Oral Session Abstracts

104th Annual International Conference of the American Society for Horticultural Science

Westin Kierland Resort and Spa, Scottsdale, Arizona

Presenting authors are denoted by an asterisk (*)

Oral Session 1: Crop Physiology 1

Monday, July 16 2:00–3:30 pm

Room: Lowell A/B

Moderator: Jim Syvertsen; JmSn@ufl.edu

2:00–2:15 pm

Water Relations and Net Gas Exchange of Salinized Carrizo Citrange Seedlings during Drought Stress and Recovery

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We tested the hypothesis that previously salt-stressed plants would recover from drought stress better than non-salinized plants. One-year-old seedlings of the relatively salt-sensitive citrus rootstock Carrizo citrange were fertilized with nutrient solution with or without additional 100 mM NaCl for 7 days; then half of the plants were drought-stressed by withholding irrigation water for 10 days, and re-watered with nutrient solution without salt for 8 days to study recovery. Salinity increased leaf Cl^- concentration and decreased osmotic potential such that leaf turgor was maintained above previously non-salinized plants during drought stress (DS). The salinity-induced osmotic adjustment was not related to any accumulation of proline, quaternary ammonium compounds, or soluble sugars. Net gas exchange and was reduced in all stressed leaves. In non-salinized DS plants, low CO_2 assimilation rate (ACO_2) was related to low turgor whereas in salinized plants, low ACO_2 was related to high leaf Cl^-. After re-watering, net gas exchange did not recover in previously salinized DS leaves which had highest Cl^-, highest internal CO_2 concentrations, and lowest chlorophyll. Plants preconditioned by salinity stress maintained better leaf water status during drought stress due to osmotic adjustment and the accumulation of Cl^-. High leaf Cl^- and Na^+, however, impeded recovery after re-irrigation, however, especially due to the translocation of Cl^- and/or Na^+ from roots to leaves.

2:15–2:30 pm

Physiological Responses of Tomato to Different Rates of Drought Stress

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Understanding how plants respond to drought is important, as drought is a major factor affecting crop productivity throughout the world. Though plant responses to drought have been studied often, observed responses were likely confounded by differences in the rate at which plants were exposed to drought. The objective was to examine the effect of different rates of drought stress on physiological responses in tomato (*Solanum lycopersicum* L.). Plants were exposed to a rapid, gradual, or constant drought and a non-drought treatment. The substrate dry down rate was faster (~20% to 10% v/v in 10 days) in the rapid compared to gradual (~20% to 10% v/v in 20 days) drought treatment, while the average water content in rapid and gradual treatments (~14% v/v) was maintained in the constant drought treatment. Results indicated that leaf water potential dropped lower, turgor was mostly negative, leaf expansion ceased sooner, electron transport rate of photosystem II dropped faster, and photosynthetic capacity [estimated from photosynthesis–leaf internal CO_2 response curves] was lower in the rapid drought treatment compared to other treatments. Plant responses in the gradual and constant drought treatments were mostly intermediate between the rapid drought and non-drought treatments. This suggests that physiological responses to drought in tomato depended on the rate of exposure to drought stress and acclimation to drought stress was more pronounced in the gradual or constant than rapid drought treatment.

2:30–2:45 pm

Predicting Genotype-specific Carbon Sequestration in Response to Water Availability

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Genetic adaptation to drought stress was investigated within the species of *Acer rubrum* L. (red maple). Genotypes of red maple were subjected to soil drying and responses to drought (gas exchange, sap flux, leaf *PAR* absorption, and biomass production) were quantified across genotypes. Using specific genotype physiological parameter sets developed from measurements, we applied ecophysiological modeling techniques to simulate genome-based physiological stress response behavior to the environment. Hence, we validated a practical technique that introduces explicit quantitative gene action into process modeling. The study demonstrates 1) intrinsic genetic attributes can be used to provide information on adaptation at the genotype level; and 2) the capability of quantifying the differences in growth among genotypes and their subsequent response to water stress using genotype-specific modeling analysis. This technique may aid efforts to select genotype specific stress tolerance characteristics. Furthermore, genotypes can be simulated under different climate scenarios and evaluated in a fraction of a tree's life span.

2:45–3:00 pm

The Influence of Spatial Physiological Activity Gradients on Whole-tree Carbon Uptake: The Temperature Acclimation Factor

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Due to the relationship between temperature and global forest productivity, understanding photosynthetic and respiratory responses to rising temperature is critical for predicting carbon uptake. We report

on a crown section warming experiment that is the first known study to separate temperature from crown light interception, vapor pressure deficit, and wind on gas exchange. In addition to isolating the conditions that pertain to canopy position, we examined the temperature dependence of photosynthetic capacity after leaf expansion in two thermally contrasting genotypes of a continuously flushing species (*Acer rubrum* L.). Our results where then integrated into a spatially explicit carbon exchange model. We found that carbon uptake estimates could be overestimated by 22% to 25% when temperature gradients are disregarded. The short-term contribution of our study is the potential improvement of both spatial and genetic parameterization for scaling carbon uptake estimates to canopies of temperate deciduous forests. We highlight the implications of our findings with regard to the weakness in current predictions of how changes in climate may affect carbon storage and release in deciduous forests worldwide.

3:00–3:15 pm

Derivatives rather than Ratios Should Be Evalulated in Biological Research

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Ratios are often used to quantify changes in biological efficiency, ecological changes or the accumulation of minerals and other substances in biological research. Changes in carbon dioxide assimilation over time; predator–prey ratios in entomological studies; and delta values that represent the ratio of a rare to common isotope are all examples where changes in ratios are routinely evaluated. Unfortunately, a ratio is often mathematically dependent on the size of its denominator. Therefore, changes in a ratio-based expression often do not reflect real changes in incremental accumulation of the numerator as the denominator increases. We present three examples where careless use of ratio-based expressions produce misleading interpretations. The three examples are 1) evaluating changes in carbon dioxide assimilation over time as a plant matures; 2) evaluating the changes in delta 13 °C values over time as fossil fuel consumption increased in the late 19th century; and 3) changes in predator–prey ratios in agricultural research. Traditional ratio-based evaluations were compared to a derivative analyses. In all cases, plots of the numerator vs. the denominator of the ratios being evaluated were used to more carefully analyze the data. We evaluated how the derivative changes as the denominator increases. In these three examples interpretations using the two approaches differed. We propose that derivative analyses should accompany all ratio-based evaluations and the use of derivatives is the more reliable investigative approach.

3:15–3:30 pm

Yield Components of Olive Trees with Different Water Status

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A field experiment was conducted over two growing seasons to determine the effect of water status on yield components of olive trees (*Olea europaea* L. cv. Leccino) with different crop loads growing in a sandy-clayey soil. Drip irrigation was managed to maintain pre-dawn leaf water-potential (PLWP) within the following ranges: a) higher than –1.1 MPa (FI, fully irrigated); b) between –1.0 and –3.3 MPa (DI, deficit irrigated); c) below –1.2 but not lower than –4.2 MPa (SI, severe deficit irrigated). The irrigation period lasted from 6 through 16 weeks after full bloom (AFB) in year 1, and from 5 through 19 weeks AFB in year 2. Tree water status influenced fruit weight and oil yield in a similar manner, but did not affect flowering or flower quality the following spring. The combined fruit yield (on a fresh weight basis) over both years of SI and DI trees was 49.0% and 81.6% that of FI trees, respectively; the oil yield of SI and DI trees was 52.5% and 81.2% that of FI trees. The fruit fresh weight in FI trees was already greater than that of DI or SI treatments at 8 weeks AFB. At harvest, FI bore the largest fruits and SI the smallest ones. The response to crop load differed among treatments, however, as the fresh weight of individual fruits at harvest of FI and DI treatments decreased as crop load increased, but no such relationship was apparent for SI trees. The oil content in the mesocarp increased as PLWP increased from about –3.5 to –1.5 MPa. The oil content at harvest of FI trees decreased from 53.1% to 45.7% d.w. as fresh fruit yield increased from 5 to 25 $kg \cdot dm^{-2}$ trunk cross-sectional area (TCSA). Fruit maturation was delayed by increasing PLWP.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

Oral Session 2: Vegetable Crops Management 1

Monday, July 16 **2:00–3:45 pm**

Room: Rainmakers Ballroom B

Moderator: Mathieu Ngouajio; ngouajio@msu.edu

2:00–2:15 pm

Rowcover Reduces Insect Infestation and Increases Growth and Yield of Cucumber in the U.S. Virgin Islands

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Spun-bonded rowcover was evaluated as an insect barrier and to enhance growth and production of field grown cucumbers in the U.S. Virgin Islands. Rowcover was used for the first 5 weeks after transplanting (12 Sept. 2006) and then was removed to allow pollination. Two control treatments consisted in non-sprayed plots and plots sprayed weekly with a mixture of Dipel, Rotenone, and insecticidal soap at the recommended rates. Thrips and melonworm infestations were extremely high in the untreated control, resulting in 83% defoliation by the fifth week and complete defoliation by the seventh week after transplanting. Melonworm and thrips were not found in the rowcover treatment at removal and only one plant was infested with aphids. Rowcover and no-rowcover air temperature was 28.7 and 27.3 °C, and average daily solar radiation was 15.9 and 11.5 $MJ \cdot m^{-2}$ per day, respectively. In addition, rowcover reduced wind speed to undetectable level. Overall, rowcover reduced evapotranspiration and plant stress favoring plant growth. Larger plants at rowcover removal sustained a higher number of fruits and yield was 62.7 $t \cdot ha^{-1}$ compared to 25.4 and 6.5 $t \cdot ha^{-1}$ for the sprayed and non-sprayed treatments, respectively. Therefore, use of rowcover appears to be effective as an insect barrier and to enhance growth and yield of vegetable crops in the U.S. Virgin Islands.

Specified source(s) of funding for the work presented in this abstract: Federal competitive

2:15–2:30 pm

Greenhouse-grown Transplants as Alternative Planting Material for Management of Soilborne Diseases in Asparagus

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Asparagus fields are established from 1-year-old crowns (OYOCR) grown in crown nurseries. Soilborne diseases constitute a serious problem for crown production and field establishment. Currently, growers reduce the impact of these diseases on planting materials by fumigating the crown nursery. However, methyl bromide is being phased out and alternative fumigants have limited efficacy. The goal of this study was to test greenhouse-grown transplants (GHGTP) as a replacement for OYOCR for asparagus field establishment and to measure the effect of transplant plug cell size on seedling growth and biomass partitioning. Field experiments were established in Summer 2006 at a commercial farm with a known history of asparagus decline. Treatments included two planting materials (GHGTP and OYOCR). Fern growth and disease incidence were assessed during the season. A greenhouse study was also conducted using nine plug cell volumes. Seedlings were sampled biweekly after emergence for a total of six sampling dates. Total biomass and biomass partitioning were measured. Plant establishment and survival during the first season was not affected by the planting material used. The number of shoots per plant was significantly greater for GHGTP than for OYOCR. The percentage of dead shoots due to diseases was consistently higher on OYOCR than GHGTP. Transplant plug volume affected seedling growth and biomass partitioning. Smaller cells imposed a significant restriction to root development as early as 2 weeks after seedling emergence. This result suggests that it is possible to use disease-free GHGTP to establish new asparagus fields. Plug cell volume is important in maximizing root development in the greenhouse but its effect on field performance is not known.

Specified source(s) of funding for the work presented in this abstract: Federal competitive

2:30–2:45 pm

Photoselective Netting Improves Productivity of Bell Peppers

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We have developed a new concept, by which shade nets are designed to differentially filter sunlight, for promoting desirable physiological responses, concomitantly with protecting from excessive solar radiation, environmental hazards, and flying pests. A series of photoselective nets was developed, each one differently screening the sunlight spectrum, and additionally enriching the relative content of diffused light. Earlier studies revealed dramatic responses of ornamental crops to photoselective shading, including stimulation of vegetative growth (red and yellow nets), dwarfing (blue), branching (gray). Photoselective netting of fruit trees was found to selectively affect fruit set, maturation rate, size and quality. Bell peppers are commercially grown at the B'sor region of Israel under 30% black shade nets. We compared several pepper cultivars grown under the black net to their performance under the red, pearl, and yellow nets, at the same shading factor. Plants were planted in May, and harvested between August and December. All tested cultivars showed increased productivity under the photoselective shading. Fruit yield increased by 30% to 40% (number of fruit/plant), and 20% to 30% (ton/acre), compared with the common black net. The red net had some productivity advantage over the pearl and yellow nets. Although the shade nets allow free passage of small pests (aphids, whiteflies, thrips), the risk for infestation by these pests, and the incidence of insect-borne viral diseases were significantly lower under the yellow net, compared to all other nets. The results demonstrate the potential of photoselective, light-dispersive netting for improving horticultural crops. They further emphasize that the quality of the light within the shade can make a lot of difference.

2:45–3:00 pm

Grafting Tomato Improves Yield Potential but Presents Challenges in Rootstock–Scion Compatibility and Retention of Desirable Scion Traits

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FG98-218 processing tomato produces high levels of lycopene but displays stunted growth and susceptibility to disease. In 2006, we examined whether these limitations of FG98-218 could be overcome by grafting. Success would provide additional evidence that grafting can enhance the use of underutilized field-grown vegetable genotypes, particularly if they possess traits important to human health. Replicated plots of FG98-218, ungrafted and as a scion with Maxifort (commercial greenhouse rootstock), Beaufort (commercial rootstock) and FG03-554, were established in non-irrigated, silt-loam soils at the OARDC with conventional and certified-organic management histories that were continued in 2006. Eight-week-old grafted seedlings were transplanted to the field 14–19 June, with plots (four plants each) arranged in RCBD with two replications per management approach. Plant height and the number of adventitious shoots growing from the rootstock and number of trusses on the scion were recorded weekly for 12–14 weeks. The above-ground portion of each plant was collected on 22 Sept. (organic plots) and 4 Oct. (conventional plots) and fruit number, weight, and quality and foliar mass above the graft were recorded. Grafting success in the greenhouse ranged from 80% to 85% (Maxifort, Beaufort) to 50% (FG03-554). Maxifort as a rootstock formed adventitious shoots that were removed by pruning. Overall, total plant yield, plant fresh weight, and fruit pH were greater following growth in conventional than organic plots but genotype performance was unaffected by production system. Total yield among rootstocks followed the pattern Beaufort = Maxifort > FG03-554 = FG98-218 with yield per plant following the pattern Beaufort = Maxifort = FG03-554 > FG98-218. Fruit pH and titratable acidity were unaffected by rootstock but fruit Brix followed the pattern FG98-218 = FG03-554 and FG98-218 > Beaufort and Maxifort. Grafting may heighten the performance of desirable scions but issues of rootstock-scion compatibility and maintenance of desirable scion phenotypes demand further research.

Specified source(s) of funding for the work presented in this abstract: Federal competitive

3:00–3:15 pm

Early Infestation of Broad Mite [*Polyphagotarsonemus latus* (Banks)] in Greenhouse Bell Pepper (*Capsicum annuum* L.) Can Be Managed with *Neoseiulus californicus* McGregor

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Peppers infested with broad mites just previous to transplanting can host a few of the microscopic mites which are often undetected by growers. The seedlings do not present mite damage symptoms at transplanting; however, rapid increases of mite populations later damage crops in greenhouses if mites are left uncontrolled. Management of broad mite based on the predaceous phytoseiid *N. californicus* and micronized sulfur were evaluated in Fall 2004 and Spring 2005. Seedlings infested with two broad mites were transplanted in a greenhouse 3 days later. When the pest was not managed there was no marketable fruit. Releases of two predators once (4 days after transplanting, DAT) in Fall 2004 and Spring 2005, or twice (4 and 21 DAT) or three times (4, 21, and 30 DAT) in Fall 2004, led to relative fruit yields on a first-single harvest that were <68% than in non-infested plants (100%). In Spring 2005, yield from plants with four predators/plant at any of the release times (6 days before, at, or 4 days after transplanting), or two predators per plant 6 days before transplanting, were not different from non-infested plants. *N. californicus* established well in both crops. Crop production variables decreased with pest abundance over time following exponential decay relationships. Sulfur sprays were effective when started preventively on transplants and as long as sprays were not interrupted. Spraying was less costly than biological control but multiple sprays against *P. latus* will disrupt biological programs in greenhouse-grown peppers. The preventive release of *N. californicus* on transplants is critical in IPM and will minimize plant injury and avoid yield loss in early, and potentially, in full season production.

3:15–3:30 pm

A New Greenhouse Crop: History and Production of Datil Pepper

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Datil pepper (*Capsicum chinense*) is not native to Florida, but history provides evidence that it most likely arrived in St. Augustine during the late 1700s after the Spanish traded Florida to Britain for Cuba. How datil pepper came to Florida is unknown as are the reasons why they are peculiar to the St. Augustine, FL, area. Capsicums are almost exclusively native to Brazil and these *C. chinense* sp. most likely originated from there. Datil peppers are especially liked for their unique sweet-hot flavor for cooking, hot sauces, relishes, and other condiments. Seeds are not available from commercial seed companies, but must be obtained via the Internet, hot pepper festivals, and Master Gardeners; however, most have been passed down through family generations. Hot sauce producers have difficulty finding datil pepper fruit year-round as most commercial production is in backyard gardens. The objective of this research was to determine if high quality (flavor, capsaicin) datil pepper fruit could be produced under greenhouse conditions on a year-round basis. Seed lots from five sources were obtained for cultivation in Citra, FL. On 15 Mar., seeds of lines named 'Datil Dew', 'Terra Time', 'Sensation', and 'Wanda' were transplanted, while a fifth line, 'Linda', was transplanted on 17 May 2006. Plants were harvested 10 times from 8 June 2006 to 3 Jan. 2007. 'Linda' was harvested five times (Aug.–Nov. 2006). As plants increased in size, more fruit were produced. By November, plants had grown to a 4-m height and yielded a mean weight of nearly 1 kg per plant during a single harvest. Plants were cut back to a 0.5-m height, allowed to regrow, and continued to produce fruit on into spring. Datil pepper plants required shading during the summer months. Greenhouse production of datil pepper may provide for a year-round source of the fruit needed by the processing industry.

3:30–3:45 pm

Growth Response of Onion Varieties to Varying Photoperiod and Temperature Regimes

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Growth chamber experiments measured the growth response of six onion varieties to varying photoperiods and temperature regimes. The daylengths (longday and shortday) and temperatures were selected to mimic the early and late onion growing season of the high desert region near Lancaster, CA. For both regimes, temperatures and photoperiods were changed daily to represent the natural progression of the season, with the longday chamber having higher temperature regimes from seeding to bulb initiation. Each growth chamber contained four replications of six commonly grown onion varieties that grew from seeds planted in a 19-L pot filled with UCR no. 3 soil mix. All onion varieties in the longday growth chamber germinated faster than those seeded in the shortday chamber. Similarly, plants grown in the longday chamber were taller, produced a higher number of leaves and had larger neck diameters and greater bulb sizes. The varieties varied in their response to temperature and photoperiod. For example, the 'Cometa' variety showed enhanced germination, leaf emergence, plant height, production of higher number of leaves, larger neck diameter and larger bulb sizes compared to the 'Vaquero' or 'Grannero' varieties regardless of temperature or photoperiod. These findings are being used by growers to determine the optimal planting date for onions in the high desert region.

Oral Session 3: Human Issues in Horticulture 1

Monday, July 16 **2:00–3:45 pm**

Room: Rainmakers Ballroom C

Moderator: Edward Moydell; emoydell@longwoodgardens.org

2:00–2:15 pm

An Examination of the Mutual Awareness between Public Horticulture and the National FFA Organization

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Youth education in public gardens is becoming an important option to increase their community outreach and educational opportunities, and to develop a future audience for public horticulture. It is often perceived that this education is primarily focused at the elementary level but some secondary horticulture education exists as well. FFA is a national leadership organization for agricultural education students and is comprised of approximately 500,000 members. The FFA has remained relevant and strong among educational standards that continue to evolve in a dynamic industry. This research explored the degree of mutual awareness of public horticulture and the National FFA Organization and the possible benefits of a collaboration. mAs public horticulture grows in urban areas and the FFA tries to diversify their primarily rural membership, location was a major factor that was accounted for early in the development of the methodology. In addition to a national survey, a separate survey was conducted that specifically targeted urban FFA chapters. This research also explored other possible factors that affect a collaboration between public horticulture institutions and local FFA chapters, such as funding, general interest, stereotypes, and time. Furthermore, research consisted of interviewing affiliates of public horticulture and the FFA; and examined an existing internship program between Longwood Gardens and W.B. Saul High School in Philadelphia. As the urban lifestyle increases for Americans, this collaboration would allow the FFA to capitalize on the resources

that public gardens offer and, in turn, allow public gardens to capitalize on an already established audience.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

2:15–2:30 pm

Developing a Center in Public Horticulture at the University of Delaware

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This research examined the feasibility of establishing a Center in Public Horticulture at the Univ. of Delaware (UD) dedicated to interdisciplinary education, research, and outreach. The Univ. of Delaware is strategically located within a 50-mile radius of more than 25 member gardens of the American Public Gardens Association. Qualitative assessments were conducted of the Plant and Soil Sciences Department, existing academic centers at UD, and the professional field of public horticulture. Surveys, interviews, and focus groups were conducted with stakeholders from public horticultural institutions, academia, the green industry, and government. The results identified the Center's potential educational, research, and outreach activities; and the collaborations, trends, and significant planning issues associated with the Center's establishment. A proposed definition of public horticulture as a professional field, as well as a mission statement, goals, and operational strategies for the Center have been developed. The Center will produce public horticulture professionals through innovative education programs for students of all ages and career stages. It will also conduct, organize, and disseminate public horticulture research. In addition, the Center will coordinate partnerships among academic institutions, public gardens, and professional organizations. The Center's initial projects include establishing a Website, implementing a unique internship program, and integrating itself into the existing UD undergraduate and graduate curriculum.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

2:30–2:45 pm

The Role of Healing Gardens at Assisted Living Residences

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Assisted living facilities are a relatively new and growing elder-housing phenomenon that gives seniors a way to maintain their independence and functionality. These life-transition facilities require major adjustments for older adults, creating a unique teaching opportunity for health education. There is, however, a serious lack of health promotion programs specific to those elderly transitioning from living in their own homes to assisted living. Silver Sky, Nevada's first affordable, nonprofit assisted living center for low-income Nevada elderly, provides a venue to develop, pilot test, evaluate and model, research-based educational programming that includes the health promotion and quality-of-life benefits of a healing garden project. This experimental healing garden represents collaboration between a UNCE aging issues specialist and a social horticulture specialist merging the unique expertise of each discipline. This project will add to the body of knowledge on the impact of healing gardens in residential facilities for the senior population. The Silver Sky project presents a way to provide educational, life-enhancing services to an underserved segment of the community. At the same time, it demonstrates that flexible integration of interdisciplinary areas of cooperative extension can expand the scope of educational outreach programs to a much larger and more diverse community audience.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

2:45–3:00 pm

Evaluation of Learning and Behavior Change of Master Gardener Trainees in Oregon

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In 2005 and 2006, we conducted a statewide evaluation of learning and behavior changes following our winter programs. In both years, training coordinators were offered the choice of participating within their county, and completion of the questionnaires by participants was voluntary; all instruments were approved for by the Oregon State Univ. Institutional Review Board. In 2005, 180 individuals from eight counties participated; in 2006, 88 students from five counties participated. The questionnaires focused on "core" subjects such as entomology, pesticide safety, and plant pathology. Immediately following the completion of the in-class training, participants were asked to do a self-assessment by measuring their level of knowledge before and after the training sessions using a scale of four levels of learning (not at all, very little, moderately well, and extremely well). Six months later, we mailed a one-page follow up survey, asking for self assessment on a scale of 1 to 5 (with 1 being "not true at all" and 5 being "very true") of whether their gardening techniques or behavior had changed as a result of the training. Both years yielded statistically significant increase in knowledge learned and behavior changes made. The largest increases in self-assessed knowledge were in the areas of understanding soil pH and nutrients, integrated pest management practices, and "references for recommendations." The greatest increase for the follow-up survey was understanding and following more carefully the label instruction on any pesticide container (91%).

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

3:00–3:15 pm

North Desert Village: The Effect of Landscape Manipulation on Microclimate and Its Relation to Human Landscape Preference

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In 2004, a long-term multidisciplinary experiment was initiated within the North Desert Village (NDV) community to study the effects of landscape design on residential urban ecology in metropolitan Phoenix, Arizona. The NDV community consists of 152 single family houses and adjoins the Arizona State Univ. Polytechnic campus. Front and backyards landscapes surrounding 24 houses were selectively manipulated into one of four regionally common landscape design themes with six houses clustered in each landscape design theme surrounding a common area (about 2 acres in size). A cluster of six other non-landscaped houses

within the NDV community serve as an observational control. The four groups of six contiguous groups of homes receive one of four treatments that vary landscape design and water delivery: mesic (high water use plants and turf grass, with an overhead sprinkler irrigation system); oasis (a mixture of high and low water use plants and turf grass, with both drip irrigation and sprinkler systems); xeric (low water use plants without turf grass, with a drip irrigation system); and native (plants native to the Sonoran Desert with no irrigation after establishment). During the first two years of study, microclimate differences around homes with the mesic or oasis designs with high vegetation and turf grass compared with the home with the xeric or native designs with less vegetation and decomposing surfaces were most likely caused by evening increases in sensible heat loss mitigated by differences in latent heat transfer. Surveys of NDV residents showed that length of residence in the Southwest may not affect perceptions of the natural desert, but appears to increase the belief that the desert does not belong in home landscaping.

Specified source(s) of funding for the work presented in this abstract: Federal competitive

3:15–3:30 pm

Farm Workers Provide Insight for Improving Field Labor Retention in Arizona

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A 60-question assessment was administered to over 200 field workers during 2006–07 to identify factors that could aid Southwest vegetable producers with retaining current field labor. The population surveyed included 38% females and 62% males with over 50% crossing the U.S./Mexican border daily. Age distribution of the survey participants was 0.9, 14.9, 10.3, 20.6, 29.0, 21.5 and 2.8% for <17, 18–24, 25–34, 35–44, 45–54, 55–64, and over 65 years old, respectively. The results indicated that only one-third of the respondents would recommend their current job. Contrary to the conventional belief that salary is the only true mechanism to retain field labor, our study revealed several factors that may be equally important. In improving the appeal for field labor, salary was only indicated by 20% and 12% of respondents who would either recommend or not recommend field work, respectively. Of workers who do not recommend field labor, 30% indicated the need for additional breaks and 13% wanted better benefits. Workers who recommend their job value convenient work schedules in addition to salary. Although 50% of the respondents did not initially expect to work more than 4 years in the field, 33% of all respondents would likely work when ill, revealing potential implications associated with food safety. Overall, this study provides a direction for agricultural labor leaders to initiate efforts aimed at retaining field labor. In addition to increasing salaries, field workers consider including health-care benefits, consistent breaks, and a more convenient work schedule as paramount if they are to continue to provide a stable workforce in the region. A discussion of the influence of age, gender, and place of living on the type of responses is also provided.

Specified source(s) of funding for the work presented in this abstract: Federal competitive

3:30–3:45 pm

Multistate Survey of Nursery Laborer-level Employees: Ohio, Michigan, Delaware, Tennessee, Florida, Indiana, Kentucky, Arizona, and Rhode Island

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The greenhouse and nursery industry generated more than $16 billion in sales during 2006 (Jerardo, 2006) and generated an annual payroll of more than $3 billion. Basic information on the patterns of farm labor can be obtained by four major sources: the National Agricultural Workers Survey (NAWS), the Current Population Survey (CPS), the Farm Labor Survey (FLS) and the Census of Agriculture ERS (2003). However, there have no workforce surveys conducted specifically for the nursery industry. Nowadays, the majority of the worker level of nursery staff is Spanish speaking; but there is no formal information to support that belief. The objective of this project was to characterize the nursery industry labor force in Ohio, Michigan, Delaware, Tennessee, Florida, Indiana, Kentucky, Arizona and Rhode Island. A Self Administered Questionnaire in English and Spanish was administered to our target population. A permission to collect data from the nursery workers, using an anonymous, voluntary and mailed survey was obtained by the Ohio State Univ. Institutional Review Board. A stratified random sample was taken from each state (strata) and the sample size within each strata was the number of nurseries contacted in each state. A total of 4466 surveys were sent from Columbus, OH; 1548 surveys were returned. The majority of the workers surveyed were general laborers, men between 18 to 34 years old, a middle school level education, made an hourly rate salary between $8 to $9.99 and came from Mexico. From a total of 227 crew leaders surveyed more than a half were Mexicans. 38% of the workers have been working in the industry for less than 5 years. The primary language spoken at work by the workers was Spanish (70.8%) and 22% of them do not understand English at all. The primary source of worker's technical information was the supervisor and 80% of the workers are interested in taking English or Spanish classes.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

Undergraduate Student Oral Competition

Monday, July 16 **4:00–5:00 pm**

Room: Rainmakers Ballroom A

Chair: Erin Cathcart, ACB President

Rehabilitating Wildwood: A Landscape Reconstruction of a University's 19th Century Presidential Residence

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Wildwood is the official presidential residence at Southeast Missouri State University. The university purchased the house and farm in 1922; and, it was later renovated. New wings were added at this time; and, it was converted into the president's residence. Over the years, the landscape surrounding Wildwood had fallen into disrepair and was overgrown. The process of rehabilitation began in the fall of 2004 as a result of an Introduction to Horticulture class project. A general clean-up of the property was completed and an evaluation of the remaining plants was inventoried. Three landscape plans were developed during the spring of 2006 for a 400 level Landscape Design class and were presented to the president. The project was approved; and, the three designs were incorporated into one final plan. As an Undergraduate Research project, spanning two semesters, the property was transformed. Historical consideration was given to the new plant selection and overgrown plant material was removed. Continual color throughout the seasons was an important goal of the design. This was achieved, in part, by planting Japanese Maple (*Acer palmatum* 'Sango Kaku' and 'Orangeola'), Threadbranch Falsecypress (*Chamaecyparis pisifera* 'Filifera Sungold'), azaleas (*Rhododendron* spp.), and other plants. The new landscape inspired the President's Office to have the house exterior painted and upgraded. As a capstone to this project, an

organic fertilizer, pruning, and maintenance schedule was prepared.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

Reduction of Inorganic Chemical Applications in Murray State University Greenhouses by Using Alternative Worm Casting Amendments and Compost Teas

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The Pullen Farm Greenhouse Complex serves multiple functions for Murray State University. While being a production-based greenhouse, the main purpose is to provide an ideal learning atmosphere for students. Classes are taught in the greenhouses and staffed by student workers. In addition, the complex is opened to the public for plant sales and numerous secondary educational tours. The complex contains three greenhouses and inorganic chemical Restricted Entry Intervals (REI) greatly affects normal operating procedures. Shutting down a greenhouse for 12 or more hours disrupts classes and work schedules. Reducing the amount of inorganic chemicals used would make the greenhouses safer and more efficient. Three phases were conducted in this year-long study including: production of poinsettias, flowering perennial plants and spring bedding plants. Success in reducing the number of inorganic chemical applications was seen in all three phases up to 91% for poinsettia production. Insect population numbers did not hinder over all plant health and vigor, though consumer preference was lower with some insects present in all three phases.

