaCl and a combination of KCl and CaCl₂). Leaf water potentials were measured predawn on a weekly basis. The dried plant samples were ground in a cyclone grinder and analyzed for plant nutrient concentration. A nitric acid (HNO₃) and 30% hydrogen peroxide wet acid digestion was used to prepare the samples for P, K, Na, Ca, and Mg analysis using Inductively Coupled Argon Plasma Spectroscopy. In KCl/CaCl₂ solution, T302 exhibited the highest content of Ca and K; BC had lowest content of K. In NaCl solution, T302 exhibited the highest content of K and leaf Na. BC had lowest content of K. All three genotypes had higher contents of Ca, K and lower contents of Na, Mg in KCl/CaCl₂ solution than in NaCl solution. BC showed the severest damage symptoms, followed by MC, and T302 showed the least. The leaf water potential in *Taxodium* decreased as the salt rates increased. T302 has the highest leaf water potential, BC has the lowest, MC was in between. Results indicate that MC and T302 have more salt tolerance than BC. In NaCl solution, the concentration of Na in *Taxodium* significantly increased as the salt rates increased. In KCl/CaCl₂ solution, the concentration of K and Ca in *Taxodium* increased as salt rates increased.

Boston Fern Production in Whole Pine Tree Substrates

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An experiment was conducted to evaluate processed whole pine trees (*Pinus taeda* L.) (WPT) as an alternative container substrate for Boston fern production. Three WPT substrates and a commercial peat-lite mix (PL) were each amended per cubic meter with 0.59 kg micromax, 2.37 kg Harrell's 16-2.6-10 Plus (4-5 month formulation) and 4.75 kg Harrell's 18-2.6-10 (9-10 month formulation). The pH of each substrate was modified with the addition of dolomitic lime (100% WPT = 0.59 kg/m³, 3:1 WPT:Peat = 1.19 kg/m³, 1:1 WPT:Peat = 1.78 kg/m³, and PL = 2.37 kg/m³), each ranging from 4.5-5.0 pH at the beginning of the experiment. On 21 Sept. 2007, liners (0.47 L) of true Boston fern [*Nephrolepis exaltata* 'Massii' (L.) Schott] and dwarf Boston fern [*Nephrolepis exaltata* 'Bostoniensis Compacta' (L.) Schott]

were planted in hanging baskets (4.6 L) filled with substrate. Containers were placed on the ground in a shaded greenhouse and drip irrigated twice daily with a low or high irrigation volume. The WPT substrates had a significantly lower pH at 32 DAP and project termination compared to the PL substrate. At project termination, pH ranged from 3.17 in 100% WPT to 5.13 in the PL substrate. Substrate EC was significantly lower under high irrigation in the PL substrate at project termination for each cultivar. Plants under high irrigation had consistently greater plant growth index (PGI), regardless of substrate. Shoot dry weight (SDW) was consistently greater for plants subjected to the high irrigation treatments, regardless of substrate. No significant differences in PGI or SDW occurred between substrates within irrigation treatments. Differences in substrate physical properties were observed. The PL substrate had 50% less air space and 25% higher water holding capacity compared to the WPT substrate. The air space for 100% WPT was slightly above the recommended range, although all other physical characteristics for each substrate were within acceptable ranges.

Using Vermicompost in Container Substrates

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The horticulture industry is continuing to show interest in composted or similarly stabilized organic waste products as components for container potting substrates. Vermicompost has been shown to enhance chemical and physical characteristics of potting substrate and improve plant growth. *Cleome hassleriana* was grown in a commercial potting substrate amended with vermicompost produced from beef cattle manure. *Cleome hassleriana* plugs were transplanted into 6-inch containers containing treatments of 0% (control), 10%, 20%, and 40% vermicompost: potting substrate (v/v). Data collected after 54 DAT included height and growth index, stem weight, and leaf area. Plant height and growth index were similar for the control and 10% treatment and greater than the 20% and 40% treatments. Dry stem weights were greater for the control, 10% and 20% treatments compared to the 40% treatment. There were no differences in leaf area among the treatments. One of the limitations of research using vermicompost in container potting substrates is often only reporting on single waste source products. More research is required to elucidate plant growth differences in substrates amended with vermicompost produced from differing waste stream products.