Identification of Molecular Markers Linked to New Tomato Spotted Wilt Virus Resistance Genes in Tomato using AFLP Analysis

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Tomato spotted wilt virus (TSWV) is one of the most damaging pathogens in tomatoes (*Solanum lycopersicum*). In some areas of the world TSWV has become a limiting factor in tomato production. Resistance genes to TSWV have been identified; however, all but one (Sw-5) has been overcome. Although rare, there have been new TSWV isolates identified that overcome Sw-5. Through wide crossing with wild relatives of tomato, *S. chilense*, a new source of TSWV resistance has been incorporated into cultivated tomato. F_2 and BC_1 segregating lines from this germplasm suggest a single dominant resistance gene (suggested to be designated as Sw-7) in multiple greenhouse screening trials, although penetrance of this resistance has obscured a definitive identification of specific resistant plants. Subsequently we generated F_3 and BC_1 populations from 37 F_2 and BC_1 plants showing a resistant response in the first screening.. Eight of these selected F_2 and BC_1 plants have subsequently undergone preliminary P33 AFLP analysis identifying 22 candidate markers using 256 primer combinations. These 22 candidate markers have been further tested using AFLP protocols for the LI-COR 4300. This testing has included 31 of the F_3 and BC_1 lines, with seven elite Florida lines, which have demonstrated resistance to TSWV derived from the same resistance source but with different lineages. Using eight of the selected primer combinations with the LI-COR system, one strong candidate marker has been identified. This gene may have potential functionality in combination with Sw-5 to provide a broader resistance to TSWV isolates. Success in developing these markers will influence the breeding of tomatoes so that damage from TSWV may be minimized in tomato growing areas of the world.

Specified source(s) of funding for the work presented in this abstract: Private (Association, Foundation, Industry)

Oral Session 4: Vegetable Breeding

Monday, July 16 **4:15–6:00 pm**

Room: Greenway A/B

Moderator: Beiquan Mou; bmou@pw.ars.usda.gov

4:15–4:30 pm

Evaluation of Greenhouse, Field, and Heirloom Tomato Varieties in Hydroponic Greenhouse Production

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The greenhouse tomato industry in North America accounts for 37% of fresh tomato sales compared to 10% in 1999. This rapid growth in supply has lead to declining prices, which challenges growers to be profitable. Controlling disease and insects can often be eliminated with good management practices and variety choice. Most greenhouse varieties are bred for a European environment, which selects plants with a lower light requirement and a more moderate temperature. Thus, greenhouse varieties are not as adapted to our environmental conditions. In addition, greenhouse growers struggle more than field growers to control pests and diseases during their crop's long-term production in an enclosed environment. Developing greenhouse varieties that are adapted to North American conditions with integrated pest and disease resistance would assist the U.S. greenhouse tomato industry prosper. The first step in initiating a greenhouse tomato breeding program is to evaluate existing cultivars and germplasm. In this study, indeterminate heirloom varieties, resistant field germplasm and greenhouse hybrids were grown using commercial hydroponic production standards. Fruit were harvested and graded using USDA standards. Field varieties produced a greater percentage of large or extra large fruit and the heaviest fruit; however, they produced so few fruit, it would not be profitable to use these in greenhouse production. Greenhouse lines produce fruit earlier and higher number of large or extra large fruit. However, average fruit weight for the greenhouse lines was less than 200 g and the Brix readings were in the bottom half of the lines studied. Thus, growers require lines developed specifically for greenhouse production, but with some of the traits of lines used in field production.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

4:30–4:45 pm

Evaluation of Resistance to White Mold Disease in Snap Bean Based on Greenhouse Tests and Field Trials

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White mold [*Sclerotinia sclerotiorum* (Lib.) de Bary] is a common

pathogen in crops grown in cool-wet environments worldwide. In snap beans (*Phaseolus vulgaris*), white mold results in yield reductions due to weakened stems and discolored pods. A recombinant inbred population (GA) and an independent inbred backcross population (GPP) that share a common resistant parent, G122, were developed in crosses to snap bean cultivars Astrel and PLS8088, respectively. The GA and GPP populations were field-evaluated over 2 years for disease incidence (DI) and severity (DS) and evaluated in the greenhouse for reaction to oxalic acid (OX) and based on the straw test (ST). The heritabilities of the greenhouse-based evaluations (ranging from 0.45 to 0.65) were higher than the heritabilities based on field evaluations (ranging from 0.24 to 0.38) over the GA and GPP populations. Nevertheless, the correlations between the greenhouse-based evaluations and field based evaluation were low, ranging from 0.0 to 0.26. The results suggest that plant architecture and avoidance mechanisms may be more important in field resistance to white mold than is physiological resistance based on OX and ST. Marker data confirmed that QTLs associated with field resistance based on DI and DS were generally nonsignificant for greenhouse evaluations based on OX and ST.

4:45–5:00 pm

Inheritance of Resistance to Leafminers in Lettuce

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Leafminer (*Liriomyza* spp.) is a major insect pest of many important agricultural crops including lettuce (*Lactuca sativa* L.). Source of resistance to leafminers has been identified in wild relatives of lettuce. The objective of this study was to determine the genetics of resistance to leafminer (*Liriomyza langei*) stings in a *Lactuca saligna* accession, PI 509525. PI 509525 was crossed to susceptible cultivars Da Ye Wo Sun, Margarita, and Salad Bowl, and progenies were evaluated in the field for leafminer sting density in three years. F_1 plants all had low sting density, indicating that the resistance was dominant. Chi-square analyses of F_2 progenies showed that the resistance was conferred by a dominant allele at a single locus in PI 509525. Monogenic control of resistance was confirmed by the segregation ratios of F_3 families. We have named this locus *Lm1* for the first leafminer resistance gene found in lettuce. Identification of the resistance gene will greatly facilitate the integration of leafminer resistance from the wild species into cultivated lettuce in a breeding program.

5:00–5:15 pm

Development of Uniform Double-crossed Varieties using Near-isogenic Lines Produced by Marker-assisted Selection in Radish (*Raphanus sativus* L.)

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Numerous F_1 hybrids have been developed using the self-incompatibility (SI) system in *Brassica* crops. However, the prevention of self-pollination caused problems on parental seed production. In this study, we tried to develop double-crossed (DC) varieties for the purpose of convenient parental seed production while using near-isogenic lines (NILs) to maintain the seed uniformity. Two hybrids, 'Gwandong yeoreum', the most popular variety for summer cultivation in Korea having S1S10 haplotypes of class-I, and 'Pyeongji yeoreum', a heat-tolerant and disease-resistant cultivar having S4S5 haplotypes of class-II, were used as plant materials. During segregrating generations from DC F_1 to DC F_5, class specific primer sets were used to select one SI heterozygote from four sib plants in each 600 lines, respectively. The selected SI heterozygotes were bud-pollinated for generation advancement. From this procedure, a total of 310 SI heterozygotes were identified at the DC F_5 generation. One set of cross-compatible NILs were developed using PCR-based selection with progenies of a DC F_5 plant. Considerable amount of parental seeds were produced through bee-pollination in a restricted net house. Using these NILs, we developed two elite double-crossed varieties and various valuable NILs.

5:15–5:30 pm

The Anthocyanin Fruit Tomato Gene (*Aft*) is Associated with a DNA Polymorphism in a MYB Transcription Factor

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Anthocyanins are naturally occurring plant pigments of considerable interest because of their perceived human health benefits. Tomato (*Solamum lycopersicum*) fruits do not normally have anthocyanin pigmentation, but several wild relatives do. *Anthocyanin fruit* (*Aft*) has been transferred from *S. chilense* and exhibits weak to moderate anthocyanin expression in cultivated tomato fruit. A candidate gene analysis was undertaken to determine the genes responsible for purple fruit color in tomato. PCR primers were designed to amplify genes involved in anthocyanin production using publicly available tomato, potato, and petunia DNA sequences. PCR was conducted using genomic templates and the resulting PCR amplification products from normal and purple fruited tomatoes were examined for polymorphism associated with purple fruit color. A 700 bp allele of the MYB transcription factor *an2* was present only in purple fruited tomatoes with the *Aft* gene in their pedigree. The co-segregation of the 700 bp allele with the *Aft* gene was verified in 121 individuals of a 'Legend' x 'LA 1996' (*AftAft*) F_2 population. The 700 bp allele from LA 1996 and the 1100 bp allele from 'Legend' were sequenced. Both alleles appear to encode 82 amino acid functional portions of a Myb protein. The two alleles had 98% amino acid identity with each other and SGN-U228086, a tomato cDNA with homology to *an2*. The 'Legend' allele had a 382 bp insertion in the second intron flanked by 12 bp direct repeats, an indication that the insertion was caused by a transposon.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

5:30–5:45 pm

Genetic Diversity in Chinese Melon (*Cucumis melo* L.)

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Melon (*Cucumis melo* L.; 2n = 2x = 24) is a morphologically diverse outcrossing Cucurbitaceae species. Genetically mapped random amplified polymorphic DNA (RAPD) markers have been used broadly to define genetic relationships (GR) among melon botanical groups and commercial market classes. Such information is important for developing breeding strategies that incorporate exotic germplasm. Although standard marker arrays (SMA) and reference accessions (RA) have been employed to assess the genetic diversity of melon landraces and cultivars from diverse geographical regions worldwide, a comprehensive analysis of China (CH), a secondary center for diversity and domestication, has not been performed. Thus, a RAPD SMA (32 loci), and several morphological traits were employed to assess the GR between and among 68 CH melons and 97 RA from Africa, Japan, Greece, Spain,

Turkey, USA, and Europe. CH melons were genetically distinct from RA, and were partitioned into three groups based on geography, fruit exocarp, and culinary uses. CH melons were most similar to India and Africa melons suggesting potential breeding strategies for germplasm enrichment, and routes and sites of domestication.

Specified source(s) of funding for the work presented in this abstract: Federal competitive

5:45–6:00 pm

The Evolution of Tropical Supersweet Corn

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Corn evolved in the tropics and has been harvested green as a vegetable for millennia, but it is not sweet. Sweet corns based on the mutant sugary-1 evolved in northeastern USA two centuries ago. Strikingly dissimilar from tropical corn, they mature early and have tillers and long husk leaves based on gene grassy tiller. They cannot be grown commercially in the tropics as they are intolerant of short days (low incident light) and are susceptible to major tropical diseases and pests. Breeding of tropical sweet corns began in Hawaii in the 1940s, and expanded in the 1970s to high-sucrose corns in Thailand and Australia. Three significant populations, among 21 released from Hawaii, undergird most tropical improvement—'Hawaiian Sugar' in 1944 (gene, sugary-1), 'Hawaiian Supersweet #1' in 1968 (gene, shrunken-2), and 'Hawaiian Supersweet #9' in 1977 (gene, brittle-1). These varieties are about 25% temperate and derived largely from Caribbean flint varieties that served historically as vegetable corns. Sweet corn breeding nurseries have been planted monthly in Hawaii for four decades, and harvesting is weekly. 'Hawaiian Supersweet Silver', released in 2006, has 25 cycles of recurrent selection. Inbreds like Hawaii's Hi38cy1 counts 78 generations in its pedigree. Major breeding methods are recurrent mass selection applied before pollination and backcross conversion. Diallel and generation mean analyses have helped identify and map major quantitative trait loci for quality traits and for resistance to tropical viruses, southern and common rusts, turcicum and bacterial blights, and insect pests. Tropical processing is year-round and increases annually as hybrid seeds become available to growers.

Oral Session 5: Viticulture and Small Fruits 1

Monday, July 16 **4:30–6:00 pm**

Room: Rainmakers Ballroom B

Moderator: S. Kaan Kurtural, skkurt2@uky.edu

4:30–4:45 pm

Rooting-zone Restriction—A New Prosperous Technique in Fruit Tree Cultivation

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Rooting-zone restriction (RZR) is a new technique in fruit tree cultivation, the principle of which is based on the fact that vegetative growth and reproductive growth of fruit trees could be regulated by restricting root system growth. Normally, field cultivation usually causes extensive root growth, making it difficult to control the absorption of soil moisture and nutrients. The technique broke through the traditional theory of fruit tree cultivation—to have deep roots and luxuriant leaves, and has advantages in saving fertilizer and water, improving fruit quality, controlling shoot growth and decreasing carrying capacity of environment. Therefore, there is a bright future in production of high quality fruit, water conservation, development of eco-farm and sightseeing orchard, and utilization of mountains and beaches, and precision management of orchard. Effects of this technique have been studied in more than 10 fruit-tree species, such as grapevine, peach and citrus. Recently, the technique has been widely adapted in grapevine cultivation in arid and semiarid areas in northwestern China. Compared with normal field cultivation, the efficiency of saving water under rooting- zone restriction was improved by 50% and better accumulation of skin color and higher Brix berries were obtained. Practicable technique standards of grapevine cultivation under rooting-zone restriction involved in nursery, favorable cultivation types under different ecological areas, management of fertilizer and water, and training, had been established in China. Moreover, a national cooperation network of rooting-zone restriction in fruit tree cultivation has been established, including 19 provinces, with more than 600 ha of grapevine and other fruit-tree species.

4:45–5:00 pm

Demographic Analysis of Consumer Purchase, Consumption Habits, and Attitudes for Locally Grown Table Grapes

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A survey of consumers at various direct markets measured the influence of consumer demographics on consumer purchase and consumption habits and attitudes about locally grown table grapes. The survey consisted of two parts: 1) a pre-sample survey consisting of 26 questions was administered before exposure to locally grown table grape samples, and 2) a post-sample survey soliciting a visual and palate evaluation of five locally grown varieties ('Jupiter', 'Marquis', 'Vanessa', 'Neptune', and 'Mars'), and seven follow-up questions. Income and education showed the greatest effect on consumer response. In the pre-sample survey income, age, and gender influenced table grape consumption (lb/wk), but only income and gender affected frequency of consumption (how often). Consumers with the highest income (>$75,000) had a greater frequency of consumption than those with the lowest income (<$20,000). Ethnicity, income, and education affected distance to favorite supermarket venue, while income and gender affected willingness to drive for "the highest quality" local grapes. In the post-sample survey, education and income affected willingness to drive for grapes. Consumers in the middle income bracket ($30,000 to $49,999) were the most willing to drive for grapes like our samples as compared to the lowest income (<$20,000).

5:00–5:15 pm

Deficit Irrigation Enhances Arbuscular Colonization of Fine Roots by Mycorrhizal Fungi in Grapevines

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Regulated deficit irrigation (RDI) is used to control canopy growth and improve fruit quality, but little is known of how water deficits

alter roots or colonization by beneficial, arbuscular mycorrhizal fungi (AMF). Thus, root growth and amF colonization were determined over three years in 'Cabernet Sauvignon' grapevines exposed to three RDI treatments. Vines under standard RDI were irrigated at 60% to 70% of full-vine evapotranspiration (FVET) from 2 weeks after fruit set until harvest, a standard industry practice. Early deficit vines were exposed to a more extreme deficit (30% FVET) from 2 weeks after fruit set until veraison, and thereafter reverted to standard RDI. Late deficit vines were under standard RDI until veraison, then exposed to a more extreme deficit (30% FVET) between veraison and harvest. The production of fine roots was reduced in both the early and late deficit treatments, but the reduction was more consistent in the early deficit vines because the added deficit was imposed when roots were more rapidly growing. The frequency of arbuscules in fine roots was greater in both additional deficit treatments than in the standard RDI, a response that appeared chronic, as the higher frequency of arbuscules was observed throughout the season despite the added deficits being applied at discrete times. It appears that grapevines compensated for lower production of fine roots by stimulating arbuscular colonization. Irrigation did not affect yield or quality of grapes, but reduced whole-vine photosynthesis during the added deficit periods. It appears that high quality grapes can be produced in this region with less water than the current RDI practice, due in part to a more efficient root system resulting from greater arbuscular colonization by amF.

5:15–5:30 pm

Analysis to Separate Direct Biochemical Influences of Vintage, Site, and Vine Vigor on Pinot Noir Grape Anthocyanins and Proanthocyanidins Profiles from Indirect Scaling

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The influence of vintage, site, and vine vigor on flavonoid accumulation in fruit was determined. The research hypothesis was that low vigor zones within the vineyard would produce fruit with higher levels of phenolics in the fruit. An additional hypothesis was that differences in vintage, site, and vine vigor could produce shifts in enzyme activity in the flavonoid pathway resulting in variations in the flavonoid compositional profile. Vine growth parameters were used to designate vigor zones within two vineyard sites to study differences in fruit flavonoid chemistry. Total accumulation can be influenced indirectly by berry size or directly by increased flavonoid biosynthesis. Variations in flavonoid composition (calculated as a ratio or percent of total) can be an indirect statistical artifact related to scaling with total accumulation or could be a direct effect of increased biosynthesis. As there were large differences in total skin proanthocyanidins and anthocyanins between vintages, differences in the proportional data could be due to multiple causes. All ratio-based expressions mathematically scale (dependent on differences in denominator size) if a plot of the denominator versus the numerator has a non-zero y-intercept. In this paper, we show how different interpretations are found when comparing proportional composition and regression analyses that account for scaling effects. The impact of scaling can create significant effects that are an artifact or mask real effects. Methods that account for scaling of the total can provide better insight into regulation of the flavonoid biosynthetic pathway.

Specified source(s) of funding for the work presented in this abstract: Federal competitive

5:30–5:45 pm

Geographic Information Systems Assist with Site Selection of Vineyards in Midwestern United States

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Geographic information system (GIS) technologies and a weighted linear indexing model were utilized for suitability analysis of potential vineyard sites in Kentucky and Ohio. The model included a macroscale climate variables layer (40 points), a mesocale climate variables layer (40 points), a soil properties layer (10 points) and a current land use variables layer for a total of 100 points. Macroscale climate variables, occurrence of –26 °C (hybrids) and –22 °C (vinifera), winter severity index, spring frost index, frost-free days, growing degree days, and growing season mean temperature in 30-year period were interpolated using thin plate smoothing splines over the terrain using 100-m^2 digital elevation models (DEM.) Using the same DEMs absolute elevation, slope and aspect were classified using surface analysis to model the effects of mesoclimate. Locations in the study area that were 259–394 m in absolute elevation, with gently rolling slopes (5% to 10%) facing north, east or northeast received the most points in mesoscale climate layer. Soils that drained well, with moderate organic matter content pH 5.5-6.8 received the most points. Lands that eased conversion into vineyards (not used for urban purposes) were assigned the most points for current land use layer. A portion of existing peach orchard and vineyard acreage in the study area was surveyed with a global positioning system for application and proofing of the model. This approach to site selection in midwestern US assists researchers, extension personnel and prospective vineyardists to avoid costly mistakes, by expanding grape acreage only in best sites to diversify land-use, and creation of new jobs.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

5:45–6:00 pm

Field Testing of Transgenic Grapevine for Bacterial and Fungal Disease Resistance

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Efficient genetic transformation procedures have been established for an increasing number of grapevine (*Vitis* sp.) scion and rootstock cultivars. The ability to routinely produce transgenic plants has facilitated in situ screening of genes for disease resistance under greenhouse conditions. To date, two genes that encode hybrid lytic peptides (LIMA-1 and LIMA-2) and one that encodes *V. vinifera* thaumatin-like protein (VVTL-1) have emerged as promising candidates for control of bacterial and fungal diseases. USDA/APHIS-approved field sites have been established in Florida and the US Virgin Islands to evaluate selected transgenic plants for resistance to bacterial Pierce's disease (PD) and a range of fungal diseases endemic to the region. In 2007, transgenic *V. vinifera* 'Thompson Seedless' and hybrid rootstock 'Freedom' were planted. In 2008, additional scion cultivars and rootstocks will be added. Transgenic rootstocks will be grafted to determine whether PD resistance is transmitted to non-transgenic scions. Non-transgenic control vines, along with native resistant hybrid selections in border rows, will serve as pollen trap plants to facilitate study of transgene flow.

Specified source(s) of funding for the work presented in this abstract: Federal competitive

Oral Session 6: Organic Horticulture 1

Monday, July 16 **4:00–5:45 pm**

Room: Rainmakers Ballroom C

Moderator: Dario Stefanelli; stefanel@msu.edu

4:00–4:15 pm

The Response of 'Pacific Gala' on Three Rootstocks to Three Orchard Floor Management Systems under Organic Protocol

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In organic apple production, orchard floor management is of greatest importance since it determines weed management and fertility. In this experiment we evaluated the response of the cultivar Pacific Gala on three rootstocks of different vigor: M.9 NAKB 337, M.9 RN 29, and Supporter 4 (in respective order of vigor from dwarfing to semi-vigorous). The three rootstocks were also evaluated for the response to three orchard floor management systems: mulching (alfalfa hay), flaming, and strip tillage on each side of the row with natural vegetation allowed to grow on the tree row (Swiss Sandwich System). The experiment was conducted in an orchard planted in 2001 and certified organic since 2003. The OFMS treatments did not have an effect on the tree growth parameters measured except for foliar nitrogen concentration that was higher with alfalfa mulch. Trees on Supporter 4 were most vigorous, as anticipated. There was an interaction between treatments and rootstocks with M.9 RN 29 showing the highest yield and "yield efficiency" per tree in flame and sandwich while no differences were noticed between the rootstocks in mulch despite its better growing conditions. This suggests that M.9 RN 29 is a rootstock that adapts well to more stressful conditions (lower SOM and N, and in case of the Sandwich vegetated area, water content) posed by sandwich and flame treatments. Cumulative yield/ha was highest in mulch and sandwich and lowest in the flame treatment. Overall, considering the sandwich system coupled with the M.9 RN 29 rootstock seems to be a suitable choice for growers that want to grow 'Pacific Gala' under organic protocol in Michigan and similar climates.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

4:15–4:30 pm

Fine Root Development of Apple as Affected by Orchard Floor Management Systems under Organic Protocol

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One of the major challenges in organic fruit production is the implementation of a successful orchard floor management system (OFMS) to maintain productivity. Many plant root systems can adjust nutrient uptake capacity to meet variation in shoot demand caused by environmental changes. Root turnover is an important indicator of plant productivity and a measurement of carbon return to the soil. In adverse soil conditions, negative impact on root development and generation could be detrimental for tree production, thus making that OFMS less suitable. The aim of this experiment was to evaluate fine root development and diameter class distribution as affected by two different OFMS using the minirhizotron technique. The experiment was conducted in an orchard of 'Pacific Gala' (*Malus* ×*domestica* Borkh.) on M.9 NAKB 337, planted in May 2001. The OFMS used were mulch of alfalfa hay (MU) and strip tilling at each side of the tree row while natural vegetation was allowed to grow undisturbed on the tree row (Swiss Sandwich System, SS). We measured SOM and N concentration at 2 depths (0–10 and 0–30 cm) for 4 years. Root development was monitored by minirhizotrons. Root characteristics (number, length, diameter, area, volume, number of branches, and angle of branch insertion) were monitored and measured utilizing YODA root analyzer. Orchard floor management systems did have an effect on fine root development. The different soil conditions created from the systems (higher N concentration in mulch) were likely responsible for the increase in fine root life span measured in the sandwich system (50–60 days against 30 for the mulch). Fine root production initiated earlier in SS vegetated area than MU and more fine roots were found in SS vegetated area than MU.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

4:30–4:45 pm

Evaluation of Soil Particulate Organic Matter as a Sensitive Indicator of Soil Fertility in Sweet Cherry Orchards

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Orchard floor management (OFM) is relying more heavily on organic amendments to increase SOM, which enhances multiple soil functions critical to orchard health. Traditionally, changes in whole soil organic matter (SOM) concentrations have been monitored to determine success but these changes often occur too slowly. Therefore, researchers are investigating a biologically active fraction of SOM, particulate organic matter (POM), which is more responsive to management and has been successfully used as a fertility index in annual cropping systems. However, no studies have assessed its use in perennial orchard systems. We are evaluating POM-C and POM-N in 10 orchards (two research farms and eight commercial farms) with different OFM strategies, soil types, and climates to determine their potential as soil fertility indicators for sweet cherry orchards in Oregon. In Oct. 2006, soil samples were collected from 0–15 and 15–30 cm depths. They were analyzed for POM-C, POM-N, N mineralization potential (Nmin), soil nitrate and ammonium concentrations, and five enzyme potentials involved in C, N, P, and S cycling. Soil Nmin and enzyme activities served as proxies for soil nutrient status and overall biological activity, respectively. In general, POM-C and POM-N concentrations were higher in organically managed systems that added organic amendments relative to orchards that relied more on rapid-release fertilizers. In the organic orchards, POM was significantly correlated with four out of the five soil enzymatic activities ($r > 0.60$; $N = 56$; $P < 0.0001$). Moreover, in all orchards, these concentrations were positively correlated with N mineralization potential ($r > 0.47$; $N = 98$; $P < 0.0001$) and the sum of nitrate-N and ammonium-N ($r > 0.65$; $N = 98$; $P < 0.0001$) indicating that POM holds potential as a soil fertility index in cherry orchards.

Specified source(s) of funding for the work presented in this abstract: Federal competitive

4:45–5:00 pm

Spring and Fall–Winter Production of Leafy Vegetables in Organically Managed High Tunnels in Ohio: Compost Matters

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The yield and quality of leafy vegetables grown in high tunnel-covered soils undergoing organic transition at the OARDC were tracked in 2003-2006. Four 6.4-m × 14.6-m high tunnel main plots were established in Spring 2003 in an area previously used for conventional vegetable-grain production. Subplots (2.6 m × 12.5 m) either received springtime applications of composted dairy manure (rate calculated to provide the portion of the anticipated nitrogen requirement not provided by a leguminous rotation crop and/or carryover from previous compost application) or no compost application. Main-season crops of potato (2003), squash (2004), green bean (2005) and tomato (2006, certified-organic) were bracketed by March–April and October sub-subplot (1.3 m × 2.9 m) plantings of a radish–spinach–beet–swiss chard–mesculun lettuce rotation. Lettuce, spinach, and swiss chard sub-sub-subplots were harvested in November–January following October plantings while sub-subplots were harvested in May following March–April plantings. Lettuce and swiss chard sub-subplots were also harvested in June to test treatment effects on crop regrowth. Leaf fresh and dry weight, area, length, width, and Brix were measured and seven other variables were calculated. Leaf size, weight, moisture, Brix, etc., values varied with transition stage (year). Still, overall, total and marketable yield and leaf area index were higher following compost application, regardless of year, crop, planting, and harvest, with 18 of 30 comparisons (3 variables × 10 crop-planting-harvest) significant ($\alpha = 0.05$). Compost incorporation tended to decrease leaf tissue Brix values, with three of ten comparisons significant. Multiple soil properties were also tracked: values for most changed with year and were observable ultimately as improved tilth in compost-amended versus non-amended plots. The data suggest that a soil amendment such as compost may be needed to maximize leafy vegetable yield under the conditions studied and that amendment may influence perceptions of crop quality and measures of soil health.

Specified source(s) of funding for the work presented in this abstract: Federal competitive

5:00–5:15 pm

Assessing Ethnic Consumer Demand for Horticultural Crops

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USDA's National Research Initiative (NRI) funded this study to document market demand to reveal opportunities for East Coast farmers to grow and cooperatively market ethnic crops. The four largest ethnic groups in this region account for just under 6 million residents and grew by 23% (Puerto Rican), 218% (Mexican), 59% (Chinese) and 105% (Asian Indian) between the 1990 and 2000 US Census surveys. Approximately 60% or more of each of these ethnic populations live in the Mid-Atlantic region, with the exception of the Mexican group. More than 65% of the Mexican population resides south of Maryland. Community mapping by the Rutgers Food Policy Institute highlighted clusters of recent ethnic immigrants and 75% of ethnic consumers surveyed indicated they reside within 10 miles of an ethnic grocery store. A bilingual survey of these four major ethnic groups allowed produce preferences to be ranked by each group from a total list of 42 vegetables. Collaborators from Florida, New Jersey and Massachusetts refined this list from a production perspective to select a range of potential crops for production trials which were initiated in the 2006 growing season and continue in 2007 and 2008. This market-driven initiative bridges the supply-demand gap in an attempt to sustain the economic viability of the East Coast vegetable industry while contributing to the nutritional and health needs of regional consumers. In outreaching these results, the World Crops project is generating production and marketing data for these preferred vegetable crops to be compiled into factsheets, web resources (worldcrops.org) and other educational materials to connect growers with these emerging markets. Other grant team members include Venkat Puduri and Kim Pappas (Rutgers Univ.), Frank Mangan (Univ. of Massachusetts, and Mary Lamberts and Gene McAvoy (Univ. of Florida).

Specified source(s) of funding for the work presented in this abstract: Federal competitive

5:15–5:30 pm

High Tunnels Trigger Early Flowering and Fruit Set in Organic Southern Highbush Blueberry

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Success with vegetable production in high tunnels has spurred research into small fruit production in high tunnels. The goal of this research was to examine the feasibility of producing out-of-season organic blueberries through the use of high tunnels. Six high tunnels, each 53.5 m^2, and two outdoor control plots were constructed near Athens, GA and planted with southern highbush blueberries 'Emerald' and 'Jewel', cultivars with a low-chilling requirement. Plantings took place in 15-20 cm deep, raised beds of ground pine bark. High-density planting facilitated 80 plants per tunnel. Pollination was provided by bumblebee colonies. Plants were grown organically with the use of a 5–3–4 granular organic fertilizer. Higher soil and day-time air temperatures inside the tunnels resulted in earlier flowering, fruit-set, and initiation of vegetative growth compared to the outdoor plots. Surprisingly, there was little effect of these single-bay high tunnels with pine-bark-bed culture on the temperatures during the night, making frost protection with portable propane heaters necessary. High tunnels could enable blueberry growers to market a fresh product before the normal ripening date, thus adding value to their crop

Specified source(s) of funding for the work presented in this abstract: Federal competitive

5:30–5:45 pm

Soil Management History (Conventional, Organic) and Compost Incorporation Affect Lettuce, Sweet Corn, and Tomato Seedling Growth

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Soil management history and compost incorporation effects on seedling growth were tested in greenhouse-grown romaine lettuce, sweet corn, and fresh market tomato. Silt loam soils with long conventional and certified organic potato management histories were collected in Nov. 2005 and Oct. 2006 from the upper 25-cm of the soil profile at two nearby sites located at the OARDC, placed in 130-L plastic containers and transferred to a greenhouse. Moist soil was placed in 4-cm × 2-cm × 20-cm hinged Rootrainer cells on 1 Feb., 27 Mar., 25 Oct., and 1 Nov. 2006, either alone or after being mixed with composted dairy manure (15% soil-compost, v/v). Within 48 hours thereafter, seed were sown in Rootrainer cells and covered with soil or the soil-compost mix.

The factorial set of treatments (soil history, compost application) were arranged in a RCBD (four replications, eight cells per replication or six replications, four cells per replication) in climate-controlled greenhouses and irrigated (distilled water only) from the top and bottom. Emergence was recorded regularly and whole plants were removed from their cells at 2 (H1) and 5 (H2) weeks after seeding. Shoot and root fresh and dry weight, root volume and leaf area were measured and seven other variables calculated. The study was repeated twice in sweet corn and tomato and four times in lettuce, which was also harvested seven weeks after seeding (H3). Compost and soil effects measured at H1 were minimal in all crops but compost incorporation tended to increase crop growth measured at H2 and H3, regardless of soil type. At H2 and H3, incorporating compost into organic soil significantly increased the values of four to seven of 10 characteristics and increased the value of up to three others relative to the remaining treatments. At H3, plants grown in conventional soil without compost registered significantly smaller values than other treatments in five of ten characteristics. And, in tomato at H2, values for plants grown in organic, amended soil and organic, unamended soil were highest and lowest, respectively, in five of 10 characteristics.

Specified source(s) of funding for the work presented in this abstract: Private (Association, Foundation, Industry)

Oral Session 7: Nursery Crops

Tuesday, July 17 **8:00–9:30 am**

Room: Lowell A/B

Moderator: Richard C. Beeson; rcbeeson@ufl.edu

8:00–8:15 am

Growth and Physiology of Landscape Trees in Response to Varying Nutrient Levels for Pot-in-Pot Production

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In order to improve nutrient management of trees in pot-in-pot (PIP) systems for Michigan growers, we installed a PIP research study at the MSU Horticulture Teaching and Research Center in 2006. Bare root liners (*Acer* ×*freemanii* 'Jeffersred', *A. rubrum* 'Franksred', *Liriodendron tulipifera*, *Platanus* × *acerifolia* 'Bloodgood', *Quercus rubra*, *Ulmus japonica* ×*wilsoniana* 'Morton', and *U.* 'Morton Glossy') were potted in 25-gal (100-L) containers in 85% composted pine bark, 15% Canadian peat moss amended with 2# sulfur & 1# ferrous sulfate per yard with a target pH of 5.5. Trees were fertilized with one of four rates (100, 200, 300, or 400 g of 15–9–12, 7–9 month controlled-release fertilizer per container). Trees were irrigated according to standard nursery practices. We measured tree height and caliper, photosynthetic gas exchange rates, soil moisture, and nitrate-N content in leachate periodically throughout the growing season. Growth response to fertilization varied among species. We generalized the caliper growth response of the species as continually increasing (*U.* 'Morton Glossy', *Liriodendron tulipifera*), increasing to a plateau (*U. japonica* ×*wilsoniana* 'Morton', *Acer* ×*freemanii* 'Jeffersred', *A. rubrum* 'Franksred'), or relatively insensitive (*Platanus* ×*acerifolia* 'Bloodgood', *Quercus rubra*). Net photosynthetic rates for all cultivars rose over the first half of the growing season to a peak in early August, then declined in the fall. Pour-through nitrate concentrations varied in proportion to fertilizer rate and peak release occurred in mid-July. The first year results of this two-year study suggest that changes in productivity due to fertilization are species dependent as a function of physiological responses, leaf area development and phenology.

Specified source(s) of funding for the work presented in this abstract: Private (Association, Foundation, Industry)

8:15–8:30 am

Forest Residuals: New Substrates for Container-grown Crops

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Concern over the future supplies of current nursery and greenhouse substrates has led to the evaluation of alternative products derived from forest operations. In-field harvesting for clean chips and boiler fuel are forest management practices that yield possible alternative products for substrate use. Clean chip residual (CCR) is a by-product (bark, limbs, needles) of "clean chip" operations which process pine trees into small chips for the paper industry, this product can be further ground in a hammermill with different screen sizes to meet particle specifications. Boiler fuel is obtained in a similar fashion by feeding entire trees through a whole-tree chipper to produce a WholeTree (WT) substrate. Several studies have been conducted comparing CCR and WT to standard substrates. In the first study herbaceous annual species were grown in trade-gallon containers in the greenhouse for 45 days. Subsequent studies involved perennial species grown outdoors in different screen sizes (1.91 and 1.27 cm) of CCR with 100% pinebark (PB) as a control treatment. Next, three perennial species were grown with and without supplemental nitrogen outdoors (all treatments contained the same pre-plant amendments). Five woody species were grown outdoors in one of four screen-sized particles (3.12, 1.91, 1.27, and 0.95 cm) and compared to a traditional PB based substrate for one year. Results indicate that crops grown in CCR and WT exhibit similar growth to those grown in 100% PB with or without supplemental N at the 0.95 cm screen size. Preliminary data indicate that CCR and WT can be manufactured to given specifications for particle size distributions that result in plant growth similar to substrates currently used.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

8:30–8:45 am

Responses of Five Nursery Plant Species to Chlorinated Water and Efficacy of Using Chlorine to Control Diseases in Irrigation Water

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To protect natural water resources, nursery and greenhouse growers in some developed countries have designed production blocks to maximize the recycling of irrigation water in container-grown crops. Of concern is the increased risk of spreading pathogens in recycled irrigation water,

therefore, water disinfection can play a vital role in reducing this risk. Chlorination is one of the most economical water treatment methods and has been adopted by some growers to disinfect irrigation water and systems. Previous research has attempted to evaluate the efficacy of chlorinated irrigation water to control *Phytophthora* and *Pythium* species, and revealed that different pathogens have different sensitivities to chlorine. Furthermore, there is very little information regarding the phytotoxicity of chlorine to nursery crops. To address this information gap, we investigated the phytotoxic responses and chlorine thresholds for five nursery crops (*Spiraea japonica* 'Goldmound', *Hydrangea paniculata* 'Grandiflora', *Physocarpus opulus* 'Summer Wine', *Weigela florida* 'Alexandra', and *Salix integra* 'Hakura Nishiki') under field conditions. Plants were overhead irrigated with water containing 0, 2.5, 5, 10, and 20 mg·L^{-1} of free chlorine for 6 weeks. Growth and physiological parameters were used to assess treatment effects. We also determined the critical free chlorine thresholds and contact times required to control several plant diseases commonly found in irrigation water (*Phytophthora cactorum, Phytophthora infestans, Rhizoctonia solani, Pythium aphanidermatum*, and *Fusarium oxysporum*). Pathogens were treated with water containing 0.3 to 12 mg·L^{-1} of free chlorine over five contact times (0.5, 1.5, 3, 6, and 10 min) after which pathogen mortality was assessed. Results from both trials will be presented.

8:45–9:00 am

ETo-based Operational Model for Irrigation of Container-grown Woody Ornamentals

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Actual evapotranspiration and canopy dimensions were collected from *Ligustrum japonica* plants during production of rooted cuttings to market size plants in 11-L black polyethylene containers. From this data, along with corresponding reference evapotranspiration (ETo), a model based on canopy closure and canopy size was derived. This model, along with two simplified models, were compared to a manually adjusted irrigation based on 1.78 m of overhead irrigation annually. Models required only tri-weekly manual inputs of average canopy width and container spacing. Applications rates and frequency of irrigation were controlled by a data logger and based on the previous day's ETo and rainfall. The model and one of the simplifications produced >85% of the measured plants to market size with less irrigation than the control, and under the 1.78 m target. Explanation of the model and its expansion to other species will be discussed.

9:00–9:15 am

Fertilizer, Irrigation, and Mycorrhizal Effects on Container-grown Nursery Crop Biomass Accumulation and Leachate Nutrient Content

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The amount of irrigation water and nutrients applied per unit area is much greater in container-grown nursery operations compared to other agricultural production systems. Increased levels of applied fertilizers and irrigation frequencies can result in high levels of nutrients in leachates and runoff from nursery operations. In a randomized complete-block design with four replications coast leucothoe (*Leucothoe axillaris*), Japanese pieris (*Pieris japonica*), and Golden Mop falsecypress (*Chamaecyparis pisifera*) were grown in a 11.34-L container medium containing pine bark, peat moss, and sand (8:1:1) amended with mycorrhizal rhododendron root fragments and compared to non-inoculated plants. Plants were fertilized with Polyon Plus (14-16-8) at the commercial recommended rate (56 g supplying 7.84 g N per container) and at half the rate (low), and drip irrigated weekly at low (15.6 L) and high (25.2 L) rates. Mycorrhizal assessments were made from randomly selected samples of roots taken from the plants at harvest. On average, mycorrhizal inoculation increased leucothoe and pieris plant biomass by 37% and 34%, respectively, and did not improve that of chamaecyparis. Reductions in ammonical nitrogen and orthophosphorus concentrations in leachates were observed in mycorrhizal amended plants, especially at lower irrigation and fertilization rates. Nitrate levels in leachates varied among plants species and increased as fertilizer rate increased, especially in amended plants. There were no significant differences in mycorrhizal colonization (arbuscules, hyphae or spores) between the presence or absence of inoculum within any plant species. There was, however, a distinct, but non-significant increase in arbuscule abundance in inoculated pieris, compared to non-inoculated plants.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

9:15–9:30 am

Viburnum Root Mass and Fall Carbohydrate Levels as Affected by Container Type

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Viburnum trilobum 'Alfredo' in 25-L plastic and fabric containers were left in a production block to overwinter in 2004–05. All plants in plastic pots died while all plants in fabric pots survived and resumed normal growth in the spring. We hypothesized that fall accumulation of carbohydrates may be greater and confer increased cold acclimation to roots in fabric containers. The surviving plants were stepped up to 41-L fabric containers in Aug. 2005 and same-size plants (over-wintered previously in protected plastic pots) were potted in plastic containers. Root samples cut from the eastern quadrants on 26 Sept., 21 Oct., and 20 Nov. were dried, ground, and sugars extracted with 80% hot ethanol. Root starch was digested enzymatically. Sucrose was cleaved by Invertase. Glucose was quantified spectrophotometrically using a commercial glucose oxidase reagent. Plants were grown through 31 July 2006. Root dry weights and root to shoot ratios were significantly greater in fabric than in plastic containers. Root samples from fabric containers had significantly higher starch levels in the September samples and higher glucose levels in the October and November samples compared to plastic. It is evident that container type can affect root mass and carbohydrate metabolism, but the correlation between carbohydrate levels and cold tolerance could not be made since total carbohydrates were the same by end of November in both treatments and all the plants survived the second winter.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

Oral Session 8: Citrus Crops

Tuesday, July 17 **8:00–9:30 am**

Room: Rainmakers Ballroom A

Moderator: Arnold W. Schumann; schumaw@ufl.edu

8:00–8:15 am

Controlled-release Fertilizers Reduce Groundwater Nitrate Concentrations in Citrus Orchards

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Controlled-release or "slow-release" fertilizers use a variety of relatively new manufacturing technologies to gradually deliver nutrients

to plants over an extended time period. In citrus production, a season-long supply of nutrients from a single controlled release fertilizer (CRF) application would be beneficial if it can reduce application costs, enhance nutrient uptake by the trees, and reduce the leaching of nutrients, especially nitrate-N to groundwater. The objectives of this study were to test the impact of two CRFs alone and in combination with quick release fertilizer (QRF) on groundwater nitrate concentrations, fertilizer N uptake, and fertilization costs in a mature 'Valencia' orchard. A field experiment was established in a 16.2-ha orchard of 'Valencia' sweet oranges, using large plots of 174 trees (6 rows × 29 trees) to permit groundwater monitoring. Two groundwater monitoring wells were installed near the centerline of each plot and water samples were collected monthly for analysis of pH, EC, ORP, and nitrate-N concentration. The standard 100% N fertilization rate for these trees was 202 kg·ha^{-1} per year in 2005 and 224 kg·ha^{-1} per year in 2006. CRF1 was a commercial coated granular 15–3–19 (15%N–1.3%P–15.8%K) product designed to supply mature trees with nutrients for 12 months. CRF2 was a 10–2–12 (10%N– 0.874%P–9.96%K) liquid product based on urea formaldehyde and designed to supply nutrients over a 2- to 4-month period. Treatments consisted of one QRF and the two CRF fertilizers in the following combinations: (1) 100% QRF in four splits/year; (2) 75% CRF1 in one winter application; (3) 50% CRF1 in one winter application; (4) 25% QRF in winter, followed by 50% CRF1 in spring; (5) 50% CRF1 in winter, followed by 25% QRF in spring; (6) 75% CRF2 in three splits/year. Average nitrate-N concentrations in the groundwater were significantly affected by fertilizer treatments in the first 20 months of the experiment. Treatments were ranked 1, 5, 4, 2, 3, 6 in order of decreasing groundwater nitrate-N impact but treatment 6 supplied inadequate nutrients to the trees for normal production.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

8:15–8:30 am

Lime (Kagzi Lime): A Novel Source of Bioactive Principles

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Mexican lime (*Citrus aurantifolia* Swingle) is called kagzi lime in India and mainly used for pickles. Lime has certain health-maintaining properties. While conventional wisdom says citrus fruits are a good source of vitamin C, recently emerging research suggests that citrus may have at least 100 bioactive compounds, such as flavonoids, limonoids, folic acid, carotenoids. Some of these compounds have potential for prevention of certain diseases, based on in vitro and in vivo studies. Our study was focused on the isolation and characterization of specific bioactive principles from kagzi lime seeds from India. Seeds were dried, powdered, and subjected to successive extraction using hexane and ethyl acetate in a Soxhlet-type extractor. Furthermore, EtOAc extract was subjected to purification on a silica gel column using different mobile phases. The fractions were analyzed by TLC and HPLC. Fractions with similar peaks were pooled and crystallized to obtain two compounds, which were identified by mass spectra as limonin (0.14 %) and sitosterol glucoside (0.011%).This is the first report on the isolation of these compounds from *C. aurantifolia*. It is possible that the results of the study may open a new vista for industrial utilization of seeds for bioactive principles. This project is based upon work supported by the USDA-CSREES #2006-34402-17121, "Designing Foods for Health," through the Vegetable and Fruit Improvement Center.

Specified source(s) of funding for the work presented in this abstract: Federal competitive

8:30–8:45 am

Growth Flush and Flowering is Delayed by Winter Drought Stress in 'Valencia' Orange Trees

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We determined if drought stress during winter could delay spring vegetative flush and flowering of 'Valencia' sweet orange trees in order to avoid young fruit loss during late-season mechanical harvesting. Using Tyvek® as a rain shield groundcover under 10-year-old trees, four treatments were begun in December: 1) drought, no irrigation and covered soil; 2) partial drought, occasional irrigation under the cover; 3) rain only, no irrigation, no cover; and 4) normal irrigation, no cover. There were significant treatment differences in soil water and midday covered leaf water potentials throughout January and February. Flush growth and flowering were visible about 1 Feb. in irrigated treatments but was delayed about 4 weeks in the drought stressed treatments. Covers were removed during the third week in February and normal irrigation and fertilization was resumed. Bi-weekly numbers of mature leaves per branch, new expanding leaves, flower buds and flowers revealed less initial growth and flowering in drought stressed treatments but this difference diminished in March after treatments ceased. Fruit growth after delayed bloom in the drought treatment partially caught up with the previously well watered treatments since early fruit development occurred later in the season during warmer weather. New flush growth and flowering clearly were delayed by winte-time drought and final yield will determine if the delay in flowering was accomplished without loss of yield or fruit quality.

8:45–9:00 am

Nitrogen and Phosphorus Applications for Fertigated Young Navel Orange Trees in Arizona

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A field experiment was conducted using 7- to 9-year-old trees in central Arizona (AZ) to evaluate effects of N and P fertigation on leaf N and P concentrations, fruit yield and quality along with N and P removal in 'Newhall' and 'Fukumoto' navel oranges (*Citrus sinensis*) on 'Carrizo' citrange (*Porcirus trifoliata* × *Citrus sinensis*) rootstock. Trees were grown in a calcareous Gilman fine sandy loam soil. The experiment included 5 × 2 factorial design with five N rates (0, 91, 181, 272, 363 g of N/tree/year) from urea ammonium nitrate (32–0–0) and two P rates (0, 91 g of P/tree/year) from phosphoric acid (0–52–0). Phosphorus application did not affect yield, juice quality, leaf N and P concentrations or N and P removal in fruit. Leaf P in most of the treatments of both varieties was above the critical tissue P rate of 12 mg·g^{-1}. Maximum yields occurred at N rates of 150 to 250 g of N/tree/year equal to about 27% to 33% of currently recommended N rates for flood irrigated citrus grown in Arizona. At these rates, leaf N concentration was at or near the critical level of 25 to 27 mg·g^{-1} N removal in fruit accounted for 50% to 84% of the N applied in both varieties so N use efficiency was relatively high. N rate did not affect fruit quality. Our results suggest that optimum N rates for microsprinkler-irrigated 'Newhall' and 'Fukumoto' navel orange trees are much lower than currently recommended N rates.

9:00–9:15 am

Effect of KNO_3 Fertilization and Rootstock on Grapefruit Response to Salinity

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Citrus crops are sensitive to both the osmotic and the toxic effects of salinity. Continuous application of nitrates, such as KNO_3, is known to reduce the uptake of Cl- and thus overcome the toxic effects of salinity, yet, the contribution of nitrates towards tolerance of osmotic stress remains unknown. To examine this issue, an orchard experiment was carried out. 'Marsh seedless' grapefruit trees (*Citrus paradisi* L.) were grafted on five different rootstocks (Sunki Beneke 812, Gau Tau, Volkameriana, sour orange, and Troyer citrange) and subjected for 4 years to a linear gradient of salinity (220–880 ppm of chloride; osmotic potential of 0.04-0.13 MPa), with and without the addition of 0.5 mM KNO_3 applied through the fertigation system. Average concentrations of NO_3 were 148 ± 12 and 118 ± 7 ppm, respectively, and of K were15 ± 2 and 11 ± 1 ppm, respectively. Leaves of KNO_3-treated trees were characterized by higher levels of nitrogen and potassium, as was expected. Chloride and Na+ concentrations increased in response to salinity (up to 0.7% and 0.12% of dry mass, respectively) and were not affected by KNO_3 treatment (except for trees grafted onto sour orange and Troyer citrange, where application of KNO_3 decreased leaf chloride by 10–13%). Salinity decreased yield by 9% at the highest salinity level (346 vs. 315 kg per tree per 3 years). While application of KNO_3 increased yield by an average of 10% (344 vs. 312 kg per tree per 3 years), it did not eliminate the negative osmotic effects of salinity.

9:15–9:30 am

Effect of High-density Planting on Vigor and Yield in Kinnow Mandarin (*Citrus reticulata* Blanco)

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A study was carried out to explore the effect of tree spacing on vegetative performance and yield in 8-year-old Kinnow mandarins (*Citrus reticulata* Blanco) grafted on Rough lemon (*Citrus jambheri* Lush) rootstock. Plants were grown at three planting distances D1 (3.35 × 3.35 m), D2 (3.35 × 6.70 m) and D3 (6.70 × 6.70 m). Tallest plants (3.493 m) were observed in D1 while minimum plant height (2.69 m) was observed in D3. Plant canopy, number of growth flushes were maximum in D3 while minimum number of new flushes and leaves were found in D2. Fruit set percentage was highest in D1 (27.56%) and lowest in D3 (21.98%) whereas, maximum yield was found in D2 (593 fruits) and minimum yield was found in D1 (414 fruits). The results of this studies depicted that D2 exceeded for qualitative traits of the fruit vis-à-vis total soluble solids (TSS), titrateable acidity (TA), juice percentage and sugars as compared to other treatments. The objective of this study was to develop representative citrus yields by scion variety, rootstock and tree age that effect high density plantation and the growing conditions in the semi arid, sub-tropical irrigated plains of Pakistan.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

Oral Session 9: Crop Physiology 2

Tuesday, July 17 **8:00–10:15 am**

Room: Rainmakers Ballroom B

Moderator: Fumiomi Takeda, Fumi.Takeda@ars.usda.gov

8:00–8:15 am

Crop Load and Time of Defoliation in 'Imperial Gala' Apple Trees: Effects on Leaf Photosynthesis, Fruit Growth, and Yield

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This report focus on the effect of crop load and time of defoliation on photosynthesis (A), chlorophyll content (Chl), fruit size and yield. The experiment was conducted at Clarksville Horticultural Experimental Station (Michigan State Univ.) on 9-year-old 'Imperial Gala' apple trees on M-9 (n = 36). During the summer (20 June) after June drop, yield was adjusted according to different number of fruit per trunk cross sectional area (TCSA) to obtain three crop load levels: high (13.5 fruit/TCSA), medium (7.1 fruit/TCSA), and low (2.1 fruit/TCSA). Each crop load level was defoliated (25%) three times during the season (8 July, 25 and 19 Aug.) leaving three thinned trees for each level of crop load un-defoliated as control treatment. Spur canopy daily assimilation (A), stomatal conductance (g_s), internal CO_2 concentration (C_i), fruit growth and shoot length were measured at weekly intervals after crop load adjustment until harvest, and 1 week before harvest (14 Sept.), Chl and nitrogen leaf content was also determined. A in high cropping trees was not affected by defoliation at any time, however in medium and low cropping trees there was an increase from 5% to 20% at each time after 3 days from defoliation. A was higher during the season (from 10 to 18 %) in high cropping trees than in medium and low cropping trees. The total Chl and nitrogen was lower in low cropping trees than in medium and high cropping trees and not affected by defoliation, as well as total yield, fruit diameter and shoot length. Results reveal compensation capacity of spur leaves subtending the fruits in medium and low cropping trees. This indicates that leaf photosynthesis compensation to leaf damage occurs without reduction in fruit diameter or total yield per tree.

8:15–8:30 am

Source–Sink Relationship: Effect on Crop Load, Photosynthesis, and Carbon Isotope Discrimination of 'Imperial Gala' Apple Trees

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The natural carbon isotope composition (or 13C/12C ratio) of plant tissue is extensively used as an indicator of water use efficiency during plant growth, and is a powerful investigative tool of physiological responses of plants in different environmental conditions (e.g., water stress). In this report we tested if 13C/12C (per mil) could be an indicator of carbon source limitations other than water stress; where there may be an imbalance between source supply and sink demand during fruit growth. Trees of 'Imperial Gala'/'Bud 9' (n=30), 9 years old, field grown at the Clarksville Horticultural Research Station (MI), were hand

thinned after June drop to 5 levels of crop load by manipulating the leaf to fruit ratio (LFR: 4.5, 8.5, 15.6, 31.6, 61.5) and the number of fruit per trunk cross sectional area (TCSA: 16.1, 9.4, 6.9, 3.2, 0.8). The net photosynthetic rate (A) of leaves was monitored daily during the season; elevated rates were observed in low LFR trees. A was inhibited in low cropping trees (LFR 31.6 and 61.5) more in the afternoon (from 25% to 45% from high cropping trees) than in the morning (from 4% to 16%) and stomatal conductance showed a similar decline over the afternoon. Shoot, fruit growth and total yield per tree were affected in a range of –13% to +7% for fruit diameter, –25% to +26% for shoot lenght and –49% to +21% for yield as percentage deviation from normal crop load (LFR 15.6). Stable carbon isotope discrimination was reduced significantly in low cropping trees (–25.52 per mil), and was increased (–27.82 per mil) in high cropping trees. Similar results were reported in 2004 and 2005; carbon isotope discrimination in sink-source relationships will also be discussed.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

8:30–8:45 am

Development of Short-day-type Strawberry Transplants that Flower in Fall

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In the mid-Atlantic coast region, the primary strawberry harvest season is from early May to late June and out-of-season fruit production in the region is low. We developed a simple propagation scheme for short-day type strawberry cultivars to produce fruit in fall and spring in high tunnels without using chilling or artificial short-day photoperiod treatments during the nursery phase. Fall flowering occurred in 100% of 'Carmine' and 86% of 'Camarosa' strawberries, both short-day type cultivars, started as plug plants in early July and maintained in propagation trays until field establishment around 1 Sept. In 'Carmine' and 'Camarosa' transplants that were started as plug plants in early August, less than 30% of transplants produced flowers in the fall. July-plugged 'Carmine' and 'Camarosa' strawberry in high tunnel produced an average of 320 and 250 g of marketable fruit from late October to late December. When strawberry plug transplants were grown in tray flats (330 plants/m^2) during July and August the leaves formed a full canopy with high leaf area index above the plant crowns. The crown near the base of leaf petioles was illuminated only by light in the far-red and near-infrared region. Promotion of flowering in July-plugged transplants was correlated with high ratio of far-red light to red light reaching the crown. Spectral analyses showed that no visible radiation less than 700 nm reached the crown because the shorter wavelength light was absorbed through chlorophyll photosynthesis. The results of this study suggested that transplants of short-day type strawberries that will flower in fall can be produced by developing a plant canopy that alter the light that illuminates the crown. The key physiological mechanism operating in production of short-day type strawberry transplants with high fall flowering potential will be discussed.

Specified source(s) of funding for the work presented in this abstract: Federal competitive

8:45–9:00 am

Pistillate Flower Abortion and Pollination-induced Ethylene Production in English Walnut

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Walnut pistillate flower abortion (PFA) is the loss of female flowers approximately 2 weeks after bloom. Ovaries in PFA type flowers stop enlarging at approximately 3-4 mm in size, and abscise 10 to 14 days later. PFA in walnut is due to the presence of excess pollen on the stigma. When it lands on the stigma, pollen induces ethylene production in flowers. Previous lab and field studies indicate that ethylene is involved in PFA. The cultivar Serr is the most susceptible to PFA; and PFA in 'Serr' can exceed 90%, but other cultivars are susceptible as well. Excised walnut flowers were brought into the lab, pollinated, and ethylene production was measured with a gas chromatograph. Some flowers were treated with either amino-ethoxy-vinyl-glycine (AVG), or 1-methylcyclopropene (1-MCP) before pollination. Pollination with both live and dead pollen increased ethylene production in flowers. Ethylene production with dead pollen has also been seen in other species, and is presumably due to a decrease in membrane integrity of the pollen. Ethylene production remained low immediately after pollination, peaked approximately 24 hours after pollination, and then declined again. AVG prevented the peak in ethylene production, while 1-MCP caused a very large increase in ethylene production; this increase has also been seen in other species. Ethylene production following pollination increased in both the stigma and the ovary, but the majority of the increase was in the stigma. These results are consistent with field experiments that show ethylene inhibitors can reduce PFA in the field.

Specified source(s) of funding for the work presented in this abstract: Private (Association, Foundation, Industry)

9:00–9:15 am

Gibberellins' Effect on the Reproductive Development of *Brassica oleracea*

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During the development of *Brassica oleracea*, there are two peaks in the endogenous levels of gibberellins (GAs). Studies have proposed that the first peak induces vegetative-to-reproductive transition (curd initiation) and the second maintains curd development. However, the effect of GAs in floral induction of Brassicas is inconsistent; promoting, inhibiting or having no effect on flower induction. With respect to the GAs role in the subsequent stages of curd development, limited work suggests that GAs do not trigger reproductive development in cauliflower. Evidence in *Arabidopsis*, a close relative to *B. oleracea*, shows that gibberellin is one of the pathways influencing the vegetative-to-reproductive transition, and once the plant has initiated the reproductive development, GAs have a role in the maintenance of floral identity. Hence, the first objective in this investigation was to determine the effect of GAs in the curd initiation of *B. oleracea* cultivars. The second objective was to determine whether gibberellins affect the fate of the reproductive meristem at two different transition stages: inflorescence meristem to floral primordia, and floral organ development. Active GAs were found from both the early-13 hydroxylation pathway and the non-13 hydroxylation pathway in the vegetative-to-reproductive transition in cauliflower and broccoli. GAs role in curd development was unexpected: gibberellins influenced bract incidence in cauliflower curds, a sign of reversion toward the vegetative stage. As shown in Arabidopsis, GAs were also involved in the development of floral buds, possibly by controlling B- and C-function genes which specify stamen and carpel development in the ABC model of flowering.

9:15–9:30 am

The PGR Trinexapac-ethyl Reduces Lodging in Desert Durum Wheat

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In wheat, straw strength has been shown to be an important agronomic characteristic as it is closely correlated with crop yield. The process by which straw is displaced vertically is known as lodging which results in a crop with a permanent lean or which lies horizontally on the ground. It has been shown that in some cases, wheat yields are reduced by 5% for every 10% of the field area that lodges early. Trinexapac-ethyl, an

inhibitor of in vivo gibberellin biosynthesis, was tested at two locations within the Yuma, AZ, area namely, San Luis, AZ, and Winterhaven, CA, in Spring 2006. Both trials were conducted in 400 square foot plots embedded within existing stands of Desert Durum (var. Kofa) wheat. Trinexapac-ethyl was tested at the recommended rate as single (384 g ai/ha) or split (128 g ai/ha) applications at GS30 (jointing), 7 days after application #1 and at GS37 (flag leaf just visable). Ethryl®, has been shown to decrease stem elongation, resulting in shorter plants with increased rigidity, was also tested in this study at a single labeled rate of 280 g ai/ha at GS37. In addition to straw strength, plant height, grain yield, 1000-grain weights, phytotoxicity and stem diameter/stem wall thickness ratio were used as indicators of Trinexapac-ethyl effectiveness. Overall, the products tested have little effect on final grain yield in the absence of lodging. However, in the presence of a severe lodging event, as observed in San Luis plots, PGR's can enhance yield potential. Split applications of Trinexapac-ethyl appeared to result in greater 1000-grain weights and greater yield determinations relative to a single application and untreated checks. Trinexapac-ethyl, is a strong candidate for enhancing wheat production where lodging is a concern for producers.

Specified source(s) of funding for the work presented in this abstract: Federal competitive

9:30–9:45 am

Effects of Frond Harvesting on Absorption, Translocation, and Accumulation of Arsenic by *Pteris vittata* L., Chinese Brake Fern

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An experiment was carried out to compare the effects of frond harvesting at a 15-cm height with a non-harvested treatment on arsenic (As) absorption by Chinese brake fern (*Pteris vittata* L.) growing hydroponically in contaminated groundwater (140 $\mu g \cdot L^{-1}$ As). Arsenic accumulation and translocation in shoots and roots separated at 8 and 48 hours after initiation were determined. In a well-established plants with extensive root system frond harvesting had no influence on As uptake and As concentration in water was reduced close to 10 $\mu g \cdot L^{-1}$ (new EPA standard) in 8 hours. For both harvested and non-harvested plants, 80% and 93% of As taken up was located in the above ground tissue (rhizomes and fronds) at the end of 8 and 48 hours, respectively. Rhizome accumulated 36% to 53% of the absorbed arsenic depending upon the amount of available frond tissue and time of root shoot separation. While fronds of non-harvested plants accumulated maximum arsenic, the rhizome in harvested plants served as "buffer-tissue" for As accumulation in the absence of sufficient frond biomass. The efficiency of phytoremediation by Chinese brake fern was found to be associated with the ability of the extensive root system to translocate As to the aboveground tissue (rhizome or fronds). Our results indicate that enhanced root uptake, efficient root to shoot translocation, and differential As storage under different conditions all contribute to the As hyperaccumulation in *P. vittata*.

Specified source(s) of funding for the work presented in this abstract: Private (Association, Foundation, Industry)

9:45–10:00 am

Role of Phospholipid Signaling in Citrus Leaf and Fruit Abscission

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The citrus industry will benefit from increased mechanical harvesting efficiency through development of fruit-specific abscission agents. Hence, understanding citrus leaf and fruit abscission is essential. Evidence from preliminary research suggests involvement of lipid signaling in citrus leaf and fruit abscission. We hypothesize that specific phospholipases, and lipid messengers such as phosphatidic acid, have novel roles in early signaling events during citrus organ abscission. To characterize the role of phospholipid signaling in abscission, two phospho-inositide dependent phospholipase Cs (PI-PLCs), a phospholipase D- (PLD-) and a PLD-1 have been isolated from citrus using reverse transcriptase (RT)-PCR and rapid amplification of cDNA ends (RACE). Additionally, several phospholipase gene homologs have been identified from the publicly available citrus HarvEST database. Ethephon (600 ppm), an ethylene releasing non-specific abscission inducer, induced rapid up-regulation of PLD?1 and down-regulation of PI-PLCs in citrus leaf blades, leaf abscission zones and fruit flavedo. Real-time RT-PCR analysis indicated 10-fold induction of PLD?1 and several-fold reduction in PI-PLC expression within 3 hours of ethephon application in citrus leaf blades. Expression of additional phospholipase gene homologs was marginally altered by ethephon application. Similar results were obtained by ethylene treatment and upon application of 5-chloro-3-methyl-4-nitro-1H pyrazole (CMNP – 250ppm), a fruit specific abscission inducer, suggesting dynamic and specific roles for phospholipid signaling mechanisms in abscission. Further characterization of the role of phospholipases in citrus abscission is under way. Knowledge gained from this study will aid in future development of environmentally safe, lipid signal-altering abscission agents.

10:00–10:15 am

Ethylene Perception and Biosynthesis Gene Expression in Valencia Orange Fruit and Leaves Are Altered during Abscission

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Abscission is a process that leads to detachment of an organ from the parent plant. Plants treated with ethylene or ethephon, and ethylene-releasing agent, show an increase in the rate of abscission. The effect of 400 mg/L ethephon (2-chloroethylphosphonic acid) alone or in combination with aminoethoxyvinylglycine (AVG; ethylene biosynthesis inhibitor) and/or 1-methylcyclopropene (1-MCP; ethylene perception inhibitor) on leaf and mature fruit abscission of 'Valencia' orange (*Citrus sinensis*) was studied. Leaf abscission increased and fruit detachment force (FDF) decreased significantly 2 and 4 days after ethephon treatment, respectively. Leaf drop increased to over 55% after 7 days. When 1-MCP was combined with ethephon and applied to citrus canopies, leaf abscission was prevented but the reduction in FDF still occurred. The pattern and intensity of young fruitlet drop paralleled that of leaves, but 1-MCP reduced ethephon-induced fruitlet drop. AVG had no effect on ethephon-induced leaf and mature fruit abscission. We hypothesized that differential response of citrus fruit and leaves to 1-MCP was correlated with the presence and expression of ethylene perception, signaling and biosynthetic genes and their downstream action. To determine their expression patterns during abscission impacted by ethephon and/or ethylene perception and biosynthesis inhibitors, partial or full-length nucleotide sequences were obtained for Valencia homologs of ERS1, ETR1, ETR2, CTR1, RAN1, EIN2, EIN3, ACO, ACS1 and ACS2. Preliminary work demonstrated that ethephon application increased expression of ERS1 but not ETR1. The influence of ethephon with and without ethylene perception and biosynthesis inhibitors on expression of the above-mentioned genes will be discussed.