Growth Regulation of Loropetalum and Azalea in Landscape Beds

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In commercial and residential landscapes, a compact shape is highly desirable for shrubs planted as foundation plants such as loropetalum and azalea. Pruning foundation shrubs is a landscape maintenance task requiring intensive labor. Plant growth regulators (e.g., gibberellic acid biosynthesis inhibitors) may reduce shoot growth and promote lateral branching and reduce labor cost. Effects of the granular formulation of flurprimidol, Cutless 0.33 G were evaluated at 0.5, 1, or 2 pounds a.i. per acre applied either under or above pine straw mulch in landscape beds planted with azalea and loropetalum plants, and compared to Amtrimmec (dikegulac-sodium) which is applied as a foliar spray at 0, 1600, and 3200 mg-L⁻¹. Pruning alone provided some growth control to slow growing azalea 'Sunglow' but did not control the fast-growing loropetalum 'Merlot Lace'. Cutless 0.33 G provided prolonged control effect compared to Atrimmec on loropetalum but not on azalea. One pound a.i. per acre Cutless 0.33G provided similar control as 2 lb a.i. per acre and is recommended for loropetalum chemical pruning in the landscape. Applying under or above pine straw mulch resulted in similar control throughout the study with applying above provided better control at some sample dates. Therefore, landscapers can use Cutless 0.33 G above pine straw mulch without concerning the potential absorbent effect of the mulch.

Evaluation of Seven Mulching Treatments for Organic Rabbiteye Blueberry Production

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Organic blueberry production is increasing in Georgia, but only limited data are available on the performance of various mulches in organic production systems. This study evaluated the effect of seven mulches on growth, yield, and weed control in 'Brightwell' rabbiteye blueberry on a good blueberry soil. The treatments were: 1) unmulched control, 2) coarse pine bark, 3) pine straw, 4) peanut shells, 5) wheat straw, 6) landscape fabric (Tyvar type material, non-woven), 7) black plastic ground cover (woven), and 8) white-on-black plastic. The organic mulches (treatments 2-5) were applied to achieve a layer 4 in. deep after settling. With the synthetic mulches (treatments 6-8), the hole around the plant (~12-inch diameter) was sealed with pine bark mulch. Despite periodic weed problems the first year, the bushes grew very well and produced a good crop the second year. In 2007, wheat straw, pine bark, and woven ground cover produced significantly larger bushes compared with the unmulched control. In 2008, wheat straw, pine bark, and white-on-black plastic tended to produce the largest bushes, but the difference was not statistically significant ($P > 0.05$). In 2008, yield in the first and second harvest was not significantly different between treatments. However, compared with the unmulched control, there was a trend toward a higher yield in the third harvest with woven ground cover (34% higher). Total yield was numerically highest for woven ground cover and pine bark, both of which produced more than 2 lb per plant (about 1500 lb per acre), a good yield for the second-leaf plants even by conventional standards.

Recent Experiments Involving 'Veinte Cohol': A Short Cycle Banana for Fruit Production In Non-tropical Environments

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Most cultivars of banana require 9-15 months of warm, frost-free weather to produce mature fruit. The production of fruit from bananas in warm temperate climates can be approached using one of several methods. One methodology for the production of fruit in these climates involves carrying modest-sized plants through the winter in a protected environment and transplanting them into the soil after the danger of frost has passed in the spring of the following year. After screening >50 cultivars of bananas in this approach, a little-known cultivar, 'Veinte Cohol', was found to perform very well using this method. Preliminary results employing 'Veinte Cohol' for edible fruit production in the warm temperate conditions in southeastern Georgia have recently been published. This method for fruit production relies on transplanting a 'Veinte Cohol' plant (that had been overwintered in a cool greenhouse) into the soil in mid-April. If the transplant is of sufficient height at the time of planting, mature fruit can be harvested by mid-October. One experiment carried out during the past growing season was aimed at determining the minimum height transplant needed to ensure mature fruit production employing this method. The preliminary results from the most recent set of experiments suggest that transplanted 'Veinte Cohol' suckers as small as 1.5 ft (pseudostem height at planting) will reliably produce mature fruit using this method. The average bunch weight from this set of experiments was ~17 lb with an average number of fingers per bunch of ~160. Although a number of banana cultivars will produce flowers and immature fruit using this approach, only 'Veinte Cohol' has been capable of reliably producing mature fruit in our climate using this method. The key to success with this approach lies in the short cycling time (both planting to flowering and flowering to fruit maturation) displayed by 'Veinte Cohol'. This discovery may represent a major breakthrough in banana production in warm temperate climates. Extrapolated yields are >15,000 pounds per acre (employing a 6 x 6 ft plant spacing).