Oral Session 10: Organic Horticulture 2

Tuesday, July 17 **8:00–10:00 am**

Room: Greenway A/B

Moderator: Kathleen Delate; kdelate@iastate.edu

8:00–10:00 am

Weed Suppression with Mulches for High Tunnel Organic Cucumbers

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Weeds are frequently cited as the top pest problem by organic growers. Three mulches useable in organic production were evaluated for their ability to suppress weeds in a high tunnel cucumber crop. This study was conducted in 2005 and 2006 at the Russell E. Larson Research and Education Center, Rock Springs, PA, in four high tunnels under organic management. A split-plot design was used with mulches (wheat straw, shredded newspaper, sheets of newspaper and no a mulch-control which was hand weeded once during the growing season) applied to whole plots. Subplots consisted of four cucumber cultivars ('Sweet Marketmore', 'Lemon', 'Diva', and 'Prolific'). Yields, mulch degradation and weed populations were recorded. In both years marketable yields were highest and fruit largest from 'Sweet Marketmore' and lowest from 'Lemon' plants. In 2005, the number of cucumbers did not differ by cultivar. In 2006, the most cucumbers were harvested from 'Sweet Marketmore' and the least from 'Diva' plants. All yield parameters were not affected by mulch treatments. Cultivar grown did not effect weed populations in either year. Weed populations were highest in control plots and lowest when shredded newspaper was used. By the end of the growing season in each year, sheets of newspaper degraded the most followed by shredded newspaper and straw. While the shredded newspaper was the most effective for suppressing weeds, yields were not influenced by any mulch treatment indicating weed populations were below thresholds regardless of mulch treatment.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

8:15–8:30 am

Impacts of Organic Transplant Media on Plant Growth and Root Rhizosphere Bacterial Communities

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Greenhouse and field trials were carried out to evaluate the overall performance of different potting mix amendments for organic tomato cv. Mt. Fresh production, including effects on microbial ecology of roots as transplants and longevity of these effects in the field. An industry standard potting medium (Sungrow) was compared to a control peat and vermiculite medium with no amendments (BASE) or this medium amended with thermogenically composted dairy manure (TC), a dairy manure based vermicompost (VC), alfalfa meal (AM), or sesame meal at 1 or 2.5% v/v (SM1, SM2.5). am amended potting mix had the lowest seedling emergence rates due to high potassium levels in the medium. However, plant growth in this treatment was only slightly lower than the top (SM2.5) and second best (SM1) media. The SM mixes had the highest midseason plant biomass and early fruit, but there were no differences in total yield among the amended mixes. Plants grown in the BASE mix were smaller throughout the experiment and this slow growth resulted in significantly lower yields. A low rate of 1% SM appears promising as a nutrient amendment for organic potting media. Plant-based vs. compost-based amendments resulted in distinctly different bacterial communities in the transplant rhizosphere. These differences were detectable at a mid-season sampling from the field, indicating that compost and plant-based organic fertilizers can influence the rhizosphere ecology of the plant and contribute differentially to seedling growth and out-planting success.

Specified source(s) of funding for the work presented in this abstract: Private (Association, Foundation, Industry)

8:30–8:45 am

Alternative Management of Purple and Yellow Nutsedge in Southern California Vegetable Production System

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Purple and yellow nutsedge are serious perennial weedy pests whose rapid growth can overwhelm vegetable crops. The objective of this study was to evaluate several alternative methods to control nutsedges. A standard low desert crop rotation of spring cantaloupe–summer fallow–and winter broccoli was compared to treatments that included: cultivation, smother crops wheat and sudangrass (wheat–sudangrass–winter fallow), combining smother crop wheat with solarization (wheat–solarization–broccoli), and combining sweet corn plus halosulfuron application with sudangrass (sweet corn–sudangrass–winter fallow). When broccoli was planted without any nutsedge control for two seasons, purple and yellow nutsedge tubers increased from 0.66 tuber/m^2 and 1.32 tuber/m^2 to 1260 tuber/m^2 and 111 tuber/m^2 in the top 15 cm of soil, respectively. Halosulfuron and smother treatments did not reduce the number of purple nutsedge tubers significantly despite sudangrass effectively shading the soil during most of the summer months. Cultivation in the two growing seasons reduced purple nutsedge tubers by 93% compared to control plots. Purple nutsedge was effectively controlled by solarization, with almost no live tubers found in the plot after each summer. Yellow nutsedge did not grow as vigorously as purple nutsedge in the hot southern California desert. All methods controlled yellow nutsedge effectively, especially when there were no crops growing in the summer. After two growing seasons, solarization increased broccoli marketable yield by 92% compared to crop control without purple nutsedge, while all other treatments had lower yield than crop control without purple nutsedge. In both purple and yellow nutsedge field, planting sudangrass in the summer had the lowest broccoli yield.

Specified source(s) of funding for the work presented in this abstract: Federal competitive

8:45–9:00 am

Organic Seed Use in Certified Organic Production

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Organic agricultural sales increased to a $15 billion in the US in 2005 and continue to expand 20% annually. Current estimates place the value of organic agriculture at $25 billion worldwide. The USDA–National Organic Program requires that organic producers source certified organic seed/cultivars for their operations, but because the organic seed industry is still in its infancy, many growers continue to seek exemptions for the use of non-treated conventional seeds. The Organic Agriculture Program at Iowa State Univ. has evaluated yield and plant performance comparisons between organic and conventional seed under certified organic field conditions. Results from these four-year trials include an average 12% lower yield with organic corn seed, but a 19% higher yield

with organic soybean seed, compared to conventional seed. Organic vegetable seed (bell peppers) has also provided excellent yields. Key among considerations of organic seed performance, however, is management under organic conditions. Among the most important production issues are managing soil fertility and timely pest management (for weeds, insects and diseases). Working with organic farmer groups and organic seed companies can help speed the analysis of cultivar performance across a wider spectrum of environmental conditions. An overview of current participatory plant-breeding projects at Iowa State Univ. and in the US will be presented.

9:00–9:15 am

Organic Greenhouse Production of Basil and Spearmint: Nutrient Uptake and Postharvest Quality

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Barriers to organic herb greenhouse production are high due to lack of available technical information and the low number of producers experienced in this area. The objective of this study was to develop a plant tissue monitoring program and examine the impact of fertilization regimes on postharvest quality of greenhouse-grown fresh cut organic basil and spearmint in a perlite-filled trough system. Two separate experiments for basil 'Nufar' and a local spearmint strain were conducted inside the same double-layer polyethylene covered greenhouse with fan and pad ventilation at the Univ. of Florida's NFREC–Suwannee Valley near Live Oak, FL. Four certified organic fertilizer treatments with % N, P, K analysis (4.0–0.9–2.5, 4.0–0.9–3.3, 8.0–2.2–4.2, and 8.0–2.2–4.2 plus a sidedress of fish emulsion 5.0–0.9–1.7) were evaluated in comparison to a standard non-organic hydroponic fertilizer treatment (150-50-200 mg/L); each treatment received the same total nitrogen amount. Treatments were arranged in a RCB design with six replications. Plots were drip irrigated, except the hydroponic treatments which received water plus nutrients. Herbs were harvested and stored under commercial conditions for 7 and 14 days at 12.5 C for basil and 5 C for spearmint. Leaf color, moisture content and subjective ratings for foliar firmness and extent of decay were assessed for both crops. Postharvest quality of basil and spearmint was very high and with few exceptions was equivalent to the quality of hydroponically grown herbs. Leaf N and K content in basil was similar among treatments 109 and 150 days after transplanting, but petiole sap N content differed among treatments and sampling date. Spearmint petiole sap N ranged from 1537 to 2667 ppm but was not different among treatments.

Specified source(s) of funding for the work presented in this abstract: Federal competitive

9:15–9:30 am

Effect of Tillage Interval on Purple Nutsedge Suppression

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Weekly tillage during summer appears to be an excellent practice for suppressing purple nutsedge (*Cyperus rotundus* L.) in organic vegetable production systems in Florida. Repetitive tillage increases the opportunities for tubers to be brought to the soil surface where they undergo desiccation and death. In addition, multiple successive shoot removals may deplete tuber storage reserves and buds, resulting in loss of viability. However, such frequent tillage cannot be regarded as sustainable and can be expected to have a negative impact on soil. Therefore, a study was initiated to evaluate the effect of tillage interval on purple nutsedge suppression to determine whether equivalent nutsedge suppression could be accomplished with less frequent tillage. After initial soil preparation to remove existing vegetation, over a 12-week period plots were tilled at intervals of 1, 2, 3, 4, 6, and 12 weeks. Pretillage tuber viability ranged from 35% to 57%. The response to increasing length of tillage interval on tuber viability was quadratic with the lowest intervals of 1, 2, and 3 weeks reducing tuber viability to less than 20%. Tuber viability with the 6-week interval was 40%. Purple nutsedge shoot density 2 and 4 weeks after the cessation of treatments (WAT) also increased with tillage interval in a quadratic manner. No resprouting had occurred with the weekly tillage treatment by 4 WAT, but nutsedge densities were 11, 29, and 66 plants/m^2 with 2,- 3-, and 6-week intervals, respectively, at 2 WAT. Therefore, tillage at longer intervals was not as effective as a weekly treatment. Unless supplementary control measures are used, the suppression afforded by tillage every 2 or 3 weeks may be insufficient to prevent yield loss in a subsequent crop.

Specified source(s) of funding for the work presented in this abstract: Federal competitive

9:30–9:45 am

Managing Phosphorus for Organic Crop Production

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An adequate P supply is essential for successful crop production. Growers using organic production techniques are encouraged to use on-farm resources or products receiving minimal processing. Crop producers using compost and manures as a N supply generally apply more P than is removed in the harvested crop, leading to long-term P accumulation. Rock P is generally insoluble until it reacts with an acid source in the soil which greatly limits its usefulness. Microbial additives and mycorrhizal fungi may help solubilize a small portion of the soil P, but they perform best in low soil P conditions where deficiencies are common. Cover crops may help acquire soil P, which is subsequently released when it is killed, but they provide no additional P to the soil. Careful soil analysis should be used to avoid P deficiency leading to loss of yield and quality, and also avoid excessive P accumulation, which can pose potential problems with water quality.

9:45–10:00 am

Plant Population, Variety, and Sampling Effects on Organic Kraut-type Cabbage Plant and Head Traits

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Plant population and variety effects on crop yield and quality in organic, kraut-type cabbage are poorly characterized. On-farm study can help close this gap in the literature. In 2006, eight varieties (17698, Kaitlin, Krautman, Megaton, SG3378, Superkraut, TransAm, XBC2329) were transplanted to an organically managed, non-irrigated field in Luckey, Ohio, on 1 June in single, replicated, randomized 200-m rows located in two adjacent blocks. In-row spacing of 35.6 cm (block 1) and 40.6

cm (block 2) and between-row spacing of 84 cm gave 33.5 (block 1) and 29.4 (block 2) thousand plants/ha. At head initiation (22 Aug.) and crop maturity (10 Oct.), five consecutive plants or heads were removed from four areas within each row separated by 15 m and transferred to refrigerated storage at the OARDC. Then, a total of 14 plant and head variables were measured, most on individual heads. Plant and head traits were more consistently and strongly affected by variety than by plant population and Brix levels varied with the position in the head from which samples were taken. Eight of 56 tests (7 variables × 8 varieties) of the influence of plant population were significant ($P = 0.05$) while variety significantly affected all but one variable (tissue mass/ha at head initiation), regardless of plant population. Among varieties, the influence of plant population was inconsistent for all variables except yield and whole-head Brix. Yield tended to be highest at 29.4 thousand plants/ha, although the effect was significant for only two varieties. Brix levels were measured in four regions of 320 individual heads: outer half-top half, outer half-bottom half, inner half-top half, inner half-bottom half. Regardless of plant population and variety, Brix values were greater in tissue taken from the bottom- vs. top-half and the inner- vs. outer-half of mature, trimmed heads. However, this effect was significant for only the top-bottom comparison. Whole-head Brix values tended to be highest at 33.5 thousand plants/ha, although the effect was significant for only two varieties.

Specified source(s) of funding for the work presented in this abstract: Private (Association, Foundation, Industry)

Oral Session 11: Postharvest 1

Tuesday, July 17 **10:00–12:30 pm**

Room: Rainmakers Ballroom C

Moderator: D. Mark Hodges; HodgesM@AGR.GC.CA

10:00–10:15 am

Effects of Harvesting Time and Storage Period on the Quality of Winter Squash Grown in Korea

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Three varieties of winter squash were harvested 20, 25, 30, 35, 40, 45, and 50 days after flowering and evaluated for fruit weight, soluble solids (SSC), starch, sugar and vitamin C. Squash varieties harvested 45 days after flowering were stored for 0, 1, 2, 3, 4 and 5 weeks at room temperature. SSC was measured every 7 days. Fruits reached maximum size 25 to 30 days after flowering in all varieties. Starch content was highest at 30 days after flowering and gradually decreased as the fruit matured, implying starch was converted into soluble sugars in all varieties. The level of Vitamin C was highest 35 days after flowering in 'Bochang' and 'Ajijimang', and 45 days after flowering in 'Ebis'. SSC rapidly increased within 40 and 45 days in all varieties. In this period, 'Bochang' increased from 8.4 to 12.1 °Brix, 'Ajijimang' from 5.8 to 10.7, and 'Ebis' from 5.1 to 8.7. Sucrose was the primary soluble sugar. Sucrose comprised 57% of the soluble sugar(Sucrose, glucose, fructose) in 'Bochang', 78% in 'Ajijimang, and 53% in 'Ebis'. SSC was still low at harvest but gradually increased while in storage. SSC of 'Bochang' and 'Ajijimang' reached a maximum of 16 °Brix 4 weeks after harvest from the initial 10 °Brix at harvest. On the other hand, the behavior of the increase in SSC in 'Ebis' was different. SSC increased slowly until 3 weeks after harvest but rapidly increased during the next 2 weeks. SSC eventually reached a high level of about 16.8 °Brix. The results indicated that the optimal harvest time of winter squash is 45 days after flowering, and the optimal distribution time is 3 to 4 weeks after harvest in 'Bochang' and 'Ajijimang' and 5 weeks in 'Ebis'.

Specified source(s) of funding for the work presented in this abstract: Federal competitive

10:15–10:30 am

Effect of Edible Coatings on the Flavor of 'Valencia' Oranges

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Commercial coatings used for citrus fruit include carnauba- and shellac-based waxes or resins. A new formulation containing only food grade ingredients was tested, along with an experimental polyethylene-candellila (PE) wax emulsion, and two commercial citrus coatings, one shellac-based, and the other carnauba wax-based. The food-grade formulation contained hydroxypropylmethylcellulose (HPMC), beeswax, and shellac. Valencia oranges were obtained from a local grove in Florida in May 2006. Fruit were washed, hand-coated and dried, and stored at 5 °C for 0, 3, and 6 weeks. After storage, fruit remained at room temperature (25 °C) for an additional 2 weeks prior to evaluation. Carnauba, PE, and HPMC based coatings provided the best weight loss control over 6 weeks (5 °C) + 2 weeks (25 °C). Fruit coated with commercial carnauba and shellac had the highest gloss, followed by PE-coated fruit. However, in a taste panel, preference was given to fruit with intermediate shininess such as those coated with carnauba and the PE-based emulsion. Flavor of shellac-coated fruit was least preferred after 3 and 6 weeks at 5 °C + 2 weeks at 25 °C. Shellac coated fruit had significantly higher levels of internal ethanol and CO_2 compared to other treatments. However HPMC-coated fruit also had high ethanol levels, intermediate between shellac and other treatments. Volatiles analysis showed that ethanol, ethyl acetate (two indicators of fermentative metabolism), methanol, hexanol, ethyl butanoate, and methyl butanoate were high in shellac-coated fruit, while uncoated oranges had most of the volatile compounds characterizing fresh citrus flavor (terpenes and alcohols). Carnauba and PE:candellila emulsion provided the best compromise for visual appearance and reduced ethanol production.

10:30–10:45 am

Evaluation of Apple Fruit Aroma Character from the Geneva *Malus* Core Collection

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Mature apple fruit from 184 lines (41 species) from the *Malus* core and Kazakhstan collections of the germplasm repository at the New York Agricultural Experiment Station in Geneva, NY, were evaluated. Volatile compounds, taste, weight, internal ethylene concentration, starch index, firmness, and Brix were measured when the fruit were ripening. Fruit mass of individual lines ranged from 0.3 to 342 g. Small-fruited lines produced no or few detectable esters. Medium-sized fruited lines tended to have unusual flavors and unique scents. Large fruit had more diversity in and a higher production of esters and alcohols, but did not possess unusual or peculiar aromas. Some species produced mostly straight-chain esters while others contained abundant branched-chain

esters in addition to straight-chain esters. Unsaturated esters and ester precursors were detected predominantly on small-fruited lines. Esters with even-numbered carbon chain-lengths for the alcohol and acid portion were more common. The most frequent esters detected were C4, C6, and 2-methylbutanoate esters. The emission of volatiles and elevated internal ethylene concentration did not always correlate with a high starch index. Commercial apples were found to be balanced with sweetness, acidity, floral, and fruity.

10:45–11:00 am

Effect of Increased Ascorbate Content on Postharvest Quality of Fresh-Cut Spinach Leaves

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A decrease in ascorbate (vitamin C) content during storage has been associated with increases in oxidative stress and subsequent reduced quality of fruits and vegetables. Previous work has shown that spinach cultivars with lower levels of endogenous ascorbate were more susceptible to postharvest-associated oxidative senescence than cultivars with higher ascorbate content. In order to better characterize the importance of ascorbate in postharvest quality, spinach plants were pre-treated with the ascorbate precursor L-galactono-γ-lactone in order to enhance ascorbate content. Control plants were pre-treated with water. Plants were harvested and placed into storage with regular removals. On removal days, samples were analzyed for postharvest quality, indices of oxidative stress, and antioxidant activities/content. The effect of increased ascorbate content on antioxidant potential and postharvest quality of spinach leaves will be discussed.

11:00–11:15 am

Microbial Growth in Fresh-cut Lettuce Is Increased When Wound-induced Phenolic Accumulation Is Suppressed

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One consequence of exposing plant tissue to sub-lethal levels of biotic and abiotic stresses is to induce a response that increases the tissue's resistance to the delirious effect of subsequent stress. Phenolic metabolism is stimulated by many stresses and many of the resulting compounds produced by the tissue contribute to increasing the tissue's physical (e.g., lignin) or chemical (e.g., phytoalexins) resistance. Any treatment that suppresses the tissue's naturally ability to respond to biotic and abiotic stresses and limits the production of these protective compounds could permit the proliferation of microorganisms than would not have occurred in normally responding tissue. If some microbes are tolerant of the control treatment and flourishes after treatment, it may appear that these control treatments promote the microorganism's growth when in fact the treatments have simply eliminated the naturally induced inhibition of growth that would have resulted from stress-induced changes in the tissue. A number of treatments were used to suppress the wound-induced accumulation of phenolic compounds in lettuce leaf tissue. The tissue was inoculated with lettuce pathogens and their rate of growth was measured. It appears that a number of treatments that suppress the tissue's natural ability to respond to abiotic and biotic stresses increase the ability of natural and introduced microorganisms to proliferate on the tissue. The importance of these findings on food safety will be discussed.

11:15–11:30 am

Effect of *trans*-Resveratrol Treatment on Bioactive Compounds of Satsuma Mandarin

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Satsuma mandarins (*Citrus unshiu* Marc.) are an important citrus commodity known for their nutritional and antioxidant properties. Mandarin fruits are highly perishable and susceptible to postharvest decay. Although synthetic fungicides are effective in suppressing the occurrence of postharvest pathogen decay environmental and chronic health effects are noted. Among the new alternative non-chemical technologies reported effective in suppression of postharvest spoilage is the use of the natural plants defense. Resveratrol is a naturally occurring phytoalexin produced in response to a variety of stress such as pathogenic attack or with UV irradiation. In addition to its antifungal properties, resveratrol also has antioxidant properties, which have positive effects on fruit conservation during storage. In this study, satsuma fruits were either submersed in varying concentrations of resveratrol (1.6×10^{-3} M, 1.6×10^{-4} M, and1.6×10^{-5} M), tap water or combination of wax and imazalil (IMZ) and stored for a duration of 12 weeks at 10 °C and 95% RH. The effect of these treatments on total phenolic content (TPC), total flavonoid (TF), total carotenoid (TC) content and total antioxidant capacity (TAC) as assessed by ferric reducing power (FRAP) were determined at 0, 4, 8, and 12 weeks of storage. In all assays determined, *trans*-resveratrol treatment was the most effective treatment in maintaining shelf-life and nutritional quality when compared to either water or wax. In summary, the results of this study indicate postharvest treatment of *trans*-resveratrol to satsuma mandarins may offer an additional measure of extending the shelf life and maintain antioxidative properties of stored citrus fruit.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

11:30–11:45 am

Hexanal Vapor Inhibits Fungal Growth and Controls Postharvest Fruit Decay

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Penicillium expansum, Botrytis cinerea, and *Monilinia fructicola* are the dominant fungal pathogens causing decay of many fruits during storage, and their control is important to the food industry. The effect of the natural volatile hexanal as an antifungal agent on the major postharvest fungal pathogens *P. expansum, B. cinerea*, and *M. fructicola* was studied. The antifungal effect of hexanal vapor was dependent on concentration and treatment duration, but sensitivity of the pathogens varied. Spore viability of *P. expansum* was reduced by 80% whereas, 100% of *B. cinerea* and *M. fructicola* spores were killed after exposure to 900 μL/L for 12 hours at 20 °C. Hexanal treatment at 450 μL/L for 24 hours resulted in a 50% reduction in spore viability of *P. expansum* and greater than 95% reduction in spore viability of *B. cinerea* and *M. fructicola* at 20 °C. Only moderate numbers of spores were killed at a concentration of 200 μL/L. Morphological changes in developing fungal spores treated with hexanal were assessed using light microscopy, and scanning and transmission electron microscopy. Fungal cultures were exposed to each of two concentrations (450 or 900 μL/L hexanal) for

6 or 24 hours. Damage to cell walls and leakage of cellular material was observed. The antifungal effect of hexanal vapor was further tested on peach and apple fruit inoculated with 5×10^4 spores/mL of *M. fructicola* and *P. expansum*, respectively. Effective control of decay was attained in peaches and apples after exposure to 900 μL/L hexanal vapor for 24 and 48 hours, respectively. Significant reduction of decay and improvement of marketable fruit were also shown in high bush blueberries. Hexanal, when used as an antimicrobial fumigant, provides a promising alternative to synthetic fungicides and will meet the consumers' demand for safe food.

11:45–12:00 pm

Optimizing Protein Extraction Protocols for Two-dimensional Electrophoresis and Mass Spectrometry Analysis

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Proteomics is a systematic approach to study changes in proteins, providing an essential linkage between the transcriptome and metabolome. Protein extraction and sample preparation is one of the most critical steps in the 2-DE proteomic study of fruit. This is largely due to low protein content and the presence of interfering substances. Although some protocols have been reported, optimum conditions for the preparation of protein extracts from plant tissues that are suitable for 2-DE have primarily been developed for immature vegetative tissues. Establishing a reliable and effective protein extraction procedure is an essential step in conducting proteomic research. A modified phenol-based protocol and a phenol-free protocol that involves hot SDS extraction followed by TCA precipitation in acetone, were qualitatively and quantitatively compared and evaluated on apple peel and strawberry fruit. The phenol protocol resulted in better performance with significantly higher protein yields of 2.35 ± 0.1 and 0.46 ± 0.06 mg/gFW from apple and strawberry fruit, respectively, compared to the SDS protocol which produced 0.74 ± 0.1 and 0.27 ± 0.02 mg/gFW, respectively. 2-DE analysis of protein extracts revealed 1422 and 1368 protein spots in association with the phenol protocol and 849 and 956 spots with the SDS protocol in apples and strawberries, respectively. Qualitative differences were found between two protocols for apples and strawberries. Spots from each fruit tissue and extraction procedure were selected and total of 26 were identified by LC/MS/MS with good confidence. Overall, this study demonstrates the complexity of protein extraction of fruit tissues, and suggests that a phenol-based protein extraction protocol should be used as a standard procedure for recalcitrant fruit tissues, while a SDS protocol with or without a clean-up procedure may be used as an alternative protocol. Examples of using optimized protocol as a proteomic approach to identify proteins from apple fruit in relation to ripening and "scald" development were shown.

12:00–12:15 pm

Phospholipase A2 Activity Is Involved in Development of Peel Pitting in Citrus Fruit

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Accumulating evidence indicates that postharvest peel pitting of citrus at non-chilling temperatures is mediated by peel water status of fruit. Water-related stresses generate downstream molecular cascades common to other stresses such as chilling and wounding. Lipid-derived cascades originating from membrane degradation may play a dual role as physiological signals with protective activity and amplifiers of cellular damage. Phospholipases are a wide group of lipolytic enzymes that trigger lipid signaling and/or degradation cascades in plants responding to altered water conditions. We hypothesized that phospholipases could play a role in initiation and development of peel pitting in citrus fruit. Changes in RH from 30 to 90% promoted membrane degradation, increased total PLA2 activity and induced pitting in flavedo. Previous treatment with aristolochic acid, a specific inhibitor of PLA2, reduced membrane leakage, decreased PLA2 activity and markedly reduced peel pitting symptoms. Upregulation of a transcript encoding a low molecular weight secretory PLA2 closely followed the change in RH and preceded pitting, whereas other high molecular weight PLAs were not affected or downregulated, suggesting a complex regulation the phospholipases. Taken together, results provide evidence for involvement of lipid-signaling in the development of postharvest peel pitting of citrus fruit.

12:15–12:30 pm

Comparing Carotenoid Profile in Peel and Juice of Two Orange Cultivars Treated with the Abscission Chemicals Ethephon and 5-Chloro-3-methyl-4-nitro-1H-pyrazole (CMNP)

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The compound 5-chloro-3-methyl-4-nitro-1H-pyrazole (CMNP) selectively induces mature citrus fruit abscission, senescence of mature fruit and advances some maturation traits, such as chlorophyll degradation and increased total carotenoid content in flavedo. Carotenoid accumulation occurs during fruit maturation, and carotenoids serve as vitamin A precursors and antioxidants, reducing the risk of certain forms of cancer. Citrus is one of the most complex sources of carotenoids among fruit. We hypothesized that CMNP treatment induced differential changes in the carotenoid profile of citrus mature fruit peel and juice. The effect of CMNP and ethephon on the carotenoid profile of juice and peel was examined. 'Valencia' and 'Hamlin' (*Citrus sinensis*) trees were sprayed with 200 ppm CMNP, 400 ppm ethephon or water at three times during the harvest season that represented early, mid and late fruit maturation stages. Four days after application, fruit were harvested and peel and juice sampled. Ethephon induced a shift in the carotenoid biosynthetic pathway from ?,?-carotenoids to ?,?-carotenoids by downregulation of ?-LCY transcript expression that appeared to mimick natural maturation. In contrast, CMNP treatment increased ?- and ? –LCY transcripts and levels of ?,?- and ?,?-carotenoids in peel, especially during mid and late maturation stages. Similar but muted changes were observed in juice during early and mid maturation stages, but more strikingly at the late maturation stage. Thus, CMNP increased transcription of key carotenoid genes and increased accumulation of ?-carotene in flavedo and juice, demonstrating a positive impact on juice quality.

Oral Session 12: Vegetable Crops Management 2

Tuesday, July 17 **10:15–12:00 pm**

Room: Rainmakers Ballroom B

Moderator: Harlene Hatterman-Valenti; H.Hatterman.valenti@ndsu.edu

10:15–10:30 am

Control of Root Rot of Melon by Hot Water Soil Sterilization in Consecutively Cultured Fields

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Root rot and vine decline of melon caused by *Monosporascus cannonballus* in greenhouse production system is a widely distributed and very destructive disease in commercial growing areas in Korea. Damage ranged from 35% to 100% yield reduction in severely infected areas. General symptoms of the disease include yellowing and death of the crown leaves and a gradual decline of the vine as the plant approach maturity. A rapid collapse of this disease occurred about 20 to 30 days before harvest. In some highly infected areas with the disease, a few farmers applied methyl bromide and rijorex treatments as a preplant treatment at Cheongyang in Chungnam Province, but effects were not satisfactory. Therefore, hot water treatment trials were applied to reduce the disease over 2 years from 2005 to 2006 in the same location. As a preplant treatment, hot water (90 to 98 °C) was drenched at 55 tons/10 acres through irrigation tape into soils for 3 to 4 hours, which resulted in significant ($P \leq 0.05$) reductions in the percentage of root infected compared with the nontreated controls (75% to 98%) and methyl bromide- (MB) treated plots. Likewise, in hot water-treated plots, soil EC was a little lower (0.4–0.5) than in the original soils. On the contrary, pH increased a little (0.3–0.4) compared with that of original soils. This study demonstrates that hot water treatment could be suggested as an environmentally friendly control technology to reduce soilborne pathogen as well as to solve the problem of salty soil in consecutively cultivated soils. The time required for hot water treatment should be adjusted according to soil type.

Specified source(s) of funding for the work presented in this abstract: Federal competitive

10:30–10:45 am

An IPM Strategy for Managing Phytophthora Blight (*Phytophthora capsici*) in Cucurbit Fields

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Phytophthora blight, caused by *Phytophthora capsici*, is a serious threat to production of cucurbits worldwide. *Phytophthora capsici* causes seedling death, foliage blight, and fruit rot in cucurbits. A strategy using fungicide seed treatment, field scouting, and fungicide spray was developed to manage phytophthora blight of cucurbits. Seed treatment with mefenoxam (0.42 mL Apron XL LS/kg of seed) significantly reduced seedling infection until 5 weeks after sowing seeds. Field scouting, especially after rainfalls, and disking areas with localized infected plants, significantly reduced spread of the disease. In experimental plots, seed treatment with Apron XL LS and spray applications of famoxadone-cymoxanil (700 g of Tanos 50WDG/ha) plus copper hydroxide (1.5 kg of Kocide-2000/ha) plus maneb (3.75 L Manex 37F/ha) alternated with dimethomorph (437 mL of Forum 4.16SC/ha) plus Kocide-2000 (1.5 kg/ha) resulted in only 5.0% vine and 9.3% fruit infection, compared to 31.3 and 40.3% vine and fruit infection, respectively, in untreated plots. Similar results were obtained in the plots sprayed with Folpan 80WDG (6.73 kg/ha) and captan (6.73 kg Maestro 80DF/ha). In commercial fields, integration of seed treatment with Apron XL LS, field scouting, and disking localized infected plants, and spray application of Forum (437 mL/ha) plus copper hydroxide (1.5 L of Champ 37.5F/ha) alternated with Tanos (700 g/ha) plus Champ 37.5F (1.5 L/ha), at 7-day intervals, beginning at the first sign of phytophthora blight, reduced yield losses to less than 10%, compared to more than 50% yield losses in untreated fields.

10:45–11:00 am

The Effect of Time of Whitefly Infestation and Plant Nutrition on the Development of Tomato Irregular Ripening Disorder

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Tomato irregular ripening (TIR) is a physiological plant disorder caused by *Bemisia tabaci* biotype B feeding on foliage and resulting in incomplete ripening of longitudinal sections of fruit. Our objective was to determine the effect of time of whitefly infestation and plant nutrition on the development of TIR. Healthy tomato plants were introduced to whitefly infestations at different developmental stages of plant growth: 1) 5–7 true leaf, 2) flower, 3) green fruit, 4) breaking red fruit and compared to uninfested control plants of the same age. Plants were fertilized weekly (exp 1) or bi-weekly (exp 2). All fruit (98% to 100%) produced by tomato plants infested with whitefly at stages 1 and 2 (78 and 56 days of whitefly exposure, respectively) developed TIR. Plants infested at stage 3 (35 days of whitefly exposure) had 77% to 84% of the fruit develop TIR. Surprisingly, 57% to 60% of fruit from plants infested at stage 4 (14 days of whitefly exposure) also developed the disorder indicating that tomatoes may need to be protected from whitefly until harvest to avoid this disorder. Seed germination was not affected by TIR. Regardless of time of infestation or fertilizer regime, plants infested with whitefly had higher foliar nutrient levels than uninfested control plants at final harvest. On average, whitefly infested plants had foliar macronutrients (N, P, K, Ca, and Mg) and micronutrients (B, Cu, Fe, Mn, Mo, and Zn) 1.6- and 2.1-times greater, respectively than uninfested control plants. The foliar macronutrient and micronutrient most affected by whitefly infestation was P and Zn, respectively. At final harvest, the mean foliar level of P and Zn in whitefly infested and uninfested control plants was 0.46 and 0.26 % P and 45.87 and 13.33 ?.g^{-1} Zn, respectively.

11:00–11:15 am

Broadleaf Weed Control in Transplanted Cabbage

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The number of herbicides for weed control in cabbage is rather limited, especially for broadleaf weed control. All three herbicides registered for preemergence broadleaf weed control in cabbage have factors associated with their use (e.g., carryover, availability, and short residual) that makes them less than ideal choices. Thus, a field trial was initiated to examine weed control methods. Cabbage transplants were placed in two-row beds with a 2-ft row spacing and 1.5 ft between plants on 22 May 2006. Initial treatments consisted of herbicides applied just prior to or immediately following transplanting using a CO_2-pressurized sprayer equipped with 11001 flat fan nozzles with a spray volume of 20 GPA and a pressure of 40 psi. Four treatments had a second herbicide application. Evaluations indicated that common purslane, Venice mallow, and redroot pigweed control 3 WAT was greater than 85% when dimethenamid-P, oxyfluorfen (water-based formulation), or sulfentrazone were applied prior to transplanting. However, by 7 WAT, broadleaf weed control was below an acceptable measure (85%) for all treatments except oxyfluorfen (water-based formulation) applied pre-transplant followed by oxyfluorfen (EC formation) applied post-emergence, which had the greatest total yield from the two harvests. This was almost twice the yield from the untreated and approximately 25% more than the dimethenamid-P treatment, which was the second highest yielding treatment. The water-based formulation of oxyfluorfen caused less cabbage injury than the EC formulation when applied postemergence to the cabbage and weeds, but because the initial application was at a lower rate, broadleaf weed pressure was much greater

and many of the broadleaf weeds were beyond a controllable size at the time of application

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

11:15–11:30 am

Variable Rate Balan® Application Reduces Lettuce Injury, Enhances Yield

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Lettuce is an intensively managed specialty crop for which there is little tolerance for weeds. The herbicide Balan® (benefin) is commonly used in preplant and preemergence applications to control weeds during lettuce stand establishment. In fields with high clay contents, considerably more of the herbicide is required for adequate weed control than fields with soil with higher sand contents. Thus, soil texture is critical when determining Balan® application rates since excessive amounts can injure young lettuce roots. Variable rate (VR) Balan® applications were conducted at a 20-acre grower-cooperator leaf lettuce field in Yuma, AZ to determine the effectiveness of site-specific application of this soil applied herbicide. The experimental field was composed of three distinct soil textures: loam, sandy loam and loamy sand. Balan® application rates were based on soil texture with zones with the highest clay contents receiving 2.5 lbs./acre and sandy areas, 1.5 lbs./acre. The intermediate rate of 2.0 lbs./acre was previously determined as the control rate for this study. Green and ruby red lettuce injury was noted as a stunted plant with a leathery leaf appearance. Injury counts were determined in each of the soil textural zones in both conventional (control) and variable rate plots and final unharvested lettuce counts were made immediately following harvest to determine VR impact on final yield. Site-specific placement of Balan® resulted in a 20% reduction in seedling injury in heavy/medium textured soils and a 35% reduction in lettuce seedling injury with over 40% more marketable lettuce observed in lighter textured soils. Precision herbicide placement is an effective shows promise for Arizona vegetable producers in severely nonuniform soil textures.

Specified source(s) of funding for the work presented in this abstract: Private (Association, Foundation, Industry)

11:30–11:45 am

Effect of Fruit Development on Susceptibility of Diverse Cucurbits to Infection by *Phytophthora capsici*

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Phytophthora capsici is a major disease affecting production of a broad range of vegetable crops including cucurbits. In the process of screening for resistance to *P. capsici*-induced fruit rot in cucumber, we observed that fruits exhibit a marked reduction in susceptibility that coincides with the end of the period of rapid fruit elongation (10–12 days post-pollination). In this study, we examined whether developmental change in susceptibility to *P. capsici* also occurs in other cucurbit crops. Cucumber (*Cucumis sativus*), melon (*Cucumis melo*), watermelon (*Citrullus lantus*), butternut squash (*Cucurbita moschata*), zucchini, acorn, and yellow summer squash, and pumpkin (*Cucurbita pepo*) were planted in a field with no history of *P. capsici* infestation. Fruits of variable size and maturity were harvested, inoculated with *P. capsici*, and scored for symptom development for a period of 10 days post-inoculation (dpi). Zucchini, yellow summer squash, and melon were most susceptible, with frequent development of water soaking symptoms within one day and 55% to 70% of the fruit sporulating by 4 dpi. Other species were less susceptible, reaching 50% sporulation at 9–10 dpi. Like cucumber, all the tested species showed developmental change in susceptibility; older and larger fruit were less susceptible than younger and smaller fruit, but to varying degrees. Acorn and butternut squash, and pumpkin showed decreasing susceptibility with fruit growth; however, their drop in susceptibility was not as pronounced as for cucumber. Although susceptibility also declined somewhat with fruit growth for zucchini and yellow summer squash, these fruits remained highly susceptible even when large. Among the tested cucurbits, susceptibility did not correlate with species classification, or thickness or toughness of rind.

11:45–12:00 pm

Overcoming Compaction Limitations on Cabbage Growth and Yield in the Transition to Reduced Tillage

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Growth and yield reduction are major barriers to widespread adoption of conservation tillage for vegetable production, particularly in cool, rainy climates such as the northeastern US. Strategies to transition from full-width tillage to zone tillage systems for cabbage were tested with the goals of overcoming soil temperature and compaction limitations, producing crop yield and quality similar to conventionally-tilled, and maintaining or enhancing soil quality. Treatments were factorial combinations of two tillage widths (15 and 30 cm) and two tillage depths (10 and 30 cm), plus a conventional rototilled treatment (full width and 20 cm depth). All treatments were established with or without surface rye mulch. Increasing tillage depth from 10 to 30 cm reduced soil penetrometer resistance by up to 1 MPa, increased plant growth by 28% in 2004 and yield by 22% in 2003, similar to conventional tillage but with only 20-40% of the soil surface disturbed. Surface rye mulch enhanced soil quality, increasing wet aggregate stability by 4% in 2003 and reducing soil penetrometer resistance by up to 1 MPa in both 2003 and 2004. Mulch, however, reduced cabbage growth by as much as 30% and yield by 21% in 2003; in 2004, mulch reduced crop growth by 14%, but not yield. Soil temperature reduction from mulch was less than 2ºC, too minimal to account for differences in growth and yield; instead, allelopathic interference from rye mulch may have affected growth. Tillage depth and its reduction of soil compaction was more important to the success of this system than tillage width and its minor increase in soil temperature; vertical zone tillage to 30 cm depth therefore can be an effective transition to conservation tillage for transplanted cabbage.

Specified source(s) of funding for the work presented in this abstract: Federal competitive

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Oral Session 13: Floriculture 1

Tuesday, July 17 **10:30–11:45 am**

Room: Kirkland

Moderator: Mike Compton; compton@uwplatt.edu

07/17/07

10:30–10:45 am

Growth of Showy and Yellow Lady Slipper Orchids in Soilless Media using Anaerobic Digestion-derived Biosolids or Coconut Coir

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Timothy Zauche, Univ. of Wisconsin–Platteville, Platteville, WI, zauchet@uwplatt.edu

Growth of showy (*Cypripedium reginae*) and yellow (*Cypripedium*

parviflorum var. *pubescens*) lady slipper orchids in soilless media containing coconut coir or anaerobic digestion-derived biosolids (ADDB) was compared for two successive growing seasons. Showy lady slipper plants grown in medium containing ADDB alone, or mixed with coconut coir, were significantly larger than plants grown in control medium utilizing coconut coir as the sole organic addendum. Crown and root growth was about 2.2- to 2.95-fold greater for plants grown in medium containing ADDB than those grown in medium with coconut coir while shoot growth and the number of shoots per plant were 1.2- to 1.7-fold for the former media. No statistically significant differences in growth of yellow ladyslipper plants were observed among the various test media. Use of anaerobic digester-derived biosolids in horticultural growing media is a protected intellectual property and available for license through the WiSys Technology Foundation.

Specified source(s) of funding for the work presented in this abstract: Private (Association, Foundation, Industry)

10:45–11:00 am

Effects of Phosphorus on Morphology of Hydroponically Grown *Scaevola aemula* R. Br. 'Whirlwind Blue'

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The popular hanging basket plant, fan-flower (*Scaevola aemula* R. Br. 'Whirlwind Blue'), is cultivated from low phosphorus soils and requires minimal supplemental phosphorus. To accurately evaluate the effects of phosphorus on morphology, fan-flower was grown hydroponically in order to maintain concentrations of all nutrients except phosphorus at equal levels. The nutrients were supplied in half-strength Hoagland solutions containing 0, 20, 40, 60, or 80 mg·L^{-1} of phosphorus and 134 mg·L^{-1} of nitrogen. Plants grown with 0, 60, or 80 mg·L^{-1} had significantly fewer flower branches and total flowers than those grown at 20-40 mg·L^{-1} when plants were considered marketable. Plants grown with 20-60 mg·L^{-1} of phosphorus had the longest branches; however, plants grown with 0 mg·L^{-1} of phosphorus had roots 40% to 54% longer than those from plants grown at all other concentrations. Little new root growth was observed in fan-flower grown at the highest phosphorus concentration. Furthermore, foliage from these plants was chlorotic to nearly white. Results indicate that phosphorus concentrations higher than 40 mg·L^{-1} reduced growth, flower number, and thus quality of fan-flower. Growers should avoid applying fertilizers with high phosphorus concentrations to these plants.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

Note: Donglin Zhang is also a guest professor at Central South University of Forestry and Technology, Changsha, Hunan, China.

11:00–11:15 am

Effect of High Temperature on Extreme Substrate Acidification by Geranium (*Pelargonium ×hortorum* Bailey)

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The cause of sudden substrate pH decline by geranium is unknown and previous reports suggest it may be due to high temperature. The first of 2 experiments compared plants grown at four temperatures (14/10, 18/14, 22/18 and 26/22 °C day/night). With increasing increments of temperature, substrate pH declined from 6.8 to 4.6 at 63 days. Low tissue P has also been shown to cause plants to acidify. In the first experiment, tissue P was deficient (below 0.2) in the 3 highest temperature treatments and it was unclear whether the cause of substrate acidification was due to P deficiency and/or high temperature. The second experiment was a factorial of 3 temperatures (18/14, 22/18 and 26/22 °C day/night) by 5 preplant P rates [0, 0.33, 0.67, 1.33, 2.67 g triple superphosphate (TSP)·L^{-1} substrate]. At 28 days tissue P was adequate in plants at all temperature and P treatments except 0 TSP. Yet, pH was lower in the high temperature treatment with all P rates except the highest, indicating that temperature acts independent of tissue P level. At 63 days in the 0.33 and 0.67 TSP treatment, tissue P was deficient but not significantly different and pH decreased with increasing temperature from 5.6 to 4.8 and 5.9 to 4.7, respectively. At the 1.33 TSP treatment tissue P was adequate at low temperature and deficient at the two higher temperatures yet pH decreased as temperature increased. In the highest P treatment all tissue P levels are adequate and pH declines with each increase in temperature. Again, the 63-day results show that temperature is acting independent of tissue P. When plants received P at high temperature, pH fell to below 5.2 by 57 days. Data indicate high temperature stressed geraniums increase the rate of acidification, which offers one explanation for sudden substrate pH decline.

11:15–11:30 am

Effects of NO_3-N to NH_4-N Ratio on Growth and Flowering of a Hybrid *Phalaenopsis* Planted in a Bark Mix or Sphagnum Moss

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Chin-Jung Tsai, Texas A&M Univ., College Station, TX,

Plants (three leaves, 15-cm in leaf spread) from a vegetatively propagated clone of *Phalaenopsis* Taisuco Kochidian were imported bare-rooted in late May, planted in a mix consisting of three parts of medium grade Douglas fir bark and one part each of perlite and peat (by volume) or in sphagnum moss and irrigated with plain reverse osmosis water until the beginning of July. All plants were then given 221 N, 124 P, and 515 K, 100 Ca, and 50 Mg (all in mg·L^{-1}). The total N varied from 100%, 75%, 50%, 25% to 0% NO_3-N. The balance of N was from NH_4-N. No supplemental minor nutrients were provided. Plants were fertigated when the medium had become dry. Plants in sphagnum moss produced more leaves than those in the bark mix (4.5 vs. 3.4), regardless of NO_3-N to NH_4-N ratio. Leaf number did not differ across the various ratios of N sources in either medium. Plants in both media were smaller when receiving 100% NH_4-N. There is a tendency of decreasing top leaf width and whole-plant leaf spread as NO_3-N decreased from 100% to 0%. Applying 100% NH_4-N to the bark medium or 75% or 100% NH_4-N to the moss resulted in shorter top leaves than those in other treatments. Plants in the bark mix spiked 10 to 14 days earlier than those planted in moss. Plants receiving 50% or more NO_3-N spiked earlier. Nearly all of the plants in the bark mix produced flowers, whereas none in moss receiving 100% NH_4-N bloomed. These results suggest that *Phalaenopsis* does not grow well with 100% NH_4-N and must be fertilized with no less than 50% and preferably 75% NO_3-N for best performance.

Specified source(s) of funding for the work presented in this abstract: Private (Association, Foundation, Industry)

11:30–11:45 am

Growth of Poinsettia Plants in Soilless Media using Anaerobic Digestion-derived Biosolids Compared to Peat-based Growing Media

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Growth of poinsettia (*Euphorbia pulcherrima*) plants in soilless media containing 60% anaerobic digestion-derived biosolids (ADDB), 60% sphagnum moss peat (SMP), or a blend of 30% SMP and 30% ADDB were compared. Stem dry weights of plants grown in media containing equal parts ADDB and SMP or SMP alone were greater than that of plants grown in medium with ADDB alone. No difference in stem dry weight was observed among plants grown in medium containing SMP alone or a blend of equal volumes ADDB and SMP. This study demonstrates that ADDB can be used to grow high quality poinsettias when blended with SMP. Use of anaerobic digester-derived biosolids in horticultural growing media is a protected intellectual property and available for license through the WiSys Technology Foundation.

Specified source(s) of funding for the work presented in this abstract: Private (Association, Foundation, Industry)

Oral Session 14: Environmental Stress Physiology

Tuesday, July 17 **10:30–12:00 pm**

Room: Greenway A/B

Moderator: Carole Bassett; carole.bassett@ars.usda.gov

10:30–10:45 am

Leaf Dry Matter Content Determines Pigment Concentrations in Kale and Spinach Greens

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Kale (*Brassica oleracea* L. var. *acephala* D.C.) ranks highest, and spinach (*Spinacia oleracea* L.) ranks second among vegetable crops for carotenoid content, including lutein and beta-carotene. Several experiments were conducted to determine the impact of air temperature, irradiance, photoperiod, radiation cycle, nitrogen concentrations, and leaf ontogeny on the phytonutritional value in these crops. The overall goal of the experiments was to determine the impact of environmental conditions on pigment accumulation (chlorophyll's, lutein and beta-carotene), biomass production (fresh mass and dry mass) and dry matter content (%DM). Data from growth chamber and greenhouse experiments were combined to determine the impact of %DM on pigment concentrations. The recorded %DM ranged from 5% to 15% for spinach and from 9% to 23% for kale leaves. Comparing the %DM data with the pigment concentrations measured on both a fresh mass (FM) and dry mass (DM) basis resulted in a significant linear trend. Increases in the %DM resulted in a linear increase in the pigment concentration measured on a FM basis and a decrease in the pigment concentration measured on a DM basis. Further evaluation of the data using principal components analysis showed that the %DM could be used to explain approximately 40% of the variance in the pigment concentration. Results of this study will allow researchers to estimate pigment concentrations on a FM and DM basis, based on the recorded %DM of the leaf tissue.

Specified source(s) of funding for the work presented in this abstract: Federal competitive

10:45–11:00 am

The Effect of Water Supersaturated with Oxygen on Plant Growth

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Flooding, soil compaction, and pot-bound roots all reduce the availability of oxygen to plant root systems, causing reduced growth, poor quality, and decreased yield. Methods to supplement irrigation water with oxygen have also been shown to improve plant growth. Air injection and hydrogen peroxide increase oxygen to the root systems and can improve plant performance. Both methods, however, have disadvantages. The experiments presented in this paper use a novel electrolysis technology to produce micro-bubbles of oxygen that are forced into solution producing supersaturated oxygenated water. One-gallon watering containers fitted with the oxygenating units were capable of increasing the oxygen level in the water to 180% in 20 minutes. We compared petunia, coleus, geranium, cyclamen, and hydrangea greenhouse-grown plants. We conducted two separate experiments. Experiment 1 compared 100% (typical of well-aerated surface water), with 180% oxygenated water. Experiment 2 compared 30% (typical of well water), with 180% oxygenated water. Seedling plugs were transplanted into 4-inch pots and watered daily under flooded or non-flooded conditions. There was no statistical difference between plants in experiment 1. However, in experiment 2, petunia and geranium plants watered with 180% oxygen produced significantly more flowers than plants watered with 30% oxygen under both flooded and non-flooded conditions. Coleus plants watered with 180% oxygen had more vibrant foliage and significantly greater quality ratings. The simplicity of the oxygenation system and the significant increase in plant performance suggests that under oxygen-deficient conditions, electrolysis produced super-oxygenated water may prove a viable production alternative.

11:00–11:15 am

Radish Growth and Development Is Sustained under Hypobaric Pressures

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Bioregenerative life support systems (BLSS) for long duration space missions will require specialized chambers and environmental conditions. Growing crop plants under hypobaric pressures has several advantages, including reduction in structural mass of chamber, reduction in pressurization gas, and reduction of chamber leakage. This experiment was designed to test the hypothesis that radish (*Raphanus sativus* L.) adapts to hypobaric conditions independent of O_2 and CO_2 concentration. Radish was selected as the test species due to its rapid growth, partitioning characteristics, and known responses to other environment factors. A 3 × 3 (treatment × chamber) Latin Square design was used and the experiments conducted at the Controlled Environment System Research Facility (CESRF) at the Univ. of Guelph. The plants were maintained at 22 °C and 65% RH at 300 μmol·m^{-2}·s^{-1} *PAR* with an 18-hour light/6-hour dark photoperiod. The pressure was maintained in each of three chambers at 33, 66, or 96 kPa for the duration of the experiment (approximately 1/3, 2/3, and 1 atm.). For all pressure treatments in this study, the $ppCO_2$ was maintained at 0.12 kPa and ppO_2 at 21 kPa. Plants were harvested at 21 days after planting and canopy coverage and growth data collected. Results showed no significant differences in radish growth characteristics (total fresh mass, dry mass, radish size, leaf area, or harvest index) nor daily canopy level photosynthesis or respiration rates between the 96, 66, and 33 kPa treatments. These results clearly show that hypobaric conditions down to 33k Pa (at 21 kPa ppO_2) can be applied without negatively impacting the growth or development of radish.

11:15–11:30 am

Bark Cracking

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Bark cracking on nursery tree stock is an occurrence affecting growers across the country, resulting in millions of dollars in losses (Mathers, 2006). This phenomenon is not solely an environmental problem. This is attributed to the fact that the occurrence is increasing in severity and it is occurring in so many varying locations, from the southeast to the northwest. Thin-barked trees are more susceptible in developing a crack in the bark (Coder, 2006). Butin and Shigo state that the actual cause of bark splitting is a preset wound. This wound can be induced by a number of various factors, such as excess fertilization, heavy pruning, late cultivation, spray injury, and thin/sandy soils (Simons, 1995). The cold injury is what makes the crack in the bark, but it is the wound that is previously present that triggers the visible wound. Two studies were conducted which investigated the freezing tolerance of trees by visual readings and triphenyltetrazolium chloride absorbency readings on stem cuttings. The first study consisted of four species of trees (*Cercis canadensis, Quercus rubra, Malus* 'Prairiefire', and *Acer rubrum*) in relation to three environments (peak cravo, grown outside, and Oregon liners). The second study entailed three species (*Cercis canadensis, Quercus rubra,* and *Malus* 'Prairiefire') in relation to three treatments [herbicide applied in fall and spring (flumioxazin), grass/groundcover, and clean cultivation]. In both studies there were no significant differences noted with temperature between all species in the TTC readings, but all species visually showed differences with regard to temperature.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

11:30–11:45 am

Mapping Transcript Start Sites for Three Peach (*Prunus persica* L. Batsch.) Dehydrins: Differences in Transcript Initiation during Fruit Development

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A number of stress-responsive genes are expressed during fruit ripening in several different crops, including tomato, pepper, grape and peach. In peach, a dehydrin shown to be up-regulated in bark in response to cold, *PpDhn3*, was also found to be highly abundant in ripe fruit. Two other dehydrins expressed primarily in young fruit were also detected in ripe fruit. Like *PpDhn3, PpDhn1* is up-regulated in bark and leaves in response to cold, whereas *PpDhn2* responds to water deficit. Both *PpDhn1* and *2* show differences in transcript initiation in young fruit compared to fully ripe fruit. *PpDhn1* transcripts initiate at multiple positions in 7-day-old fruit much further upstream than the transcript start site in bark or in older fruit. In contrast, *PpDhn2* transcripts initiate at several positions upstream of the bark transcript start site in fully ripe (137-day-old) fruit, while transcripts in younger fruit initiate at the same position as bark transcripts. Transcripts encoding *PpDhn3* initiate at the same position in bark and fruit of all stages examined. The biological significance of multiple start sites for *PpDhn1* and *2* transcripts is unclear at present, although there is evidence for an intron in the 5' leader of the longer *PpDhn2* transcripts. Possible functional consequences of the longer *PpDhn2* leader will be discussed.

11:45–12:00 pm

Growth and Gas Exchanges of Four Oleanders in Response to Drought Stress

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Oleander (*Nerium oleander* L.), native to southern Asia and the Mediterranean region, is a fast-growing evergreen shrub planted widely in the southern U.S. A study was conducted to quantify the growth of two breeding lines, EP1 and EP2, and two cultivars, 'Hardy Pink' and 'Hardy Red', in response to a 12-week cyclic drought stress in a greenhouse. Drought stress was imposed by irrigating the plants to container capacity and withholding the watering until predetermined water contents were reached. Compared to the control where plants were well-irrigated throughout the experiment, shoot dry weight (DW) was reduced by 52%, 41%, 11%, and 34% in EP1, EP2, 'Hardy Pink', and 'Hardy Red', respectively. Root to shoot DW ratio was higher for the drought-treated plants than the control regardless of line or cultivar. The increased percentage in root to shoot DW ratio was highest in EP1, EP2, 'Hardy Pink' and 'Hard Red', in descending order. New shoot growth was highest in 'Hardy Pink', followed by 'Hardy Red', EP1 and EP2. Number of newly developed shoots was highest in 'Hardy Pink', followed by 'Hardy Red' and EP1. EP2 did not develop any shoot under drought stress. As substrate volumetric moisture content decreased from 30%, net photosynthetic rate (Pn), evapotranspiration rate (E), and stomatal conductance (gs), decreased in all lines tested. The response of Pn and E of EP1 to decreasing substrate moisture content was sharper than other lines. Overall, 'Hardy Pink' was more tolerant to drought stress than other lines.

Oral Session 15: Ornamentals/Landscape and Turf 1

Tuesday, July 17 **2:00–3:45 pm**

Room: Greenway A/B

Moderator: Edward Bush; EBush@agcenter.lsu.edu

2:00–2:15 pm

Particle Size Distribution Effects of Bark on Physical and Chemical Characteristics

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Optimizing physical characteristics could improve plant growth and development. A 5/8" pine bark was sieved into four different sieve sizes including 3.35 mm (#6), 1.4 mm (#14), 710 μm (#25), and <710 μm (<#25) to establish uniform physical characteristics. Five treatments were established by using these particles to create media based on a mixture of the above sieve sizes. A factorial experiment was established by omiting particles from one of the four sieve sizes. Also, a combination of all particle sizes and a nursery standard (industry blend of all bark sizes <5/8") was used to establish a control medium. Irrigation was based on the effluent collected after irrigation at 20% using a modified effluent collection device. Results indicated that hardwood bark pH and EC were significantly greater than pine bark, although differences were minor (0.3 and 0.1 increase, respectively). Quality ratings of azalea, Indian hawthorn, and ligustrum were greater in pine bark compared to hardwood bark (32%, 17%, and 33% increase, respectively). Also, growth index and shoot weights for azalea, Indian hawthorn, and ligustrum were greater in pine bark compared to hardwood bark. Growth indexes increased 25%, 13%, 39%, respectively, and shoot weights increased 58%, 27%, 72%, respectively. Media substrate containing media sizes 3.35 mm, 710 μm, and <710 μm produced the greatest shoot weights

and growth index for azalea in pine bark. Media containing media sizes 3.35 mm, 1.4 mm, and <710 μm produced the greatest shoot weights, growth index, and quality ratings for Indian hawthorn and ligusturm. Hardwood bark particle size distribution had no significant effect on shoot weights, growth index, or quality ratings. Overall species plant quality was greater in pine bark compared to hardwood bark.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

2:15–2:30 pm

^{15}N as a Tracer to Evaluate Fertilizer N Uptake and Partitioning in Out-planted Immature and Mature Common Hackberry

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Annual demands for nitrogen are met through a combination of soil N derived from the mineralization of organic residues, N fixation, atmospheric deposition, and the internal cycling of previously acquired N. The relative contribution from each source to meet annual N demand is a dynamic process affected by species, tree age, and location. Nitrogen fertilization of landscape trees is intended to augment these sources for the purposes of enhancing growth or to remediate suspected or known deficiencies. Existing recommendations for annual N application rates are consistent with growth studies involving immature trees. Consequently, fertilizing mature trees at rates derived from growth studies involving immature trees may be excessive in light of changes in the source of N used to meet annual demand. This study compared uptake of a ^{15}N enriched NH_4-NO_3 applied to out-planted juvenile and mature common hackberry (*Celtis occidentalis*) trees at rates of 0.49, and 1.47 kg N/100 m^2 (1 and 3 lb N 1000/ft^2) of canopy coverage and evaluated the relative contribution from fertilizer N and previously acquired N to meet annual N demand. Newly developed tissues have been demonstrated to be the primary sinks for N during the growing season. Percentages of N derived from fertilizer (NDFF%) in newly developed tissues were about 2.5 times greater at the 1.47 kg N/100 m^2 application rate for both juvenile and mature trees. Increased uptake associated with the higher rate of application is consistent with previous studies. However, NDFF% in newly developed tissues of mature trees was approximately 60% lower than juvenile trees, regardless of application rate. Total N in newly developed tissues of mature trees was either no different from or greater than what was observed in juvenile trees. The contribution from stores of previously acquired N in mature trees is significantly greater than the contribution in juvenile trees. These findings suggest fertilizing mature trees at rates of application developed for young trees results in a greater percentage of the fertilizer N being partitioned into non-target sinks within the landscape.

Specified source(s) of funding for the work presented in this abstract: Private (Association, Foundation, Industry)

2:30–2:45 pm

Using Palm Trunk Fibers as Peatmoss Replacement for Container Media

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Palm trees removed from landscapes constitute a growing portion of undesirable waste that many recycling centers will not accept. Often, palm wastes must be disposed of in landfills. Our research shows that palm fibers ground from the trunks of four landscape palms (*Washingtonia robusta, W. filifera, Syagrus rommanzoffiana* and *Phoenix canariensis*) can be successfully used as substitutes for peat moss in container media. Palm trunk fibers contain high amounts of sodium, potassium, chloride, and magnesium, and thus required a leaching fraction before their use. Nitrogen must be added to palm trunk fibers to sustain plant growth. Palm fibers pH values were within the normal growing range for many plants. Palm fiber sources significantly affected the growth of queen palms: palms in *W. filifera* fibers grew the largest while those in *W. robusta* fibers were smaller in size and lower in quality.

2:45–3:00 pm

Efficacy and Phytotoxicity of Preemergence Herbicides in Container-grown Landscape Plants

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During the 2006 growing season, three preemergence herbicides were applied to three container grown herbaceous perennials and one woody species. They were evaluated for weed control, visual phytotoxicity, and changes in growth. The herbicides and rates were: imazolsulfuron (V-10142, 75 WG) 0.57, 1.1, 2.3 kg a.i./ha, halosulfuron (Sedgehammer, 75 WG) 0.14, 0.28, 0.57 kg a.i./ha, sulfentrazone (Dismiss, 0.2 G) 0.14, 0.28, 0.57 kg a.i./ha. Herbicides were applied to coneflower (*Echinacea* spp.), Mesa Verde® iceplant (*Delosperma* 'Kelaidis'), Christmas rose (*Helleborus niger*), and fernbush (*Chamaebatiaria millefolium*). Experiment was repeated three times with four replications per treatment. Treatments were applied twice with 28 days between applications. Plants were evaluated for phytotoxicity at 1, 2, and 4 weeks after applying herbicide treatments. Visual and growth phytotoxicity were observed on *Echinacea, Delosperma,* and *Chamaebatiaria*. No significance was observed with *Helleborus* treated with V-10142 and Sedgehammer. Application of Dismiss had mixed results on *Helleborus*. Phytotoxicity was noted on *Echinacea*, some on *Delosperma* and *Chamaebatiaria*. No phytotoxicity was observed on *Helleborus*. Weed control was excellent on broadleaf and sedge weeds, but poor on grass weed species. Herbicides tested are labeled only for broadleaf and sedge control and not for grasses.

Specified source(s) of funding for the work presented in this abstract: Federal competitive

3:00–3:15 pm

Comparison of Landscape Mulch Types and Herbicide Application Methods for Yellow Nutsedge Control in Landscape Beds

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Yellow nutsedge (*Cyperus esculentus*) is a common weed infesting landscape beds. The color, growth habit, and rapid growth rate make it a prominent distraction in the aesthetics of landscapes. Multiple applications of herbicide are needed for satisfactory control because of the numerous tubers that a single plant can make and the wide germination window from spring to early summer. Mulching is a common practice during landscape bed installation that may provide some level of nutsedge control. Three landscape mulches (cypress, pine nugget, and pine straw) were applied at depths of 10.2, 10.2, and 15.2 cm, respectively, either before or after herbicide sprays. Eptam (EPTC) 5G and Sedgehammer (halosulfuron) were applied at either low or high rates within label range on landscape beds infested with yellow nutsedge. Landscape beds were planted with liriope, gardenia, and daylily. When herbicide was not used, plots covered by mulches had significantly less nutsedge compared with bare soil plots (mulch-free plots) with pine bark nuggets providing the best control. However, none of these plots were aesthetically acceptable. When the herbicide was applied on top of mulches, only Sedgehammer at high rate (0.075

kg a.i./ha) gave acceptable control. When herbicide was applied prior to the installation of pine nugget or pine straw mulches, Sedgehammer at low rate (0.037 kg a.i./ha) or Eptam 5G at low rate (6.726 kg a.i./ha) achieved acceptable control. These results suggest that mulching is an effective method to control yellow nutsedge when combined with herbicide. The amount of herbicide and associated cost can be significantly reduced if herbicide can be applied before mulching. Ornamentals planted in herbicide treated plots showed no acute injury after overhead application of these two herbicides. During the 10-week period after treatment, plants showed different degrees of growth reduction. Liriope and gardenia were still aesthetically acceptable in terms of plant size, leaf greenness, and number of flowers (gardenia). However, daylily exhibited unacceptable short flower stalks.