Evaluation of Fresh Seed Yield of Southern Pea Genotypes in Southern Arkansas

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There is a need to identify very productive southern pea genotypes for an increasing market demand for fresh pea consumption in southern Arkansas. This study evaluated six southern pea genotypes (UAPB1, UAPB2, Early Scarlet, Empire, LA Purple, and Top Pick) in 2008 at two locations in randomized complete-block design with four replications to determine their fresh seed yield and the relationship between fresh seed yield and yield components. No interaction between genotype and location was observed. Genotypes (UAPB2, Early Scarlet, and Top Pick) with higher fresh seed yields also tended to have higher harvest indices. Fresh seed yield (on a dry weight basis) and harvest index ranged from 243.2 to 355.1 g·m⁻² (average seed moisture = 59%) and from 21.6% to 28.1%, respectively. Significant positive linear correlation coefficients ($P < 0.05$) were observed between fresh seed yield and pods/node ($r = 0.38$) and seeds/pod ($r = 0.51$). Significant path analysis direct effects of plant population, fertile nodes/plant, pods/node, seeds/pod, and seed weight on fresh seed yield were 0.49, 0.39, 0.52, 0.54, and 0.48, respectively. Negative indirect effects of plant population through fertile nodes/plant, fertile nodes/plant through plant population, pods/node through seeds/pod, seed weight through pods/node and seeds/pod were -0.28, -0.35, -0.15, -0.17, and -0.11, respectively. Sixty-nine percent of the variation in fresh seed yield was accounted for by a model including plant population, nodes/plant, pods/node, seeds/pod, and seed weight. Future studies should focus at improving fresh southern pea production by increasing fresh seed yield and the correlation between fresh seed yield and seeds per pod and pods per node.

Effect of Continuous and Rotated Crop Sequences on Vegetable Production by Limited Resources Farmers in Arkansas

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Growing vegetable crops on the same limited acreage without rotation is not a sustainable cropping system for limited resources farmers in Arkansas. Demonstration studies were conducted to evaluate yield trends between 2006 and 2008 for different summer crops (sweet potato, squash, sweet corn followed by southern peas, southern peas) followed by fall greens (broadleaf mustard or turnip) under continuous and rotated crop sequences at Pine Bluff and Lonoke research stations. Management practices for each crop were similar to what the farmers use on their farms. Southern pea and sweet corn crops did not produce yields due to summer drought and heat stresses or due to early and late planting. Sweet potato yields decreased in continuous and rotated crop sequences; but the yield decrease was more pronounced under continuous crop sequences. Compared to rotated sequences, the highest marketable US1 yield decreases in continuous sequences at Pine Bluff were 141 and 173 bushels/acre for Beauregard and Covington sweet potato varieties, respectively. Squash yields in rotated sequences were 22.7% higher than in continuous sequences in 2008. Also, in 2008, the highest yields for fall greens occurred when southern peas was the previous crop, and the lowest yields when the previous crop was sweet potato or sweet corn. Previous southern pea crop had a stimulating effect on the following fall greens; however, late planting of fall greens following sweet corn and sweet potato and/or poor nutrient supply may have resulted in less than optimum growth conditions of fall greens. In short, the rotated sequences of sweet potato and squash followed by fall greens produced higher yields than all other continuous crop sequences studied.

Efficacy of Foliar Spray for Management of Downy Mildew of Winter Squash

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Control of downy (*Pseudoperonospora cubensis*) mildew on 'Sweet Dumpling' winter squash (*Cucurbita maxima*) was evaluated at the

University of Florida, IFAS, Indian River Research and Education Center (IRREC) in Fort Pierce, FL during Spring 2008. Five foliar spray fungicide treatments were evaluated against an untreated control. Downy mildew ratings (estimated percentage of foliage damage) and marketable yields (mt/ha) were measured. The first appearance of disease was 2 Apr., early. Plants in the untreated plots had significantly higher downy mildew ratings during the first two ratings. All fungicide treatments significantly reduced the downy mildew, some as much as 75%, until the final rating. The two Revus-based protocols and weekly applications of Previcur Flex + Manzate 75 DF were particularly effective. There were significant differences among treatments compared to the control for marketable yield. Marketable fruit was up to 1.5 times higher where effective fungicides were sprayed.