Specified source(s) of funding for the work presented in this abstract: Federal competitive

3:15–3:30 pm

Distribution of Trunk-Injected ^{14}C Imidacloprid in *Fraxinus* Trees: A Test of the Sectored–flow Hypothesis

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The emerald ash borer (*Agrilus planipennis* Fairmore, Coleoptera: Buprestidae) is an invasive exotic insect pest that has destroyed millions of ash (*Fraxinus* spp.) trees in Michigan, surrounding states, and Canada. Imidacloprid applied as a trunk injection is often used as a means of control, but effectiveness can be variable. The objective of this study is to determine the extent to which movement of imidacloprid is sectored within the trunk of ash trees. Highly sectored flow could result in uneven distribution of the compound within the tree. We injected 32 trees (16 <i>Fraxinus americana, 16 <i>F. pennsylvanica) with ¹⁴C labeled imidacloprid either directly below a branch in the first whorl or at a right angle to the branches of the first whorl. Each branch of the first three whorls of the tree was labeled 0º / 180º or L90º / R90º depending on its location in relation to the injection point. Leaves, fine roots, and trunk cores were sampled at 0, 2, 7, 21, 60, and 98 days after injection (DAI). Tree stems were sampled at 60 DAI. Trees were netted in October and litterfall was collected. Imidacloprid equivalents in leaves varied with time, orientation to the injection point, and whorl height. The results of the current study are consistent with the sectored flow hypothesis. Imidacloprid equivalent concentration is higher in leaves of branches in the plane of the injection point (0º) as opposed to leaves of branches on the opposite side of the injection point (180º). Imidacloprid equivalent concentration in leaves and litterfall were more than 14 times higher than the concentration in roots, trunk cores, and stems, indicating that imidacloprid moves primarily through the xylem.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

3:30–3:45 pm

Effects of Preplant Incorporation and Postplanting Application of a Palm Special Fertilizer on Five Species of Landscape Palms

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Five palms commonly planted in landscapes in southern California (*Washingtonia robusta, Syagrus rommanzoffiana, Chamaerops humils, Trachycarpus fortunei*, and *Archonotophoenix cunninghamiana*) were planted from #1 containers in a sandy loam soil. Each planting hole was treated with 0, 500 g, or 1 kg (0x, 1x, and 2x label rate) of Apex Palm Plus fertilizer (J.R. Simplot Inc.). Six and 12 months after planting, the trees were treated with the same rates of fertilizer surface-applied and cultivated around each palm. Treatments were arranged in randomized complete-block design with five replications. The size of each palm (h × l × w), basal caliper, and number of new leaves were measured every 3 months. The overall quality of each palm was rated on a 1–5 scale (1=dead; 5=dark green, highest quality) at each measurement interval. Only *Syagrus* responded with increased quality scores associated with the two fertilizer treatments. Tissue nitrogen (TKN) content increased in treated *Syagrus* palms but potassium, phosphorus, and magnesium levels were not significantly increased above the level in untreated palms. In a subsequent study using single sources of macronutrients, only nitrogen showed a green up response in queen palms, which was correlated with specific increase of TKN in leaf tissue.

Oral Session 16: Vegetable Crops Management 3

Tuesday, July 17 **2:00–3:30 pm**

Room: Powell A/B

Moderator: Chad M Hutchinson; cmhutch@ufl.edu

2:00–2:15 pm

Effects of Genotype, Location, and Planting Date on Mineral Content of Spinach

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To improve iron levels in selected genotypes of spinach (*Spinacia olerace*) by classical breeding methods; total iron levels and other mineral levels must be determined in several environments. The 15 genotypes were selected from the Univ. of Arkansas Spinach breeding program and cultivars commonly grown in Arkansas, Oklahoma, and Texas. Two field locations were selected for plots based on similar environments to surrounding production areas: Del Monte Canning Co. Research Farm, Crystal City, TX and Univ. of Arkansas Vegetable Substation, Kibler, AR. Plots were grown over four production seasons during 2005 and 2006 similar to the growing periods in each area: Fall, Overwinter, and Spring for Arkansas and Winter for Texas. Samples were collected after at least 30 days after planting, but not longer than 60 days. Samples consisted of 18 to 30 (mid-maturity) leaves measuring 4 to 8 inches in length. Samples were cleaned with deionization water and dry down to 8% to 15% of total original weight in a drying oven. The Univ. of Arkansas Soil Testing Laboratory performed mineral analysis using an emission spectrophotometric method and total P, K Ca, Mg, S, Mn, Zn, Fe, Cu, and B was determined. Levels of Zn and Fe were significantly different for each location and production season. Levels of B, Ca, and Mn were significantly different for location but not production season. The other minerals were not significantly different for location and production season. Total mineral content of the soil, pH, and plant genotype could cause differences between locations for mineral content of spinach.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

2:15–2:30 pm

Irrigation and Nitrogen Impact on Artichoke Yield, Head Quality, and Phenolics

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Artichoke (*Cynara scolymus* L.), a newly introduced crop in southwest Texas, requires guidelines for irrigation and nitrogen management leading to high yield and head quality. A field experiment was conducted to determine the impact of three irrigation regimes (50%, 75%, and 100% crop evapotranspiration, ETc) and four N rates (0, 60, 120 and 180 kg N ha^{-1}) on yield and quality of artichoke cv. Imperial Star. Seedlings were transplanted on an Uvalde clay loam soil at 2 m between and 0.8 m within rows. After stand establishment, differential irrigation was applied using a subsurface drip system. Total head number and average head weight were higher at 100 % ETc, while a 30% yield reduction occurred at 50 % ETc. Head size was significantly larger (longer at early and wider at late harvests) at 100 % ETc, leading to a larger internal edible part (heart), but also increasing inedible part (choke) and open bracts as harvest season progressed. Overall, nitrogen had small effects on head growth and yield, even though head weight was reduced at 0 kg N ha^{-1} during late harvests. However head tip burn increased and fiber content decreased at 180 kg N ha^{-1}. Total phenolics and chlorogenic acid increased with deficit irrigation particularly at late harvests. Soluble sugar levels were similar among treatments but decreased as harvesting season progressed; sucrose to monosaccharide (glucose and fructose) ratio was greater at late harvests. Partial modification of irrigation regimes and nitrogen rates during the harvesting season may be able to control head maturity, phenolic and fiber content.

2:30–2:45 pm

The Interactive Effects of Soil Moisture and Nitrogen Fertilization on the Yield and Recovery of Slicer Carrots

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Nitrogen (N) requirement in carrots is a controversy. Ground water contamination as a result of excess N fertilizer is becoming a major concern. Since N uptake, utilization and leaching depend on irrigation, it is important to understand the dynamics of N concentration in plant tissues, in order to optimize N application without compromising yield or quality. Field experiments were conducted in 2005/06 to investigate the interactive effects of N and irrigation on yield and recovery of slicer carrots var. Oranza. Seven levels of N were applied to two adjacent blocks. One block received irrigation to maintain the soil moisture potential at –40 cbar and the second was non-irrigated. Soil and tissue samples were taken during several stages. Observations were made on yield, recovery, leaf biomass, root dimensions, as well as gas exchange parameters. In 2005, there was no significant yield enhancement at any N level when compared to the respective controls. However, applying N at a rate of 100 lbs/acre and maintaining soil moisture near –40 cbars, significantly increased yield over the non-irrigated control by nearly 60% (2005) and 103% (2006). In 2006, a significant yield enhancement due to N was seen in both soil moisture regimes. There was no enhancement in gas exchange parameters due to N or irrigation in 2005, however Pn was increased in non-irrgated plots which received 100 lbs N/ac over both the irrigated and non-irrigated controls. Stomatal conductance was significantly higher in irrigated plots in both years. The concentration of N in root tissue showed a strong correlation with yield under both moisture regimes. N application at a moderate rate of 100–150 lbs/acre with irrigation when soil moisture declines below –40 cbar could enhance yield in light soils.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

2:45–3:00 pm

Evaluation and Analysis of N Fertilizer Rates for Florida Tomato Production in Context of Best Management Practices

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Best management practices (BMPs) for Florida vegetable crops are a combination of nonstructural and structural practices which have been determined to be effective for reducing or preventing pollutant load in target watershed. Because the BMPs for tomato grown in Florida rely on the Univ.'s (UF/IFAS) fertilizer recommendations, these recommendations should reflect the different growing seasons, soil types, and irrigation systems used for tomato production. In partnership with tomato growers and state agencies, the objectives of this research/extension project were to 1) evaluate N fertilizer rate effects on tomato growth, petiole N sap, and fruit yield, and 2) prepare growers for the BMP program. Data were subjected to ANOVA, *t* test and Duncan Multiple Range Test. In the 2005–06 growing season, six on-farm trials were conducted in the fall, winter, and spring with N rates ranging from 224 to 370 kg/ha. Each trial included the UF-IFAS recommended rate and at least one grower-defined rate. Under current fertilizer costs ($0.88/kg of N), it takes a yield increase of 1 to 5 boxes (when prices are $40 to $8 per 11.5 kg/ha box) to offset the cost of a 112 kg/ha N rate above the 224 kg/ha of N recommended rate. Because these yield differences are unlikely to be detected using conventional statistical tools (ANOVA + Multiple Range Tests), yield data were analyzed using the binomial distribution and probability of the yield difference among harvests and tomato size categories. Using this approach, the effect of using a N rate higher than the Univ. rate was significant only at the third harvest in the medium size tomato category ($P \leq 0.05$). These results show that N rates currently used may be reduced for spring plantings when two harvests are done. Nitrogen rates had no effect on tomato plant biomass 30 and 60 DAT (days after transplant). Petiole sap testing appeared to be of limited practical use for seepage grown tomato (where all the fertilizer is applied pre-plant in the bed) because NO_3-N and K concentrations in sap remained above the sufficiency rages. A high level of grower engagement created a popular BMP testing program.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

3:00–3:15 pm

Development of a Nitrogen Fertigation Program for Grape Tomato

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Grape tomatoes (*Solanum lycopersicon* L. var. *cerasiform*) have recently gained in popularity among consumers because they can be eaten without being cut, they are deep red in color, and their flavor is intense and pleasant. Current N fertilization recommendations have been developed for determinate tomato varieties that have a 3-month-long growing season, whereas that of the indeterminate grape cultivars may be up to 6 months. 'Tami G' grape tomatoes were grown on a Lakeland fine sand at the North Florida Research and Education Center–Suwannee Valley, near Live Oak, FL, in the Springs of 2005 and 2006 using standard plasticulture practices under 0%, 33%, 66%, 100%, 133%, and 166% of the current recommended rate for round tomato (224 kg/ha). Due to a longer growing season, plants received an additional N rate of 66 kg/ha of N in the 100% rate that was also proportionally added to the other treatments. Tomatoes were transplanted 24 Mar. and 4 Apr. and harvested, weighed and graded five (2005) and seven (2006) times. Season marketable yield (SMY) response to N rates were quadratic (both years $p<0.01$) and highest SMY (40,340 and 36,873 kg/ha) occurred with 314 and 280 kg/ha of N in 2005 and 2006, respectively. Soluble solid concentrations ranged from 6.25 to 7.5, and 7.0 to 8.3°Brix in 2005 and 2006, respectively, and were not significantly affected by N rate. These results suggest that N fertilization for grape tomato grown in the Spring with plasticulture could be done by incorporating 56 to 78 kg/ha of N in the bed, followed by daily rates ranging from 0.5 to 3.5 kg/ha/day. Because the length of the growing season for grape tomato may vary, emphasis should be placed on daily N rates and irrigation management, rather than on seasonal N rate.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

Oral Session 17: Fruit and Nut Production 1

Tuesday, July 17 **2:00–3:45 pm**

Room: Kirkland

Moderator: Sheri Crabtree; sheri.crabtree@kysu.edu

2:00–2:15 pm

Evaluation of Novel Abscission Agents to Facilitate Mechanical Harvesting of Raisin Grapes

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The force required to detach grape berries from vines treated with one of seven different compounds, 1-aminocyclopropane-1-carboxylic acid (ACC), 5-chloro-3-methyl-4-nitro-1H-pyrazole (CMNP), coronatine, dikegulac, Maxcell, methyl jasmonate (MJ), or VBC-30050, was compared to that of berries from vines treated with solutions containing an adjuvant only, or to vines subjected to cane severance. Compounds were applied, or canes were severed, on 2 Sept., and data were collected on 12 Sept. By then, 25% of the fruit had abscised from vines treated with 10 mM MJ, and 50% of the fruit had abscised from vines treated with 20mM MJ. Berries abscised without pedicels, leaving dry scars on the stem ends of the berries. Abscised berries were free of mechanical damage such as plugging or cracking. Other treatments did not stimulate fruit abscission except for coronatine, a product that is biologically similar to MJ. Application of coronatine, unlike MJ, caused browning of sunlight-exposed berries. A lack of material prevented adequate replication of coronatine treatments so further data were not collected for that material. Application of 0.2 mM MJ reduced fruit detachment force (FDF) of 'Thompson Seedless' by almost 50% and FDF further decreased as the concentration of MJ applied increased. Applications of 0.2 or 2 mM MJ did not affect the appearance of the vine's canopy, but 10 and 20 mM MJ caused damage less than or similar to that caused by cane severance. Most other compounds tested also reduced FDF somewhat, but MJ was unique in that relatively low concentrations substantially reduced FDF without causing canopy damage.

2:15–2:30 pm

New Developments toward Mechanizing Sweet Cherry Harvest

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Due to the threat of labor shortages for sweet cherry (*Prunus avium* L.) harvest in the Pacific Northwest, our research program is investigating the potential for a mechanical harvest system for fresh market quality fruit. To date, very little research has investigated the role of ethephon on fruit-pedicle retention force (FPRF), fruit quality, and the storability/shelf-life of new varieties. Different timings and rates of ethephon were applied to 'Bing' and 'Chelan' during the 2006 season. Ethephon applications to 'Bing' trees more than 10 days prior to harvest were effective at reducing FPRF and facilitating mechanical harvest, irrespective of rate [1, 3, 5 pt A-1 (1.2, 3.5, 5.8 $L \cdot ha^{-1}$)]. Ethephon applied less than 10 days prior to harvest did not reduce FPRF sufficiently. In contrast, no rate of ethephon studied had any impact of FPRF of 'Chelan'. In separate trials, fruit quality of machine harvested (MH) and hand harvested (HH) 'Bing' and 'Skeena' fruit was assessed. Fruit were stored at 4 °C and analyzed twice weekly for firmness ($g \cdot mm^{-1}$), soluble solids (°Brix), pH, weight (g) and color (CTIFL). We observed no impact of harvest method on fruit quality at harvest or throughout storage for untreated 'Bing' and 'Skeena'. In contrast, ethephon-treated 'Bing' was ≈18% less firm than untreated 'Bing'. This research shows great potential for mechanical harvest of fresh-market quality sweet cherry fruit, especially utilizing varieties that exhibit a natural decline in FPRF.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

2:30–2:45 pm

Roles of Gibberellins in Increasing Fruit Size and Sink Demand in Japanese Pear Fruit during Rapid Fruit Growth

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In Japanese pear, the application of GA_{3+4} during the period of rapid fruit growth resulted in a marked increase in pedicel diameter and bigger fruit at harvest. To elucidate the relationship between pedicel capacity and fruit growth and to determine the main factor responsible for larger fruit size at harvest, fruit growth and pedicel vascularization after GA application were examined and the carbohydrate fluxes were monitored in a spur unit by non-invasive techniques using ^{13}C tracer. Moreover, cell wall components and sugar levels of the flesh were assessed. The fruit were then divided into the core and the flesh for examination of the activities of sucrose- and sorbitol-cleaving cleaving enzymes. Histological studies of fruit revealed that most vascular tissues were in the core tissue with little in flesh tissue, and GA increased the cell size of the mesocarp but not the cell number and core size. The investigation of carbon partitioning showed that an increase in the specific rate of carbohydrate accumulation in fruit or the strength of fruit should be responsible for an increase of fruit weight in

GA-treated trees. Observation of pedicel vascularization showed that an increase in pedicel cross-sectional area (CSA) by GA application mainly resulted from phloem and xylem CSA, but it is unlikely that an increase in the transport system is the direct factor for larger fruit size. Exogenous GAs application significantly increases sink demand and result in a bigger fruit in Japanese pear. In addition, increased sink demand by GAs is closely related to the activation of Inv-CW (cell wall-bound invertase) in the core, Inv-N (neutral invertase) and NAD-SDH (NAD-dependent sorbitol dehydrogenase) in the flesh during rapid fruit growth in pear fruit.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

2:45–3:00 pm

The Importance and Benefits of Using Gibberellic Acid (GA) on Fruit Trees

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The article includes the identification and history of using gibberellic acid (GA) as an important plant hormone in plant tissues and its different artificial kinds and its mixing with benzyleadenine (BA), in addition, how it affects on different parts of the trees (mode of action). The factors that effect on GA effectiveness and the important uses or applications of GA on fruit trees well be reviewed. The different uses are: deciduous seed breaking dormancy, Accelerating seedlings and fruiting trees growth, modifying sex ratio in some plants, obtaining parthenocarpic (seedless fruits), deciduous tree bud breaking dormancy, increasing fruit set and yield, improving fruit quality, increasing fruit period storage on the tree and delaying coloring, prolonging storage period after fruit picking.

3:00–3:15 pm

Seasonal Carbohydrate Storage and Mobilization in Bearing and Non-bearing Pistachio Trees

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An analysis of the annual carbohydrate (CHO) storage and mobilization of "on" and 'off' 'Kerman' pistachio trees on three rootstocks was conducted to determine the temporal relationship between CHO cycling, nut development and inflorescence bud abscission. CHO storage in shoots of "on" and "off" trees on all rootstocks was lowest following the spring flush of growth. In "off" trees stored CHO increased and stayed high for the remainder of the year after the initial flush of growth. In "on" trees stored CHO in stems increased in early summer during a lag phase of nut growth but were mobilized mid-season during kernel fill, and then increased again after harvest. This unusual pattern in stems of "on" trees appeared to be driven by CHO demands related to nut development and was not tempered by tree vigor. Differences in in-season mobilization of stored CHO in branches of "on" and "off" trees were much greater than differences in final concentration of stored CHO in branches at the start of the year or going into the subsequent dormant season. In-season mobilization of stored CHO from current season, 1- and 2-year-old stems that corresponded to the primary period of kernel fill also corresponded to the period associated with abscission of inflorescence buds that would constitute the basis for the following year's crop. Thus the alternate bearing pattern in 'Kerman' pistachio may be a function of mid-season mobilization of stored CHO that stimulates inflorescence bud abscission. Previously, CHO reserve accumulation during an "off" year was thought to be a necessary behavior that allows the tree to "recover" after a heavy crop year. However since CHO storage in stems recovered after harvest of heavily cropped trees the "need" for a recovery year after cropping is uncertain.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

3:15–3:30 pm

Within-cluster Hand-thinning Increases Fruit Size in Pawpaw (*Asimina triloba*)

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The pawpaw [*Asimina triloba* (L.) Dunal] is a native tree fruit increasing in commercial popularity. Fruit size varies greatly, from under 20 g to over 600 g. Pawpaw fruit sell for $3–5 a pound via farmers markets and mail order, and it is desirable for growers to produce a large fruit size to obtain a premium price. Within-cluster thinning to one fruit could increase fruit size and also improve shelf-life by allowing the peduncle of the fruit to be cut at harvest, thereby eliminating a tear in the skin caused by harvesting individual fruit from a cluster. This would preclude a major entry point for pathogens. Five pawpaw cultivars ('PA-Golden', 'NC-1', 'Mitchell', 'Taytwo', and 'Overleese') were utilized in a fruit thinning study at the KSU research farm. The objectives of the study were to 1) determine the effect of within-cluster hand-thinning to one fruit per cluster on fruit retention, size, and quality; and 2) determine the efficacy of chemical thinning using 10 mM naphthalene acetic acid (NAA) and its effect on fruit size, quality, and phytotoxicity. Treatments were: no thinning, hand-thinning the entire tree to one fruit per cluster, and chemical thinning using 10 ppm NAA. Treatments were applied on 8 June 2006. Trees treated with NAA exhibited leaf curl, but no noticeable fruit drop. Cluster counts were performed on 5 Aug. Fruit were harvested from mid-August through late September, and 25 fruit per tree were weighed to obtain average fruit weights for each treatment and variety. Fruit from hand-thinned trees had a significantly greater weight (128 g) than fruit from chemically thinned (88 g) or control trees (83 g). Chemical thinning did not affect fruit retention, with 34% fruit drop, while control trees dropped 35% of their fruit during the summer.

3:30–3:45 pm

The VCHERRY Computer Model of Sweet Cherry Tree Training for Simulation of Canopy Development, Crop Yield, and Fruit Quality

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The virtual cherry (VCHERRY) modeling project synthesizes sweet cherry research on new rootstocks, fresh market varieties, canopy architecture, training systems, and cropping physiology into an interactive and graphic computer program that 1) simulates multi-season tree development based on orchard pruning and training decisions and 2) predicts consequences with respect to yields and fruit size. Written in C++ for use on both Windows and MacIntosh operating systems, VCHERRY will visually "grow" a cherry tree week-by-week and node-by-node, allowing the user to impose pruning cuts, bending of branches, removal of buds, thinning of flowers, etc. Keyboard commands allow the user to rotate the tree image to all possible points of view as well as to zoom in and out. VCHERRY dynamically quantifies changes in leaf area and fruit number, allowing estimation of fruit yield and prediction of average fruit size. In addition to the main window which displays tree growth, there are eight other selectable user interface windows, including 1) orchard variables such as site/scion/stock, 2) architectural data fields, 3) a node-by-node positioning locator, 4) a command log file, and 5) an extensive help/documentation file. Growth and fruiting simulations can be conducted for any training system or set of decisions, and saved as text or movie files for comparisons, demonstrations, or digital file-sharing by orchard managers, consultants or extension agents, or tree fruit scientists. It is envisioned that VCHERRY will provide a valuable tool for sweet cherry growers learning how to 1) adopt new

dwarfing, precocious rootstocks and/or training systems, as well as 2) visualize the impact of pruning decisions on short- and long-term canopy development, fruit quality, and economic sustainability.

Specified source(s) of funding for the work presented in this abstract: Private (Association, Foundation, Industry)

Oral Session 18: Postharvest 2

Tuesday, July 17 **2:00–4:00 pm**

Room: Rainmakers Ballroom C

Moderator: Randy Beaudry; beaudry@msu.edu

2:00–2:15 pm

Sorption of 1-MCP by Produce

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Little is known of the fate of 1-methylcyclopropene (1-MCP) in the storage environment. The sorption of (1-MCP) by a number of 'target' plant materials was measured. Target plant materials included potato, parsnip, ginger, green bean, asparagus, tangerine, key lime, melon, apple, plantain, leaf lettuce, and mango. 1-MCP gas was added to the headspace at an initial concentration of approximately 10 ppm. Gas concentrations were measured after 2, 4, 6, 8, 10 and 24 hours. All produce absorbed 1-MCP, but the rate of sorption differed markedly. The initial rate of 1-MCP sorption for each commodity was found to correlate with the fresh weight, dry matter, insoluble dry matter, and water weight, but not soluble dry matter. The strongest correlation was with insoluble dry matter divided by the shortest radius of the organ ($r^2 = 0.63$) to adjust for the length of the diffusion path. The data is consistent with previously published data demonstrating sorption of 1-MCP by cardboard and wood, which suggested that cellulosic materials possess a high affinity for 1-MCP.

Specified source(s) of funding for the work presented in this abstract: Federal competitive

2:15–2:30 pm

Sorption of 1-MCP by Oak Bin Material: Depletion of 1-MCP and Loss in Treatment Efficacy

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Previous research indicated that a significant portion of the gaseous ethylene antagonist, 1-methylcyclopropene (1-MCP, SmartFresh™) was absorbed by "non-target" materials in the storage rooms for apple and other produce and could reduce the effectiveness of SmartFresh. To test this, we determined the dose-response for 1-MCP applied in storage environments with and without wooden bin material using a model system containing 'Jonagold' and 'Red Delicious' fruit, wetted oak boards, and air volume in proportions equivalent to those in storage rooms. The treatment chambers were inert 113-L, airtight, high-density polyethylene plastic chambers. Fruit were gathered at the preclimacteric stage and firmness and other maturity parameters assessed including internal ethylene, starch index, Brix, fruit weight, and background color. Fruit were placed in the 113-L containers and treated with initial 1-MCP concentrations of 1, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 200, 400, 600, and 1000 ppb; concentrations were determined at 0, 6, and 24 hours. Chambers were vented after 24 hours and the fruit held at room temperature or at 0 °C. Firmness retention, background color, and internal ethylene levels will be determined weekly at room temperature and at monthly intervals for refrigerated apples. Without wood, the dose-response of Jonagold fruit saturated at approximately 100 ppb 1-MCP. Wood shifted the dose-response curve toward higher 1-MCP levels such that approximately 400 ppb was required to saturate the response. The data for 'Red Delicious' are less dramatic, but similar in effect. The data suggest that if the sorption of 1-MCP by non-target materials can be reduced substantially, the amount of 1-MCP applied to obtain desired results can be reduced.

Specified source(s) of funding for the work presented in this abstract: Private (Association, Foundation, Industry)

2:30–2:45 pm

The Effect of Delays between Harvest and Treatment of Fruit with 1-MCP and DPA

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The effect of delaying diphenylamine (DPA) and 1-methylcyclopropene (1-MCP)treatment on the development of superficial scald, and of 'Cortland' and 'Law Rome' apples has been investigated. Fruit of each cultivar were either untreated, or treated with 1 $\mu L \cdot L^{-1}$ 1-MCP or 1000 μL^{-1} DPA on the day of harvest, or after 3, 7, 14, or 21 days of storage at 1 C. The internal ethylene concentration (IEC), flesh firmness, superficial scald, α-farnesene and conjugated trienols (Ctols) concentrations were measured every 2 months for 6 months. When 1-MCP was applied within 3 days of harvest, IEC and α-farnesene accumulation in the skin was inhibited, flesh firmness was maintained, while DPA did not affect these factors. DPA treatment maintained lower Ctols concentration compared with those of untreated apples, regardless of treatment timing. In contrast, as the 1-MCP treatment was delayed, Ctols concentrations were higher than with earlier 1-MCP treatments. The effectiveness of 1-MCP and DPA on superficial scald control was different for the two cultivars. DPA treatment resulted in lower superficial scald incidence in 'Cortland' than 1-MCP at every treatment time while 1-MCP treatment effectively stopped the expression of superficial scald in 'Law Rome' when applied 3 or less days after harvest. DPA treatment lowered the incidence of superficial scald in 'Law Rome' but was not as effective as 1-MCP at early treatment times.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

2:45–3:00 pm

Postharvest Low Oxygen Pretreatment Prevented Superficial Scald and Bitter Pit Symptoms in 'Granny Smith' Apples

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To avoid bitter pit and superficial scald symptoms in Californian 'Granny Smith' apples, we tested various pretreatments prior to cold storage, including chemical (0.2% diphenylamine (DPA) dip or 1.0 micro l/L 1-methylcylclopropene (1-MCP) for 24 hours at 20 °C) and physical treatments (low oxygen (low-O_2) for 10 days at 20 °C in a flushed or a closed system). Application of low-O_2 pretreatments, in both ways, to Granny Smith apples prior to cold storage reduced superficial scald and bitter pit incidence and severity after 4 months at 0 °C plus 20 days at 20 °C. The low-O2 treatment significantly induced endogenous production of acetaldehyde and ethanol, and thereby reduced ethylene production during cold storage which, in turn, reduced scald development. A reduction in scald and bitter pit was also found with DPA treatment, while application of 1-MCP was effective against scald, but

not bitter pit. Moreover, the low-O_2 treated fruits maintained a greener skin, similar to DPA or 1-MCP-treated fruit. The low-O_2-treated fruit remained firmer with higher acidity and aroma and flavor properties which were preferred over other treatments by the taste panelists. Using GC-MS and SPME to measure the headspace volatiles from the apple peel revealed that the low-O_2 treated fruit had the highest levels of volatiles, including aldehydes, alcohols and esters, compared to untreated, DPA and 1-MCP-treated fruit. In the control fruit which suffer from superficial scald and bitter pit, there was degradation of alfa-farnesene and corresponding production of its oxidation product, 6-methyl-5-hepten-2-one (MHO). In DPA, 1-MCP and low-O_2-treated fruit the level of MHO was very low. The role of low-O_2 in inhibiting scald and bitter pit will be discussed, including the advantage of using it as organic treatment.

3:00–3:15 pm

Programmed Cell Death Is Activated by Ethylene Treatment of Immature Mini-cucumber Fruit

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Studies with members of the Cucurbitaceae have demonstrated ethylene's ability to induce watersoaking. However, there is limited information about the early cellular events leading to the development of this disorder. Cellular and molecular changes in Dutch mini-cucumber fruit were monitored for 9 days with continuous air or 10 $\mu L \cdot L^{-1}$ ethylene treatment (ET). During this period, tissue integrity was evaluated with fluorescein diacetate (FDA). While tissues from control fruit exhibited bright and defined fluorescein staining of the cytosol throughout storage, the hypodermis of ET fruit showed weak cytosolic definition and slight intracellular fluorescein diffusion after 3 days. After 6 days, hypodermal watersoaking was visually apparent, and absence of stain in the watersoaked tissue indicated cellular death. After 9 days, no fluorescein staining was evident in ET fruit. The hypodermis was tested for nuclease activity and DNA laddering, indicators of plant programmed cell death (PCD). Total nuclease activity in control fruit remained constant at approximately 30 units $h^{-1} \cdot g^{-1}$ FW; however, ET fruit exhibited a 4-fold increase in activity from 3 d (31 ± 5.5 units $h^{-1} \cdot g^{-1}$ FW) to 7 d (123 ± 33 units $h^{-1} \cdot g^{-1}$ FW), concomitant with incipient watersoaking. Four nucleases of 37, 34.5, 32.5 and 31 kD were detected by SDS-PAGE followed by activity staining. The induction of 37 and 31 kD nucleases correlated with increased total nuclease activity and incipient DNA laddering. The activities of the 34.5 and 32.5 kD nucleases increased rapidly after 3 days of ethylene treatment and to a lesser extent in air-treated fruit. The data strongly indicate the ET activates PCD in cucumber fruit, leading to the development of watersoaking symptoms.

3:15–3:30 pm

Preharvest Applications of 1-MCP Delay Maturity and Ripening in 'Bartlett' Pears (*Pyrus communis*)

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Pear trees and fruit were treated at 79 N firmness with 1-MCP (Harvista) using 0, 28, and 56 $mg \cdot L^{-1}$ and harvested weekly for 3 weeks after application. Fruit were evaluated before and after ripening following 0, 3.5 and 6 months air storage at –1 °C. Fruit treated with 56 mg/L 1-MCP exhibited the greatest delay in softening on the tree, with 4.9, 4.0 and 0.9 N higher firmness with respect to untreated fruit 1, 2, and 3 weeks after application, respectively. During ripening after harvest (ripening process triggered with 100 $\mu L \cdot L^{-1}$ ethylene at 20 °C), 1-MCP treated fruit had reduced ethylene production, respiration rate and softening at all the harvest periods compared with untreated fruit, the differences being more evident in fruit harvested 1 week after application. Firmness differences after ripening (8 days at 20 °C) between fruit treated with 56 $mg \cdot L^{-1}$ 1-MCP and untreated fruit were 10.2, 3.5 and 0.9 N for fruit harvested 1, 2, and 3 weeks after application, respectively. However, there was considerable variability in fruit firmness within the treatments, indicating potentially incomplete coverage on the tree. After 3.5 months of cold storage and 5 days ripening at 20 °C, the variability in treatment effect was much less evident, and 1-MCP treated fruit presented reduced rates of ethylene production, respiration, and softening, and a lower incidence of superficial scald and internal breakdown. 1-MCP treated fruit took 1 to 3 days longer to ripen, and the strongest effect was obtained in fruit treated with 56 $mg \cdot L^{-1}$ 1-MCP and harvested one week after the application.

Specified source(s) of funding for the work presented in this abstract: Private (Association, Foundation, Industry)

3:30–3:45 pm

ACS and ACO Activity in Pear Fruit (*Pyrus communis*) Treated after Harvest with 1- MCP as Affected by Storage and Ripening Conditions

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Pear fruit were harvested at two maturities (74 and 70 N). One-half of the fruit was treated with 0.3 $\mu L \cdot L^{-1}$ 1-methylcyclopropane (1-MCP, SmartFresh). After 1-MCP treatment, fruit were held 3.5 and 6 months in regular air (RA) at -1 C. After each storage period, fruit were subjected to two temperature regimes: a) ripening at 20 °C or b) 5 days conditioning at 10 °C + ripening at 20 °C. After 3.5 months in storage, 1-MCP-treated fruit had 15 and 3 times less ACO and ACS activity than untreated fruit, respectively, and no effect of the conditioning treatment (5 days at 10 °C) was detected on enzyme activity, softening, or color change during ripening. 1-MCP-treated fruit softened more slowly and had less scald and internal breakdown (IB) than untreated fruit; however, color development was normal. After 6 months in storage, the 1-MCP treatment completely controlled scald and IB development and treated fruit softened to 25–30N after 9–10 days of ripening at 20 °C. No effect of the conditioning treatment was detected on softening or color change during ripening. ACS and ACO activity will also be presented.

Specified source(s) of funding for the work presented in this abstract: Private (Association, Foundation, Industry)

3:45–4:00 pm

Postharvest 1-MCP Dip Method Maintains Preharvest Fruit Quality in Cantaloupe

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The objective of this study was to determine the effects of 1-MCP postharvest dipping application rates and timings on cantaloupe fruit quality. Cantaloupe cv. Mission was grown in a commercial field on a silty clay loam following standard cultural practices for the Wintergarden of Texas. Three consecutive experiments were conducted. First we evaluated 1-MCP rates (0 to 10 ppm) at three levels of maturity (fruits attached, half slip and full slip), second we evaluated 1-MCP rates (0 to 10 ppm) at four dipping times (0.5, 1, 2 and 5 min), and thirdly we evaluated 1-MCP rates (0 to 1 ppm) at two storage times (10 and 20 days) and two temperatures (4 and 8 °C). After fruits remained in cold storage (10 days in experiments 1 and 2) they were transferred to room conditions (23 °C) and evaluated 1, 3, and 5 days after storage (DAS). Fruits treated with 1 or 10 ppm 1-MCP were firmer than control fruits 1, 3 and 5 DAS. Fruits tended to be less yellow and with less sunken

discoloration areas with 10 ppm 1-MCP compared to control (water) or adjuvant (0 ppm). Dipping melon fruits in 1 ppm 1-MCP for 5 min or 10 ppm 1-MCP for 1 minute gave the least decay ratings. In the last experiment, 1 ppm 1-MCP for 5 minutes provided significant benefit in maintaining fruit firmness, 22% and 43% compared to control fruits stored at 4 and 8 °C, respectively. Fruit soluble solid content was minimally affected by the treatments. Integrating the three experiments, we conclude that postharvest dipping in 1 ppm 1-MCP for 2 or 5 minutes appears a reliable method to maintain preharvest fruit quality and extend the shelf life of cantaloupe cv. Mission.

Specified source(s) of funding for the work presented in this abstract: Private (Association, Foundation, Industry)

Oral Session 19: Produce Quality, Safety and Health Properties

Tuesday, July 17 **4:00–6:00 pm**

Room: Greenway A/B

Moderator: Don Humpal; don_humpal@dai.com

4:00–4:15 pm

Extended Preservation of Small Fruit by Release of 2E-Hexenal from Poly(lactide) Films

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Blueberries are appreciated due to their high content of antioxidants and flavor so their consumption is increasing day after day. Blueberry industry contributes significantly to the American economy since the US is by far the leading producer of these fruits in the world. Successful blueberry marketing requires fruit of the highest quality. However, blueberry fruit is extremely perishable because of its susceptibility to post harvest fruit rots as well as shriveled. The development of environmentally friendly antimicrobial films would be an attractive alternative to provide prolonged protection against fruit rot, and add value to blueberries by maintaining them at a higher level of quality. In addition, news biodegradable films will be well accepted by consumers due to no waste disposal as that caused for petroleum based plastics. For obtaining these films, a natural occurring antifungal plant volatile, 2E-hexenal, was inserted into ?-cyclodextrins by co-precipitation technique. Obtained inclusion complexes were mixed with poly(lactide) resin by means of a microextruder. Pre-forms were place at a hydraulic press where antifungal films were obtained. Modified 1-L glass jars were used as bioassay system to study the effectiveness of those new films. Two hundred grams of blueberries plus antifungal film were inserted into each jar and then closed. Bioassay systems without film were used as controls. Physico-chemical and microbiological changes of blueberries were studied during storage. Also, the release of 2E-hexenal from the film was monitored. Storage of blueberries along with these films showed an improvement in fruit shelf life due to a lower weight lost, delayed respiration rate and reduction of infected blueberries.

Specified source(s) of funding for the work presented in this abstract: Private (Association, Foundation, Industry)

4:15–4:30 pm

Effect of Soil Moisture and Sunlight Prevailing during the Week before Harvest on Quality of Lettuce

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For the last 3 years we have been studying the effect of moisture at harvest on quality of lettuce (iceberg and romaine) grown in Yuma, AZ. Lettuce plants subjected to different irrigation termination (IT) schedules, and exposed to full or reduced sunlight, were examined for quality characteristics. Typically, IT schedules included 16, 8, and 4 days before harvest corresponding in the last trial with soil water potential of –1.08, –2.42, and –3.50 MPa respectively. Sunlight was reduced by covering plants with green nylon screens that blocked either 60% or 90% of light, during the last 7 days before harvest. Results with early ITs consistently showed an increase in overall visual quality during postharvest storage. Total phenolic and antioxidant activity were as high as over 25% when IT was scheduled earlier. Additionally, aerobic bacteria counts and total coliform was higher on lettuce subjected to late IT. Lettuce exposed to reduced sunlight contained lower amount of phenolic compounds and antioxidant activity in plants harvested in January, however, phenolic levels were higher in shaded lettuce harvested in April. As expected, volume yields declined with the earliest IT, however, maximum weight at harvest did not require extremely late IT. Moreover, volume yields also decrease with reduced sunlight during the week before harvest. Overall our results showed that under conditions prevailing in the Sonora Desert during the lettuce production season, full exposure to sunlight maximize yields while reduced water at harvest improve visual and microbial quality, phenolic content and antioxidant activity. Influence of reduced sunlight during the week before harvest on visual quality and phenolic content varied depending on the period of the production season.

4:30–4:45 pm

Food Safety and SPS Systems in the Transition Economies of Eastern Europe

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Eastern European states are struggling to adjust their food safety and SPS (sanitary and phyto-sanitary) systems to comply with their new status as members of the WTO (World Trade Organization). Their scientific capacity and regulatory systems for food safety, plant protection and quarantine were severely weakened after the collapse of their Soviet markets post-independence. Currency crises in the late 1990s and slow economic growth since then deepened these problems. Radical changes have taken place in production patterns and practices for fruits and vegetables. Some countries have radically changed production patterns and shifted some of their export flows to new markets in Western Europe, the Middle East, and North America. However, many Eastern European states are still highly dependent on a Russian market that is now open to competitors from around the globe. Increased inspections and sampling of fresh and process fruits and vegetables by importing countries have, however, led to rejections of shipments and outright export bans because of microbial contamination, plant pest and disease quarantine problems, mycotoxin and metal contamination, and pesticide residue issues. Assessment of diagnostic and enforcement capacity is used to illustrate the challenges faced by two countries, Moldova and Armenia, as their regulatory authorities and private companies struggle to transition to updated science-based sanitary and phyto-sanitary risk management systems.

4:45–5:00 pm

Potential Perchlorate Exposure from Horticultural Crops Irrigated with Colorado River Water

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The Colorado River is contaminated with low levels of perchlorate derived from aerospace and defense related fuel industries once located

near the Las Vegas Wash. At sufficiently high dosages perchlorate can disrupt thyroid function by inhibiting uptake of iodide. We have found trace levels of perchlorate in a number of food crops grown in the lower Colorado River region. Potential perchlorate exposures from the consumption of individual food crops produced with Colorado River water are low relative to the Reference Dose (RfD) recognized as safe by the National Academy of Sciences. However, because we observed some level of exposure with each food crop evaluated, additional work was needed to evaluate hypothetical cumulative exposure from all food crops produced in the lower Colorado River region. Results indicate that relative to the RfD, there is a potential for cumulative exposure to become a regulatory issue with small children but not adults. The iodide uptake inhibition potential of perchlorate relative to other natural goitrogens in food crops will also be discussed.

Specified source(s) of funding for the work presented in this abstract: Federal competitive

5:00–5:15 pm

Potential Heavy Metal Exposure from Vegetable Crops Produced in the Southwestern United States

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Vegetable crops produced in the southwestern United States are exposed to trace levels of several heavy metals present in the soil, irrigation water, and fertilizers and amendments. These metals include uranium, cadmium, lead, mercury, nickel, and arsenic. Studies were undertaken to evaluate the potential for crops produced in this region to be a source of heavy metal exposure to humans. With very few exceptions, most crops evaluated had heavy metal contents well below levels of concern. One notable exception is spinach (*Spinaca oleracea* L.) where cadmium levels were consistently above maximum levels proposed by the European Union. Mean hypothetical metal exposures and implications on human health in the present and in the future will be discussed.

5:15–5:30 pm

Identification of Bioactive Citrus Limonoids using HPLC-Collision-induced Dissociation Method

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Citrus limonoids are prominent but lesser known bioactive compounds, shown to prevent cancers of the mouth, skin, lung, breast, stomach and colon, based on in-vivo and in-vitro studies. Limonoids are highly oxygenated triterpenoid compounds, broadly classified as aglycones and glucosides. A new HPLC-collision induced dissociation (CID) method was developed and optimized for the analysis of limonoids in citrus fruits. Separation of individual aglycones and glucosides were achieved chromatographically using Gemini HPLC column (150 × 2 mm, 3 μ particle size). To fragment a precursor ion, CID technique was employed and MS/MS of aglycones was recorded in APCI positive ion mode while that of glucosides was recorded in ESI negative ion mode. Characteristic fragmentation of both the groups was identified and four aglycones (limonin, deacetyl nomilin, isolimonic acid and nomilin) and four glucosides (limonin glucoside, deacetyl nomilinic acid glucoside, nomilinic acid glucoside, and iso obacunoic acid glucoside) were identified in sour orange (*Citrus aurantium* L.) seed extracts. This method provides a powerful technique for identification of citrus limonoids.

Specified source(s) of funding for the work presented in this abstract: Federal competitive

5:30–5:45 pm

Total Free Radical Scavenging Capacities of Kumquats (*Fortunella japonica* Swingle)

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Clinical and epidemiological studies have established that fruits and vegetables can have beneficial effects on human health. Recently, research on antioxidant and disease prevention has been a major focus by researchers around the world. Fruits and vegetables have received much attention due to the presence of known antioxidants such as polyphenols, vitamin C, vitamin E, α-carotene and lycopene. Literature survey showed that there are no reports on antioxidant activity of different polar extracts from kumquats. In our study, kumquats were freeze-dried and extracted with five different solvents such as hexane, ethyl acetate, acetone, methanol and methanol: water (8:2). The extracts were dried under vacuum and screened for their radical scavenging activity using 1, 1-diphenyl-2-picrylhydrazyl (DPPH) method at 250, 500, and 1000 ppm. Ethyl acetate extract was found to be most active and methanol extract was found to least active. The dried extracts were used to determine their antioxidant capacity by the formation of phosphomolybdenum complex. The order of antioxidant capacity varied because of differential responses at two concentrations in each solvent and the results were expressed as equivalent to ascorbic acid (micromol/g of the extract). The order of antioxidant capacity were found to be from kumquat extracts of ethyl acetate >methanol:water > methanol > acetone > hexane. The total free radical scavenging capacities of kumquats is due to the amount of phenolics, carotenoids, ascorbic acid present in each fraction and may provide a good source of antioxidants.

Specified source(s) of funding for the work presented in this abstract: Federal competitive

5:45–6:00 pm

The Influence of Organic Production on Nutritional Quality of Fruit and Vegetables: A Meta-analysis

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Meta-analysis, a statistical method for synthesizing the results from independent studies, was performed to examine the impact of organic production on nutritional quality of fruit and vegetables. To facilitate the analysis, a database comprising more than 80 published comparative studies from the past few decades on organically and conventionally grown produce was established. An array of food quality measurements related to human nutrition and health were included: carbohydrates, proteins, lipids, vitamins, minerals, phytochemicals, and nitrates. The structure of database was designed to allow for categorization of each study based on year, location, crop type, scale of study, experimental design, soil condition, nutrient input, pest management, food form tested, and so on, with identified information that can be extracted to meet the criteria of meta-analysis. We quantified the magnitude of effect of production method on individual quality attributes from each study and then evaluated the overall significance of the average effect size across all studies included in the analysis. Subgroup analysis was also

carried out by grouping studies of a certain characteristic, for instance, scale of study, crop type, or food form tested. The results indicate that although organic production might have the potential for enhancing nutritional quality of fruit and vegetables, the picture remains rather complicated since the production effect can vary considerably, subject to a number of factors. Guidance for future research directions is provided through our analysis.

Specified source(s) of funding for the work presented in this abstract: Private (Association, Foundation, Industry)

Oral Session 20: Vegetable Crops Management 4

Tuesday, July 17 **4:15–5:30 pm**

Room: Powell A/B

Moderator: Chiwon W. Lee; drchlee@yahoo.com

4:15–4:30 pm

Growing 'Okinawan' Purple-fleshed Sweetpotatoes in Louisiana: Preliminary Data for Yield and Quality Factors

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Three virus-tested purple-fleshed 'Okinawan' sweetpotato mericlones were grown using cultural practices recommended for the 'Beauregard' variety. The experimental field (Gigger silt loam; fine-silty, mixed, thermic, Typic Fragiudalf) located at Chase, LA, was disk cultivated and Lorsban 4E (chlorpyrifos; 2 qt/acre) was broadcast applied. A second disking operation was performed prior to hipping in 42-inch rows. Plots were 42 inches wide and 25 feet long. Liquid fertilizer was applied at a rate of 40 lb/acre N, 110 lb/acre P2O5, and 110 lb/acre of K_2O. A four-row strip was not fertilized to investigate the response of 'Okinawan' sweetpotatoes to low fertility conditions. A tank mix of Command 3ME (clomazone; 2 2/3 pt/acre) and Valor (flumioxazin; 2 oz/acre) was applied immediately prior to mechanical transplanting (in row spacing=12 inches) on 2 June 2006. At 128 days after transplanting, a one-row mechanical digger was used for harvesting. Roots belonging to various yield grades were combined and weighed. The yield of the Okinawan sweetpotatoes was about 2.5 times less than the yield of 'Beauregard'. There were no differences in yield among the mericlones as well as fertilizer treatments. We noted the incidence of cracking among 'Okinawan' storage roots from fertilized plots as well as extensive damage from whitefringed beetle. Dry matter among the Okinawan mericlones was 50% higher relative to 'Beauregard'. Sucrose content was at least 50% more. Baking trials reveal that the baked storage roots were dry relative to the 'Beauregards', but had good flavor.The results suggest that the 'Okinawan' sweetpotato variety can be grown under Louisiana conditions but may require a longer growing season than 'Beauregard'. In addition, further research is needed to verify the role of in-row spacing, irrigation requirements, and fertilizer rates in improving potential yield.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

4:30–4:45 pm

Squash Cultivar Evaluation and Selection for Production of Male Blossoms in South Florida

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Male flowers from squash (*Cucurbita pepo*) are an expensive specialty crop which does not ship or store well, creating a potential for local production by small farms. In south Florida, where squash is generally grown in shorter days than in areas with summer growing seasons, many restaurants will purchase the flowers. However, growers do not have the information to choose which cultivars are best for flower production. Most modern commercial squash cultivars have been bred for fruit production, with a high ratio of female to male flowers. Squash flower production is also dependent on environmental factors such as temperature, photoperiod, light energy and nitrogen status. In order to evaluate male squash blossom production in the south Florida fall and spring growing seasons, 10 squash cultivars and one pumpkin in the 2005–06 growing season, and 11 squash cultivars and one pumpkin in the 2006–07 growing season were field grown in Boynton Beach, Florida. In the Fall 2006 trial as in the 2 preceding trials, specialty and scallop-types generally produced more flowers than the many standard zucchini and yellow squashes. Highest production of flowers per plant was from 'White Bush Scallop' (49), 'Pam' (35), 'Peter Pan' (42), and 'Papaya Pear' (41), which produced significantly more male flowers than commercial yellow squash cultivars: Multipik (13), Dixie (14), and Sunglo (12). The 2006–07 trials demonstrate similar trends seen in the 2005–06 trials, in that the best options for edible squash blossom production are those not typically grown in large-scale summer squash fruit production.

4:45–5:00 pm

Changes in Ethnic Vegetable Crops Grown in Miami–Dade and Broward Counties and the People Who Grow Them

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Ethnic vegetable crops have been grown in Miami–Dade County for many years. The influx of Cuban immigrants in the early 1960s brought producers who planted thousands of acres of cassava (yucca), tropical sweetpotato (boniato or batatas), tanier (malanga or yautía), taro (malanga isleña or malanga), tropical pumpkin (calabaza), and cilantro. Asian growers from Taiwan and South and Southeast Asia added crops such as bitter melon, silk squash, luffa, fuzzy squash, long bean, lablab bean, winged bean, tindora, parvar, betel leaf and many herbs to the mix in the 1980s. Since that time, there has been a very sharp decline in the acreage of cassava, tropical pumpkin, and cilantro with a lesser decline in that of malanga. Asian vegetables such as tindora, parvar, winged bean and betel leaf are rarely grown now. Several of the original Cuban growers have either retired or changed to traditional winter vegetables, with Hispanic growers from other countries joining this trend. Some American growers are now growing Asian vegetables, including yams, methi, and long beans. Broward County has lost most of its vegetable land to urbanization, but a recent county bond issue has funded a Farm Park where land will be leased to growers from Jamaica and other Caribbean countries to grow callaloo and other vegetables from the West Indies. As land available for vegetable production continues

to decline in both counties, growers are finding specialty vegetables, especially ethnic ones, to be a viable alternative.

5:00–5:15 pm

Production of Confectionery Seed Pumpkins in the Northern Plains Region

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The use of pumpkin seed for roasting, trail mixes, and snackfood product ingredients has been increasing. Pumpkin seed contains 40% to 50% oil, which is highly unsaturated and suitable for use in cooking. Crushed pumpkin seeds are also used in bread mixes. The feasibility of growing confectionery seed pumpkins in the northern plains region has been explored. Many breeding lines, open-pollinated progenies, and commercial cultivars of hulled and hull-less seed pumpkins have been evaluated for yield, earliness, and seed quality. Seed yield per unit area was higher when plants were grown more densely, allowing the production of one fruit per plant, than when multiple fruits were produced per vine in less denser populations. The size and weight of fruit did not influence the seed yield. Early placement of honeybee colonies in the field at the beginning of flowering is essential for pollination and seed yield enhancement. In general, seed yield was higher in hulled seed than hull-less seed pumpkins. Weed control by mechanical cultivation at an early stage of stand establishment is essential, since the use of selective herbicides is limited. Development of a dense leaf canopy before first flowering is detrimental to honeybee activity and saturation pollination. Windrowing and picking of fruits are done after light frost. Fruits with hard rind are better for mechanical harvesting, especially when frozen. Prompt handling and washing of seeds after extraction from the fruit are required. Seed cleaning by water is easier for the hulled than the hull-less seed types. Mature hulled seeds float on the water, while immature ones sink. For hull-less seeds, immature ones float on the water, while mature ones are the sinkers which make the cleaning operation difficult. As earlier maturing and high yielding cultivars are identified, commercial production of confectionery seed pumpkins in the region is highly possible.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

5:15–5:30 pm

Leafy Greens as a Winter Crop in Washington State

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It is possible to grow leafy green vegetables during winter in Washington State, but tissue nitrate levels may be high due to low light intensity and temperature and plant genetic factors. High nitrate levels are potentially harmful to humans, and fresh and processed vegetables have been cited as the major source of dietary nitrate intake in adults. The European Commission (EC) has set maximum allowable nitrate levels in leafy greens at 452 to 791 mg NO_3-N/kg fresh weight (FW). The purpose of this two-year study is to examine several environmental factors that may affect the nitrate concentration in lettuce, spinach and Asian greens grown during winter. Research trials are being managed organically in unheated, unlit hoop houses near Pullman and Vancouver, WA. Several varieties of greens are being examined for yield potential and tissue nitrate concentration. In the 2005–06 growing season, Pullman samples had average nitrate concentrations of 520, 466, and 318 mg NO_3-N/kg FW while Vancouver samples had average concentrations of 739, 1128, and 1027 mg NO_3-N/kg FW for harvest dates of 15 Mar., 28 Feb., and 31 Mar. 2006, respectively. Greens grown in Vancouver had levels above the European standards for all sample dates whereas only the 15 Mar. harvest in Pullman had levels had levels above European standards. Preliminary data suggest that variety also has an effect on nitrate concentration. With additional research we hope to develop appropriate techniques for measuring and controlling nitrate in winter-grown leafy greens.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

Oral Session 21: Herbs, Spices, and Medicinal Plants

Tuesday, July 17 **4:30–5:45 pm**

Room: Rainmakers Ballroom C

Moderator: Alain Boucher; aboucher@interchange.ubc.ca

4:30–4:45 pm

Potential of 'BetaSweet' Carrot in Cancer Prevention

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Varying polarity of solvent extracts from the 'BetaSweet' maroon carrot, developed at the Vegetable and Fruit Improvement Center, were found to exhibit significant antioxidant activity. Various sequential extracts of 'BetaSweet' carrot such as hexane, methanol and water, were subjected for its cytotoxicity ability in colon cancer cells SW480 (grown in DMEM supplemented with 10% FBS) at different concentrations. Hexane extract has shown 60% cytotoxicity at 100 ppm measured by the MTT assay. Furthermore, this was confirmed by measurement of cell numbers of SW480 cells treated with extracts for 24 and 48 hours. The ability of declining cell growth of colon carcinoma cells were also confirmed by using the LDH based cytotoxicity assay in comparison with positive control. DNA fragmentation was seen in cells treated with extracts for 24 hours, confirming the mode of cytotoxicity. These results were further supported by microscopic studies after staining for viability and DNA content. Interestingly, the carrot extracts did not show cytotoxic effects on normal cells at similar doses as tested using NIH 3T3 cells. The lack of cytotoxicity on normal cells is very critical for any potential bioactive compounds to be considered as health maintaining properties. Our in vitro results suggest that 'BetaSweet' carrot may have potential in cancer prevention, provided further animal studies and clinical trials show a similar trend as well as bioavailability studies need to confirm the fate of these compounds. This project is based upon work supported by the USDA-CSREES #2006-34402-17121 "Designing Foods for Health" through the Vegetable & Fruit Improvement Center.

Specified source(s) of funding for the work presented in this abstract: Federal competitive

4:45–5:00 pm

Anti-inflammatory Bioassays to Guide Selection of Therapeutically Desirable *Echinacea angustifolia* Genotypes

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The anti-inflammatory action of *Echinacea angustifolia* has been previously demonstrated in vitro and in vivo. Two classes of compounds, considered to be important markers, are routinely quantified for *Echinacea* product quality assessment; caffeic acid derivatives and alkylamides. Some of these compounds appear to be partially responsible for the reported therapeutic property of the plant. Their relative role in the bioactivity of the plant, however, is still unclear. This makes the choice of phytochemical criteria to be used for genotype selection somewhat dubious. We examined the possibility of using an anti-inflammatory bioassay to aid in the selection of therapeutically superior genotypes for breeding material. We found that extracts from plants grown in three different macro-environments, two field sites and one greenhouse site, had statistically significant variations in marker compound concentration. These same extracts did not differ significantly in their effect on the production of two key inflammation-related cytokines, interleukin-6 (IL-6) and interleukin-8 (IL-8), in human bronchial epithelial cell models (BEAS-2B). Cell response to *E. angustifolia* ethanolic extract varied greatly, ranging from a 30.2% reduction to a 126.7% increase of IL-6 production and a 59% reduction to a 30% increase in IL-8 production. Significant inverse relations were observed between concentrations of tetraenes, the main alkylamides in *E. angustifolia* roots, and cell secretion of IL-8 and IL-6 relative to solvent controls. No such relation was observed for any of the caffeic acid derivatives. Our findings support the role of alkylamides in the therapeutic activity of Echinacea and the value of selecting *E. angustifolia* genotypes that produce high levels of these compounds.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

5:00–5:15 pm

Productivity, Content, and Composition of the Essential Oil of Three Basil Genotypes as a Function of Harvesting

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The hypothesis of this study was that harvesting stage and genotype will affect productivity, oil content and composition of basil under the Mississippi climate. A replicated field experiment was conducted to evaluate the changes in biomass productivity, oil content and composition of *Ocimum basilicum* L. (cv. German and Mesten), and *Ocimum sanctum* L. (cv. Local). Basil grew well under Mississippi conditions, without any major pests or diseases. Three cuts were taken from each of the three basils during the cropping season. Yield of basil herbage and essential oil were high, and comparable to those reported in the literature. Overall, herbage yields decreased after the first harvest, but oil content increased with the second or third harvest. Essential oil content of cv. German varied from 0.4 to 0.75, the oil content of cv. Mesten varied from 0.5 to 0.72, while the oil content of cv. Local ranged from 0.17% to 0.50% in air-dried basil. The major oil constituent of cvs. German and Mesten was linalool (30% to 40%), while the major oil constituents of cv. Local (of *O. sanctum*) were eugenol (5% to 42%) and methyl chavicol (14% to 18%). Other constituents in both species included eucalyptol, camphene, camphor, a-pinene, a-humulene, isobornyl acetate, trans-caryophillene, and others. In addition, commercial basil oil samples were analyzed and the essential oil constitutes compared to the constituents of locally grown basil. It was found that most of the commercial basil oil samples had distinct oil composition. Results from this study indicate that both sweet and holy basils could be grown as essential oil crops in Mississippi.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

5:15–5:30 pm

Hypocotyl Grafting for Teaoil Camellia and Its Grafting Union Development

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Camellia oleifera Abel (teaoil camellia) is an important economic crop in China and has been cultivated for various purposes (mainly for cooking oil) for more than 1000 years. To better manage 4 million ha of low-yield plantation, many elite cultivars had been introduced and a rapid propagation method, hypocotyl grafting, had been applied. Regular teaoil camellia seeds were sowed in sandy boxes at least 6 cm in depth. Before the sprout reached the sandy surface, the whole plant was dug and hypocotyl was cut at 3-cm level. One-node scion (usually 1-year-old) was grafted to the splitting hypocotyl and wrapped with an aluminum strip. Grafted plants were cultivated to the field beds immediately in plastic tunnels under 30% shadecloth. Six grafted plants were collected daily. The grafted union was cleaned and stored in 75% alcohol for preparing microscope slides. In most respects, hypocotyl grafts of teaoil camellia followed regular development patterns, but specific differences were noted in initiation of callus, bridge formation, and mode of healing. Callus was formed at day 2 on both scion and stock. The development of callus on scion began to extend inward and met the callus from hypocotyl stock at day 12. More callus tissues were from scion instead of stock. Two callus bridges (not vascular bridges) formed completely through the center parenchyma tissue at day 18–20 and three distinguished parenchyma areas were observed. At day 30–34, the center portion of callus bridges differentiated to pith parenchyma to conclude the grafting union development. Hypocotyl grafting successfully connected the young and fragile tissues with mature tissues. Mechanisms and hormone effect of its grafting union should be addressed for better future application.

Note: Donglin Zhang is also a guest professor at Central South University of Forestry and Technology, Changsha, Hunan, China.

5:30–5:45 pm

Ginkgo Cultivation in China with Reference to Varietal Taxonomy

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Ginkgo biloba L. is a valuable plant endemic to China and widely

distributed across the country. It ranges from Northeast China to South China, spanning 26 provinces within the latitudes 22 to 42°N. The production centers are in Jiangsu, Zhejiang, Anhui, Hubei, Jiangxi, Hunan, Henan, and Guangxi. Presently there are more than 2 million trees nationwide, which produced 30,000 tons per year. Among them, 6000 tons were exported. Ginkgo seeds, called "baiguo" (white nut) in China, have long been used in our doctors' prescriptions and are widely welcome as an appetizer, with high nutrition and good effect in diet therapy against cardiovascular diseases. It is rich in protein (13.6%), Ca, Fe, P, and vitamins A, B, C. The ginkgolides, flavon, and biflavon isolated from the leaves are peculiar medicinal substances helping to cure patients of such diseases as tracheitis, heart disease, and cerebral hemorrhage. The long-lived ginkgo tree, which has been grown in China for as long as 3000 years, is also famous for its valued timber and ornamental characteristics of good crown, well-structured branches, and golden yellow leaves in Autumn. Therefore, more than 50 countries have cultivated this "living fossil" for its multiple uses. The intraspecific variants of *G. biloba*, due to cross-pollination, and the clones from long-time selection resulted many elite cultivars. To meet the needs of mass production and intensive management, a systematic arrangement of ginkgo cultigens was developed. The classification falls into four categories, i.e., section, group, subgroup, and cultivar.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

Note: Donglin Zhang is also a guest professor at Central South University of Forestry and Technology, Changsha, Hunan, China.

Oral Session 22: Floriculture 2

Wednesday, July 18 **8:00–10:00 am**

Room: Rainmakers Ballroom C

Moderator: Matthew D. Taylor; mdtaylo3@ncsu.edu

8:00–8:15 am

Irrigation Scheduling in Greenhouses: Substrate Water Content Effects on Growth and Physiology of Vinca (*Cataranthus roseus*)

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Greenhouses are under increasing pressure to reduce runoff of water and fertilizer and to use available irrigation water as efficiently as possible. One possible approach is to control irrigation based on substrate water content. In this study, we used an automated controller to irrigate vinca when the substrate volumetric water content (VWC) dropped below a specific set point, with set points ranging from 5% to 47% (v/v). Shoot dry weight increased linearly with increasing VWC ($r = 0.87$), from 0.6 to 1.8 g/plant. Surprisingly, VWC did not affect leaf photosynthesis, which was thus not responsible for the decreased growth associated with low VWC. Instead, growth reductions at low VWC appeared to be due to a reduction in leaf elongation; there was a strong, positive linear correlation between VWC and the area of the uppermost, fully-expanded leaf ($r = 0.93$). The positive linear correlation between the leaf area of the uppermost, fully-expanded leaf and shoot dry weight ($r = 0.96$) further supported this idea. Our data clearly indicate that leaf elongation is much more sensitive to drought than leaf photosynthesis, so irrigation management should focus on maintaining leaf elongation. There was little or no difference in shoot dry weight among plants irrigated at VWC set points from 29% to 45%, suggesting that a VWC of 29% may be sufficient for vinca.