Phenotypic Variability of Hot Pepper (*Capsicum annuum* L.) Breeding Lines

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A hot pepper breeding project at the University of Arkansas at Pine Bluff Agricultural Research Center developed new populations from a Habanera/Scotch-bonnet natural cross. The segregating populations in the 3rd generation exhibited remarkable variability. Eight selected lines were grown in two-row plots, 20 plants in each row, along with the parental lines in 2008. Data on pepper (fruit) yield, fruit length and width, and their length-width ratio were analyzed to estimate means and variances for determining the extent of variability within and between progeny lines. Statistical means and variances as measures of phenotypic variability within and across progeny lines were remarkably high indicating good selection potentials in per-plant yield, individual fruit size, and fruit length & width. The mean progeny yields per plant were less than that of the parental yield, especially Habanera (35.62 g/plant). Fruit length was the most variable trait (39.25) followed by fruit width (22.26). Length-width ratio was the least variable parameter (1.21). Although the observations were made on a relatively smaller population size, considerable variations were available to make plant selection for better yield and desirable fruit characteristics. Conclusive results are expected in two or three more generations of selection.

Horticulture as Therapy

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In a time when marketing is so important to the green industry, it is imperative that the many benefits of horticulture be recognized. Horticulture therapy is one avenue in which the industry touches people's lives in a qualitative manner. It is well documented that green spaces, plants, and floral arrangements boost mood. Horticulture therapy takes that notion a step farther by providing opportunity for people-plant interaction. The process of combining plants and people is at the core of horticulture therapy. As a treatment used in psychiatric settings, horticulture therapy programs strive to create environments that promote and allow for growth. The Mental Health Association of Mississippi is an advocacy agency giving voice to the mental health needs of three coastal counties. The Association's Opal Smith Day Support Center provides recreational, social, and work skills training opportunities for persons with a mental illness or experiencing homelessness. An initial invitation to help the Center's clientele plant flowers in containers has grown to become a quarterly programming opportunity. Programs now include container gardening, vegetable identification, preparation and nutrition, as well as food hygiene. The goal of this work is not only to educate those citizens with mental health concerns, but also to promote cognitive, physical, psychological, and social functioning through the use of horticulture. Feedback from participants has been overwhelmingly positive. In some instances, the clients have never even planted a seed before. The experience of nurturing a living thing throughout the season instills a sense of wonder and pride in the patients. Throughout the exercises, clients are encouraged to ask questions and participate in discussion. Often questions arise about the particulars of the plants and the handling of

the material. On many occasions, clients simply share their own gardening experiences with the group. While the field of horticulture therapy is rapidly growing, there is still a great need for applied research.

Field Trials of Tissue Culture Taro (*Colocasia esculenta*) in the Northern Mariana Islands

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The Commonwealth of the Northern Mariana Islands consists of a group of islands in the Western Pacific. Taro (*Colocasia esculenta*) is one of the important subsistence food crop grown in the Northern Marianas, which continues to provide an important contribution to the dietary needs of the population and food security through out the year. The quality and production of taro crop is severely affected in recent years by the introduction of major diseases and pests such as taro leaf blight impacting on taro production. The downturn in the islands' economy, natural disasters such as droughts and typhoons, and paucity of quality planting material have also considerable constraints on taro production in the Commonwealth. Cooperative Research, Extension and Education Service department of the Northern Mariana College introduced tissue culture program for the in vitro multiplication and propagation of quality planting material of taro in 2008. New varieties of taro produced in vitro were introduced from the certified institutions and evaluated for the resistance to insect pest and diseases, high yield, taste and superior agronomic characters. Twenty-three varieties of taro propagated through tissue culture were tested at the Agriculture Experiment Station. Field trials and taste testing of new varieties successfully conducted through out the islands of Saipan, Rota and Tinian. Results indicated that new varieties performed well in local soil and climatic conditions of the Northern Mariana Islands. The selected varieties of taro were identified as the economically and culturally important ones that have been tested for superior characteristics in the region.

Strategies for Evaluation and Introduction of Ornamental Germplasm in Virginia

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Beautiful Gardens™ is a multi-institutional plant introduction program established by the Virginia green industry in partnership with Virginia Tech, governmental, and other organizations. Its goals are to provide the consumers with new and underutilized ornamental plants, thoroughly tested in a wide range of climatic conditions; increase the profitability and visibility of the Virginia nursery industry; and present alternative opportunities for Virginia tobacco farmers by involving them in commercial scale liner production. Beautiful Gardens™ established and operates five one-acre test sites throughout Virginia located in USDA plant hardiness zones from 6a to 8a, and AHS heat zones from 4 to 7. Each evaluation site has a comprehensive infrastructure for rigorous plant evaluation, with plant performance data collected by professionals and Master Gardeners. The germplasm is evaluated in replicated trials with 4 plants per genotype compared against 4 plants of industry standard. Data for phenology, resistance/hardiness, and ornamental performance are collected for 3 to 5 years depending on the species. At present nearly 100 genotypes are in trials. Nine underutilized plants have been selected for promotion in 2009:

Helleborus × *hybridus* Pine Knot Strains, *Hydrangea quercifolia* ‘Snowflake’, *Ilex* × ‘Virginia’, *Buxus* × ‘Green Velvet’, *Thuja* × ‘Steeplechase’, *Agapanthus* × ‘Monmid’ *Midknight Blue*[®], *Musa basjoo*, *Stokesia laevis*, ‘Peachie’s Pick’, *Cercis chinensis* ‘Don Egolf’. An ornamental plant breeding program has been established at Virginia Tech, which partners with tissue culture and molecular biology operation at the Institute for Advanced Learning and Research in Danville, VA. Several projects: ploidy breeding in daylily, developing high-throughput propagation protocols for *Helleborus*; developing TC protocols for propagation of native azaleas, and DNA marker development for *Hemerocallis* are directly supported by Beautiful Gardens™ program.

Initial Performance of Non-astringent Persimmons in Central Alabama

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The performance of seven non-astringent Oriental persimmons was evaluated for the first three years of fruit production in Central Alabama. The cultivars included in the study are: ‘Fuyu’, ‘Matsumoto Wase Fuyu’, ‘Izu’, ‘Ichikikei Jiro’, ‘Jiro’, ‘Makawa Jiro’, and ‘Suruga’. The soil was amended to a pH of 6.2 prior to planting and the trees were arranged in a randomized complete block design on 4.6 × 6.1 m (15 × 20 ft) spacing. Fruit yield, fruit size, harvest dates, and fruit quality have been measured since the first year of production (2006). Fruit size, number, and yield have increased considerably each year for all cultivars since the first year, with the exception of ‘Suruga’ –which did not produce a crop in 2008 due to freeze damage. In 2007, ‘Suruga’ had the largest fruit, but a relatively small number of fruit. ‘Fuyu’ (13.7 kg), ‘Matsumoto Wase Fuyu’ (15.5 kg), and ‘Izu’ (10.7 kg) had the highest yields in 2007 and the highest fruit number. Yields were much higher in 2008, with ‘Fuyu’ (63.5 kg) and ‘Izu’ (49.5 kg) producing the highest yields, followed by ‘Matsumoto Wase Fuyu’ (35.3 kg). ‘Matsumoto Wase Fuyu’ has consistently been one of the earliest to

ripen and yielded ripe fruit from October 2 to November 3 in 2008. ‘Matsumoto Wase Fuyu’ is a very high quality eating fruit, but it loses its firmness in a much shorter time frame than the other cultivars. Fruit quality (soluble solids, firmness) has been variable among the cultivars, and more years of production are needed to accurately determine fruit size, quality, and harvest dates.

Performance of New Kiwifruit Cultivars in Central Alabama

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The performance and quality of three new kiwifruit cultivars [one green-fleshed (*Actinidia deliciosa*) and two golden-fleshed (*Actinidia chinensis*)] were evaluated in Central Alabama. ‘Golden Dragon’ and ‘Golden Sunshine’ are golden-fleshed kiwifruit with smooth, hairless skin and relatively low chilling requirements (800 h for ‘Golden Dragon’ and 900 h for ‘Golden Sunshine’). The harvest period for ‘Golden Dragon’ is early to mid September, and the harvest period for ‘Golden Sunshine’ is late September to early October. ‘AU Fitzgerald’ is a green-fleshed cultivar with a chilling hour requirement of 800-850 h and a harvest period from mid to late October. Compared to green-fleshed varieties, golden-fleshed kiwifruit have a higher soluble solid content (SSC) and a higher sugar acid ratio (i.e., SSC/titratable acidity). Hence, the golden-fleshed kiwifruit are sweeter and may be more appealing in terms of consumer preference than the green-fleshed kiwifruit. In terms of nutraceutical value, the golden-fleshed kiwifruit have higher Vitamin C, polyphenols, and antioxidant capacity. Interestingly, the green-fleshed kiwifruit have higher levels of beta-carotene than the golden-fleshed kiwifruit. The green flesh is due to their much higher levels of chlorophyll. Compared to industry standards, the three new cultivars perform exceptionally well in central Alabama due, in part, to their lower chilling hour requirements and fruit quality characteristics. It is anticipated that these new cultivars will perform well for home and commercial production in similar environments, and allow for a lengthy harvest period.