Specified source(s) of funding for the work presented in this abstract: Private (Association, Foundation, Industry)

8:15–8:30 am

Effect of Calcium on Postproduction of Fresh Cut Sunflower

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Hydrating solutions have been proven to increase the postharvest longevity of many fresh cut flowers. There has been little research, however, on the chemical composition of these hydrating solutions and how they impact the uptake of water and postharvest longevity. The objective of this research was to determine the efficacy of a 2-hour pulse of calcium (Ca) supplied as calcium nitrate, calcium chloride or chelated calcium nitrate at 0, 125, 250 or 500 ppm Ca on water uptake, water loss and postharvest longevity of fresh cut sunflower. Vase life of sunflower was extended by 2 days for all Ca treatments over the controls of water, sodium nitrate or chelate alone. Although water uptake declined exponentially for all treatments, calcium nitrate and calcium chloride provided for a lower water uptake and decreased water loss, but maintained a greater fresh weight during postharvest. Those sunflowers pulsed with chelated calcium nitrate had a higher rate of water uptake but had a higher rate of water loss compared to all other treatments.

Specified source(s) of funding for the work presented in this abstract: Private (Association, Foundation, Industry)

8:30–8:45 am

Modified Atmosphere Use in Extending Unrooted Cutting Quality and Viability

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The value of unrooted cutting imports into the United States totaled $60 million in 2005. Methods to reduce cutting losses during shipping are of critical interest for cutting producers, rooting stations, and finished plant producers. One node cuttings of *Impatiens hawkeri* 'Sonic Red' were harvested and stored in gas concentrations ranging from atmospheric air (21:0.03) to 1:20 oxygen:carbon dioxide for 8 days at 20 °C. Cuttings held in 1:20 oxygen:carbon dioxide generated higher concentrations of ethylene than any other treatment including atmospheric control. Ratios of 10:10, 10:5, 5:10, 5:5 oxygen to carbon dioxide during storage resulted in less ethylene production compared to atmospheric control. During storage no leaf abscission, yellowing or wilting differences were observed among the treatments. However, cuttings held in atmospheric air or 1:20 declined rapidly in the propagation environment. Only 25% or 72% of the cuttings stored in 1:20 or 21:0.03 survived propagation and rooted. Alternatively, 99% of cuttings stored in 5:5, 5:10, 10:5, 10:10 rooted within 11 days of sticking and showed no necrosis or chlorosis.

Specified source(s) of funding for the work presented in this abstract: Private (Association, Foundation, Industry)

8:45–9:00 am

Endogenous Carbohydrate Status Influences Postharvest Ethylene-promoted Leaf Senescence in Pelargonium Unrooted Cuttings

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Pelargonium (*Pelargonium ×hortorum* L.H. Bailey) production for the North American market is mainly through vegetative cuttings produced in Central America or other tropical climate regions of the world. The success of the U.S. growers to meet the market demand has become

increasingly dependent on their ability to receive high-quality cuttings. However, often shipment occurs under unfavorable conditions and results in leaf senescence, indicated by a decrease in chlorophyll content and decay of cuttings during propagation. We investigated the role of ethylene action and the interacting effect of endogenous carbohydrate status and postharvest ethylene action on poststorage leaf senescence of pelargonium cuttings of two cultivars, 'Patriot Bright Red' and 'Patriot White'. Two separate experiments were carried out; in the first experiment, the application of ethylene on cuttings harvested at 8 am at the beginning of storage (in sealed bags at 20 °C for 3 days) resulted in an increase in leaf senescence during propagation, while an application of an ethylene action inhibitor (1 methylcyclopropene) decreased leaf senescence. In the second experiment, postharvest application of ethylene had no significant effect on the leaf senescence of cuttings with a higher carbohydrate status (harvested at 4 pm from the stock plants in a greenhouse). Alternatively, ethylene application on cuttings with lower carbohydrate status (harvested at 4 pm from the stock plants under black shade cloth during the day) resulted in substantially higher leaf senescence. The results suggest that the endogenous carbohydrate status of the unrooted cutting affects the postharvest sensitivity to ethylene.

9:00–9:15 am

Ethephon Residual Catalysis on Unrooted Cuttings and Stock Plants

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Ethephon, [(2-chloroethyl) phosphonic acid] is a critical part of stock plant management resulting in increased branching and sink tissue abscission. However, ethylene production caused by ethephon is suspected to cause leaf abscission during shipping. Impatiens hawkeri 'Sonic Red' stock plants were treated with 0, 250, 500 or 1000 mg·L^{-1} ethephon. One to 21 days later cuttings were harvested and stored in sealed jars for 24 hours prior to ethylene measurements. Cuttings treated with 500 mg·L^{-1} ethephon and stored at 10 °C produced 0.37 mg·L^{-1}·g^{-1} (fresh weight) ethylene compared to 3.55 from those stored at 25 C. The resulting temperature coefficient (Q10) is 4.55 assuming a linear relationship. Higher ethephon doses resulted in greater ethylene generation. Cuttings harvested 1 day after treatment with 0, 250, 500 or 1000 mg·L^{-1} ethephon produced 0.07, 1.3, 1.7 or 5.8 mg·L^{-1}·g^{-1} (fresh weight) ethylene in the first 24 hours of storage respectively. Twenty-one days after treatment, cuttings from the same plants produced 0.05, 0.05, 0.15, or 0.14 mg·L^{-1}·g^{-1} (fresh weight) ethylene in the first 24 hours of storage respectively. As cuttings were harvested from day 1 to day 21, ethylene produced within the first 24 hours of storage dropped in a quadratic fashion. Rinsing cuttings, treated 24 hours earlier with 500 mg·L^{-1}ethephon, by gently agitating for 10 s in deionized water reduced ethylene production to 0.7 mg·L^{-1}·g^{-1} (fresh weight) as compared to 1.7 for unrinsed cuttings.

Specified source(s) of funding for the work presented in this abstract: Private (Association, Foundation, Industry)

9:15–9:30 am

Ethylene Production by *Fusarium oxysporum* f. sp. *tulipae* in Live Bulbs, and In Vitro using Freeze-dried Tulip Bulb Powder

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At postharvest, tulip (*Tulipa gesneriana* L.) bulbs are very sensitive to ethylene. In ethylene-sensitive cultivars, ethylene concentrations of 0.1 ppm may cause physiological disorders (i.e increased respiration); higher concentrations (0.3 ppm) may induce gummosis, flower blasting, and stunted growth. *Fusarium oxysporum* Schlecht f. sp. *tulipae* (*F.o.t*) is a soil-borne fungus that infects tulip bulbs at the end of the growing season. *Fusarium*-infected bulbs are the most important source of ethylene during storage. *Fusarium* infections are costly not only because infected tulip bulbs have to be discarded, but also because high ventilation rates have to be used in order to avoid any damage by ethylene to healthy bulbs. Ethylene production on live bulbs inoculated with each of four single spore strains of *F.o.t* reached a mean level of 1600 μL ethylene bulb per day at 28 days post-inoculation (dpi) in cultivar Friso, while in cultivar Calgary ethylene production was 3 times less. Our results suggest that ethylene production is dependent on fungal strain, tulip cultivar, and incubation temperature.. While live infected bulbs start producing ethylene at 12 dpi and end at 50 dpi, it was found that an in-vitro assay utilizing freeze-dried tulip bulb powder produced ethylene 10 times faster starting on day 2 and finishing at 6 dpi. Future experiments will identify the causes of differential ethylene production by *F.o.t* on different tulip cultivars.

9:30–9:45 am

Effect of Phosphorus Deficiency and High Temperature on Ammonium and Nitrate Uptake by Geranium (*Pelargonium* ×*hortorum* Bailey)

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The cause of sudden substrate pH decline by geranium is unknown and may be due to a shift in cation-anion balance. Nitrogen plays a very important role in cation-anion balance since it accounts for over 50% of the mineral ions that will cross the plasma membrane and is the only mineral nutrient that can be absorbed as a cation (NH_4^+) or anion (NO_3^-). Studies have shown that P deficiency will suppress NO_3^- uptake or suppress NO_3^- uptake and increase NH_4^+ uptake. These changes cause a shift in the cation-anion uptake ratio and if favored towards NH_4^+ would cause acidification of the rhizosphere. This experiment compared geraniums (*Pelargonium* ×*hortorum* Bailey 'Designer Dark Red') grown in 200-L hydroponic tanks at two temperatures (18/22 and 22/26 °C night/day) and with or without P. Three, 11, and 19 days after transplanting (DAT), plants were placed into an identical solution containing either $^{15}NH_4^+$ or $^{15}NO_3^-$ for 24 hours. Influx of $^{15}NH_4^+$ was not significantly affected by temperature and was suppressed by P starvation 19 DAT. Influx of $^{15}NO_3^-$ was not significantly affected by temperature and was suppressed by P starvation 11 and 19 DAT. At the control temperature treatment, the $^{15}NH_4^+$: $^{15}NO_3^-$ influx ratio increased significantly from 0.34 to 0.46, and 0.30 to 0.38 when plants did not receive P at 11 and 19 DAT, respectively. This suggests an increased acidification rate by P-starved plants. pH was maintained at 5.8 throughout the experiment and tanks with plants receiving P consumed less than half the mEq of titrating base per gram dry weight plant than tanks with plants that were devoid of P. Data indicate P-stressed geraniums suppress uptake of N (primarily NO_3^-) and increase the rate of acidification, which offers one explanation for sudden substrate pH decline.

9:45–10:00 am

In Vitro Propagation of Korean Native Lilies

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Although there are about 10 species of native lilies in Korea, the numbers are getting less and less. Thus it is required to establish in vitro

propagation for rapid and mass propagation. In vitro culture condition of two Korean native lilies has been tested; *Lilium cernuum* and *Lilium concolor*. The growth regulators, BA (6-benzyladenine) and NAA (alpha-naphthalene acetic acid), kinds and concentration of sugar, culture temperature, and gelrite concentration were examined. As results, 7.7 bulblets were generated from the *L. cernuum* in the concentration of BA 1.0 mg/L and NAA 0.1 mg/L. In the concentration of BA 1.0 mg/L and NAA 0.05 mg/L, 7.5 bulblets were produced from *L. concolor*. The culture temperature at 25 °C were effective for the bulblet weight and total fresh weight. In *L. cernuum* 400 and 610 mg and in *L. concolor* 520 and 1660 mg. Two grams per liter and 3 g/L of gelrite concentration were better than other conditions for bulblet weight and total fresh weight in *L. cernuum* and *L. concolor*, respectively. In *L. cernuum* had 910 and 2250 mg and in *L. concolor,* 820 and 2440 mg. In the case of sugar, 6% fructose was more efficient for the number and weight of bulblets than sucrose and glucose in *L. cernuum*. Sucrose and glucose were less effective for bulblets' growth.

Oral Session 23:

Consumer Horticulture and Master Gardeners

Wednesday, July 18 **8:00–10:00 am**

Room: Kirkland

Moderator: Robin Brumfield; Brumfield@Aesop.Rutgers.edu

8:00–8:15 am

Using Web Broadcasting (Webcasting) via Macromedia Breeze for Delivery of Master Gardener Training

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The Iowa Master Gardener program uses multiple methods for program delivery. Those include web broadcasting (webcasting) via Macromedia Breeze, face-to-face presentations where an instructor travels to individual sites, and a hands-on laboratory experience on the Iowa State Univ. campus. The objective of this study was to determine the most effective and efficient way to deliver Iowa Master Gardener training. Participants in the training were asked to complete a brief questionnaire to share their perceptions about the different delivery methods and suggestions for improvement. County coordinators were also asked to complete another questionnaire that focused on the involvement/responsibilities of the county office training. Of the different delivery methods used, webcasting has been an efficient and cost effective way to deliver horticultural information from the university to participants in remote sites. Webcasting has enabled more participants to take the Master Gardener training in Iowa because the programs can be viewed in the local county Extension Offices instead of interactive TV sites. Local coordinators have the power to control the hours and amenities of meeting rooms as well as familiarizing Master Gardeners with resources available in their county office.

8:15–8:30 am

Intranet: An Effective Strategy for Reducing the Administrative Load of Managing a Large Volunteer Program

Lucy Bradley*, Urban Horticulture, North Carolina State Univ., Raleigh, NC, Lucy_Bradley@ncsu.edu

With shrinking staff sizes there has been an increased reliance on a volunteer workforce to manage extension urban horticulture programs. The number of volunteers as well as their level of responsibility has increased. In order to effectively manage over 500 volunteer Master Gardeners in a county program, a password-protected intranet was created. This allowed individual volunteers to assume responsibility for much of the administrative work of the program. Each volunteer was responsible for entering and updating their volunteer education and service hours, their directory information, and their profile of preferences, availability, and resources. Volunteer leaders were able to sort the database by volunteer preference as well as past service in order to identify a hot list of potential volunteers for specific projects. Volunteer directors could post information directly to the web. Scheduling meetings, speakers, and ambassadors for tradeshows was all done on line, by volunteers who were able to see what slots were available and who was already signed up prior to making a commitment. This strategy freed agents, program coordinators and secretarial staff to focus on other demands, while engaging volunteers effectively in administering the program.

8:30–8:45 am

Trials of Low-cost Greenhouses for Use by Growers and Gardeners

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Small growers do not have the funds, space, or expertise for a traditional glass or plastic greenhouse. However they could use protected space in the spring or fall for growing transplants, hardening off transplants, quarantining plants and/or growing beneficial insects. In addition, there is interest from master gardeners, schools, and farmer's markets in using a small protected structure. Research on the use of these structures is lacking and the potential users are unlikely to gamble on an untested structure. We purchased five greenhouses ranging in price from $277 to $900 and investigated their ease of setup, operation and tear down. Data were also collected on seed germination, transplant production, winter houseplant survival and greenhouse conditions such as temperature and insect pressure. Three of the houses were setup in less than a day and can be transported to another location, while the other two took several days to construct, required modifications to complete the structure according to the direction and are non-transportable. Only one of the three portable houses had intact screened windows and/or doors after 9 months of use. The non-portable houses had less ventilation and subsequently higher daily maximum temperatures and higher insect populations. The minimum house temperatures were similar across the five houses tested. Flats sown with seed were placed on the floor or a bench in each house. Location of the flat did not affect germination in general; however noticeable differences in size and vigor were apparent in plants grown on the floor. Recommendations based on these results will be presented for use by extension personnel, master gardeners, growers, and schools.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

8:45–9:00 am

Detection of Pesticides in Runoff from Residential Sources

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Water quality impact by pesticides used in residential areas is an emerging concern. Runoff from residential landscapes is currently being collected and analyzed from four drainsheds in Sacramento and four in Orange County, CA. Each drainshed consists primarily of at least 100 single-family homes. With the assistance of the Master Gardener programs in both counties, weekly samples of dry weather runoff have been collected since July 2006 in Sacramento and Oct. 2006 in Orange County. In addition, grab samples were also taken during the first few storm events of the season. The water samples have been analyzed for a range of residential-use insecticides, specifically diazinon, chlorpyrifos, various pyrethroids (esfenvalerate, bifenthrin, fenpropathrin, lambda-cyhalothrin, permethrin, cyfluthrin, cypermethrin, and deltamethrin), and the increasingly more popular ant control insecticide, fipronil. The data so far clearly show that diazinon is still widely present in runoff. More significantly, several pyrethroids have been detected, and the detection is especially frequent for bifenthrin, permethrin, and cyfluthrin. Recently, observed sediment toxicities in urban streams was associated with pyrethroid residues in the sediment. Our findings are the first evidence suggesting that pesticides used in landscape maintenance and structural pest control could be the source for pyrethroid contamination in urban streams.

9:00–9:15 am

Improving Stream Health by Meeting Homeowners as Gardeners rather than Restoration Ecologists

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Beginning in 2002, we have taught a module we call "Streamside Gardening" designed for homeowners who have existing ornamental landscapes near streams. The audience is primarily urban/suburban; however, rural property owners with streams near their homes have also participated. The goal of these workshops is to meet homeowners at their current level of knowledge in order to move them along the spectrum from gardening only to stewardship of their streams. Workshops vary by client group from 3 hours for Master Gardener training to 6 or more hours for homeowner audiences; both include classroom and formal education and outdoor hands-on activities. Workshop activities acknowledge the learner's experience and knowledge, recognize the appeal of natural beauty, provide theoretical context for stream ecology and function, allow ample time for sharing, and include a field component. To determine if workshop goals were obtained, we used questionnaire surveys and other evaluative techniques. Analysis of questionnaires for the pilot studies showed significant levels of increase in learning and increased intentions to make improvements in their streamside landscapes. With the early successes in mind, we obtained funding from the Oregon Watershed Enhancement Board to continue development of teaching modules for Master Gardeners and the general public. We will share the revised modules and explain innovative hands-on methods we developed to help participants learn about landscaping and native plant placement near streams.

9:15–9:30 am

Consumer Preferences for Price, Color Harmony, and Information Level of Container Gardens

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Retail sales of container gardens have increased dramatically in the recent past and rose 8% from 2004 to 2005, to $1.295 billion. The objective of this study was to determine consumer preferences for three attributes of container gardens. A Web-based survey was conducted on 18 Oct. 2006 with 985 respondents. Survey participants invited from an independent garden center's customer e-mail list were asked to complete a series of questions on a seven-point Likert scale. Survey participants also answered questions about past experiences and future purchase intentions with container gardens, as well as demographics. A hierarchical set of levels were used to investigate three attributes of container gardens in a 3 × 3 × 3 factorial conjoint analysis including color harmony, price and information level provided with the purchase. The surveys were analyzed using conjoint analysis which accounted for 99.8% of the variance in container garden preference. Relative importance decreased from price (70.7%), to information level (22.9%), to color harmony (6.4%). Survey participants preferred a container garden with the complementary color harmony, extensive information, and $24.99. A significant portion (77.5%) of participants in this study indicated that they would be more likely to purchase a container garden if extensive information was included with the purchase and 84.8% of participants said they would be willing to visit a website that would provide more information on how to care for and maintain a container garden. Results of this study show that there is a potential to increase the value of a container garden through providing educational material with the purchase.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

9:30–9:45 am

Appeal of Specialty Vegetables to Consumers

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Consumers were surveyed in three different Illinois market venues (supermarket, on-farm, and farmers' market) to measure their familiarity and preferences for specialty vegetables. Crops considered specialty vegetables were defined as having ethnic, heirloom, organic or unusual/exotic associations. Regardless of market venue, most participants (>80%) had purchased specialty vegetables in the past. The visual appearance of the specialty vegetable was an important factor for consumer purchase decision. Red heirloom tomatoes and sweetpotatoes were consistently across the three market venues, the two specialty vegetable products that participants were most likely to have purchased (75% and 68% of participants over all markets, respectively). Other specialty vegetables that more than 50% of consumers surveyed would purchase included garlic, specialty lettuce, and mini or personal size seedless watermelon. Specialty vegetables that were the least attractive to consumers (<20% of consumers would purchase) included fingerling white potatoes, Chinese (Napa) cabbage, yellow heirloom tomatoes, Asian melons, Asian eggplant, leek, globe artichoke, and kohlrabi. Generally, consumers at the farmers' market were almost twice as likely to purchase specialty vegetables compared to the other two markets evaluated.

9:45–10:00

How Can Greenhouse Managers Deal with Rising Energy Costs?

Robin Brumfield*, Rutgers, The State Univ. of New Jersey, New Brunswick, NJ, brumfield@aesop.rutgers.edu

Energy costs have increased in the last few years. At a whopping increase

of 103% since 2003, gasoline has increased the most, but other types of energy have all gone up as well. In a mature with intense competition, this is a concern for many greenhouse operators. How big is the cost of energy? In a survey of 30 greenhouse businesses, I looked at total costs and found that energy costs averaged 8.5% of sales. This includes heating fuel, gas/diesel, electricity, and trucking costs. How can producers deal with high energy costs in their greenhouses? Since profit = price – cost, to increase profits, either cut costs or increase prices. The options include: reduce fuel costs, conserve energy, evaluate alternative or additional fuel sources or heating systems, change production practices, use space wisely, evaluate costs to look for places to cut, or increase prices. Selecting the final strategy may involve trade-offs among various objectives. One alternative may offer the greatest financial returns, but it may be inconsistent with other objectives. At this point, producers must decide which objectives are most important.

Specified source(s) of funding for the work presented in this abstract: Federal competitive

Oral Session 24: Teaching Methods

Wednesday, July 18 **10:15–12:00 pm**

Room: Lowell A/B

Moderator: Tim Smalley; tsmalley@uga.edu

10:15–10:30 am

Using Student Learning Outcomes in Course Design and Implementation

Candice Shoemaker*, Kansas State Univ., Manhattan, KS, cshoemak@ksu.edu

Student learning outcomes (SLOs), if written well, can guide an instructor in all aspects of a course from preparing lectures, to defining assignments, to writing exams. Additionally, SLOs can guide students as they participate in lectures and labs, do assigned readings, and study. Three to five SLOs were written for each of seven units for the "Principles of Horticultural Science" course, the foundation course for all horticulture majors. Specific strategies were implemented by the instructor to reinforce the SLOs throughout the semester. A pre- and post-assessment was given to the students enrolled in the course in the fall semesters of 2005 and 2006 to determine if the SLOs were being met. The assessment was a list of 50 statements reflective of the student learning outcomes. The students were asked to indicate how confident they were in being able to do the statement on the day of the test (5 = very confident to 1 = not confident at all). The pre-assessment was given on the first day of the semester (Fall 2006 n=91; Fall 2005 n=102) and the post-assessment was given on the second to the last day of the semester (Fall 2006 n=75; Fall 2005 n=85). The average pre-assessment scores showed the students did not feel confident in being able to do any of the 50 items. By post-assessment, students were approaching being very confident in being able to do six items and confident in being able to do 22 of the items. Questions about the SLOs were also included in the teacher evaluation survey given at the end of each semester. The process, results, and implications for course design will be presented.

10:30–10:45 am

Use of Gaming to Promote Student Learning in Greenhouse Operation and Management

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Employers want experienced graduates that are creative thinkers and confident decision makers. Students can hone these skills in the classroom through problem-based learning activities. Gaming activities can be used to present students scenarios in which problems are encountered and solutions created and applied. The objective of this research was to determine if a gaming activity could be used to improve creative thinking as well as written communication, problem solving and decision making skills. Students in "Greenhouse Operation and Management" (AGSCI 3360) participated in an activity where they were instructed to construct a greenhouse facility that could be used to grow a variety of floriculture crops. Designs were created in phases in which students selected greenhouse structures and benching, environmental control systems, and irrigation and fertilizer delivery systems. After the design phase, students participated in an activity in which they put their designs into practice. During 15 years of business simulation, students were confronted with various IPM and business management issues requiring investigation and employment of diagnostic, creative thinking and problem-solving strategies plus application of designed solutions. At the end of the exercise students were surveyed for their opinion as to the effectiveness of the gaming activity. While students expressed concern in the amount of time required for the activity and completing their journals, a majority of students indicated that the activity effectively introduced them to the aspects of operating a business and the use of investigative and problem solving techniques helped them to retain knowledge of management issues faced in the greenhouse industry.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

10:45–11:00 am

An Integrated, Simple, Effective Horticulture Assessment Model

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Assessment has become an essential activity within higher education. Development of an assessment program is often an evolving process as institutions and programs gain experience and test models over time. After almost 10 years of trialing different assessment models, the horticulture program at the Univ. of Wisconsin–River Falls has evolved into a model based on Barbara Walvoord's model. This model is integrated into other on-going curriculum management activities, is straight forward in its implementation and has produced documented outcomes. The model is based on identifying program goals, charting a curricular map against the goals, identifying direct and indirect assessment measurements for the goals and the evaluation and interpretation of the data collected which leads to identifying program strengths and weaknesses. The assessment process has been deemed to be successful as the information gained has been used to make positive changes to further strengthen the program and achieve the identified program goals. The components of the UWRF assessment program will be presented.

11:00–11:15 am

Using Global Positioning Technology to Reinforce Recognition and Retention in Horticultural Plant Materials Classes

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Horticultural plant materials classes, such as, for example, ORH 3513, "Environmental Plant Identification and Use," at the Univ. of Florida, require students to demonstrate their recognition of groups of commonly used landscape plants. While this recognition component can be taught using illustrations, many instructors and students prefer using actual plants in real landscape situations, both in on-campus and off-campus field trips. When plant materials classes utilize plants in actual landscape situations, itineraries must be developed by the instructor so that locating specific plants can be accomplished in a timely and efficient manner. Global positioning system (GPS) receivers have been used to develop, map and store itineraries for subsequent use by plant materials classes.

Each individual plant on the course study lists is assigned a waypoint number, and the latitude and longitude for each waypoint is stored in the GPS receiver. With positioning sensitivity errors of less than 20 feet, locating all plants on the itinerary is facilitated. These itineraries can be used by the instructor leading classes on field trips, and also by individual students and student groups, working independently, using GPS receivers to retrace field trip itineraries to review and study the plants in more detail. Field trip itineraries for several plant materials classes will be described and illustrated

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

11:15–11:30 am

Understanding the International Travel Views of Undergraduate Students Related to Horticultural Opportunities

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The Horticulture Department at Auburn Univ. works to provide a variety of international experiences for both students and faculty. In order to develop opportunities that will attract the most participation, we surveyed undergraduate students to determine their opinions, preferences, and limitations associated with academic based international travel. The survey consisted of 25 questions regarding country selection, type of program, length of stay, and other aspects of academic travel abroad. Question formats included ratings using a Likert scale, rankings in terms of importance, yes/no, and multiple choice. The student surveys were administered in Nov. 2006 to undergraduate classes offered by the Horticulture Department (n=491, 76% response rate). 66% of horticulture majors think international experience is somewhat or very important to their degree. Of students that had international travel experience, only 7% had traveled with their department while 40% of students said they were somewhat or very likely to participate. 71% said they would somewhat or very likely travel with their department if there were no barriers such as cost (83%) and language skills (58%). The desired locations for the international programs were Western Europe (62%), Eastern Europe (53%), and South America (51%). Students preferred study abroad programs to horticulture tours and felt that it should last 1–3 months. The average out-of-pocket costs that students felt would be reasonable for a semester-long trip was $6623. By understanding these needs and barriers, we can work to provide opportunities for students that will be both meaningful and feasible to promote their professional growth.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

11:30–11:45 am

Maximizing Learning and Mimizing Costs through Cooperative Study Abroad Garden Tours

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Many horticulture departments currently organize garden study abroad tours. Some departments develop a new itinerary every year, as they choose a new destination or involve different faculty every year. Other departments use the same itinerary every year. This presentation contrasts the faculty commitment and learning outcomes of students between tours that change faculty and itineraries every year vs. tours that visit the same destination every year. The authors propose an itinerary to maximize the learning and cultural immersion of students, minimize faculty input into the tour organization, and minimize costs for students. The expected learning outcomes and resources for each destination in the itinerary will be detailed. Pooling student from different universities in the same tour will reduce costs, facilitating traveling greater distances. Pooling students will also increase interaction between students from several universities.

11:45–12:00 am

Evaluation of the College Horticulture Internships at Longwood Gardens

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A comprehensive study of the college horticulture internships at Longwood Gardens was conducted in 2006. The perceptions and expectations of potential interns were gathered from university internship coordinating faculty and current Longwood Gardens interns. Factors leading to the acceptance of a Longwood Gardens internship were also studied and defined. The general standards for college horticulture internships in public gardens throughout the United States were researched, documented, and compared with the internships at Longwood Gardens. Data collected from the green industry about expectations for their employees were used to identify ideal internship training aspects for future employability. Data collection included the use of surveys, interviews, and focus groups, from which recommendations for internship improvements were developed for Longwood Gardens. The results indicated that an internship is a valuable stepping-stone for students targeting careers in horticulture. However, the data also revealed that Longwood needs to more clearly represent itself to college students and advisors, and provide future employers with relevant and valuable details regarding internship experiences. This research also indicated that Longwood staff and intern interactions, across the entire organization, are valuable for significant, professional skill development in an environment of excellent resources and opportunities. However, it was evident that each intern must take the initiative to utilize these available resources, and seek out ways to enhance their internship experiences. These and other findings from this study will not only benefit Longwood Gardens, but are equally useful for other public horticulture institutions, green industry members, and related stakeholders.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

Oral Session 25: Genetics and Germplasm 1

Wednesday, July 18 **10:15–12:00 pm**

Room: Powell A/B

Moderator: Fenny Dane; DANEFEN@auburn.edu

10:15–10:30 am

Evaluation of Horseradish Cultivars for *Meloidogyne incognita* Resistance

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Although root-knot nematodes (*Meloidogyne incognita*) are a minor problem of horseradish (*Armoracia rusticana* Gaertn., Mey., Scherb.) grown in Illinois, root size and quality are both severely reduced when this pathogen is present in the field. Furthermore, horseradish roots are often held in cold storage for up to 6 months and infected roots tend to become necrotic and break down under cold storage conditions. Eleven horseradish clones were evaluated for resistance to *M. incognita* in a greenhouse experiment repeated from 2003 to 2005. Most clones were highly susceptible to *M. incognita* including '1069', '125A', '15K', '772A', '1038', '1722', 'D25 E2', and 'Swiss' based on gall index (percent roots with galling) and gall severity ratings (numbers of galls per root system). Although no horseradish clone was totally immune to *M. incognita* infection, several had reduced gall index and severity ratings; clones '761A' and '1573' were moderately resistant, while

'German' was highly resistant. Based upon these studies, '1573' and 'German' would probably be the best cultivars to plant in *M. incognita* infested fields. The clone '761A' is low yielding and is maintained in the germplasm collection for its resistance to internal root discoloration and would not be suitable for commercial production.

10:30–10:45 am

'Chiquitita', a New Olive Cultivar for High-density Hedgerow Orchards

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Since the mid 1990s, new high-density hedgerow olive orchards fully mechanically harvested by over row straddle harvested machines are being planted in the world. 'Arbequina' is the standard variety used. Competition among trees for radiation and difficulties for orchard management are the main constrains of this system after 6–8 years of plantation. 'Chiquitita' (progeny UC-I 8-7 in the breeding records) is a new bred cultivar selected for this orchard system. The new cultivar was originated from a cross between 'Picual' and 'Arbequina', that are both high oil yielding cultivars from Andalusia and Catalonia, respectively. Initially UC-I 8-7 was selected in a seedling field by its earliness of bearing, high oil content, small size and compact and weeping habit of growth. It was included in a comparative trial planted in 2000 with other 14 genotypes all selected by earliness of bearing and high oil yield, including 'Picual', 'Arbequina', and 'Frantoio' as controls. 'Chiquitita' showed lower vigor (canopy volume) than 'Arbequina' at the end of the sixth year of planting and its oil content and accumulated yield efficiency did not differ significantly from 'Arbequina'. Data on pomological description, SSRs markers identifying profile, oil content and composition and sensorial profile by the IOOC panel test method are presented. We propose 'Chiquitita' as a complementary cultivar for this new orchard system that will ensure easier management than 'Arbequina' for a longer period.

10:45–11:00 am

Exploring North and South Carolina in Search of Collard Landraces

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The coastal plain region of North and South Carolina is the United States center of genetic diversity for the non-heading, leafy green type of *Brassica oleracea* L. known as collard (*B. oleracea* Acephala Group). Predominantly a fall and winter crop in this region, collard is often the only green planting to be found in the yard or garden of a rural home during these cool seasons. Historically, the traditional collard patch and even commercial fields were planted with unique varieties perpetuated by individual seed savers, and collectively, the regional diversity for this crop was probably very significant for well over a century. Genetic erosion of this collard germplasm pool has been severe in recent decades as commercial hybrids have been adopted by both large-scale producers and home gardeners. Although a significant number of collard landraces are still being perpetuated, the existing diversity among landraces still grown in the region is now in the hands of an aging population of seed savers. From 2003 to 2006, we explored the coastal plain region of North and South Carolina in search of collard gardens containing traditional landraces. The exploration trips were conducted mid—winter to early spring. When a plot was found, the owner was sought out, information about the variety being grown was recorded, and when it was clear the variety was not obtained from commercial sources, seed was requested. About 90 samples of collard were obtained from seed savers during the course of this domestic exploration. Observations of morphological differences made in grow-outs of these landraces indicate that significant diversity exists in this group now being deposited into the U.S. plant introduction collection of vegetable *Brassicas*. This preserved collection could prove to be an important source of genes for *B. oleracea* improvement.

11:15–11:15 am

Genetic Diversity of the *Malus sieversii* collection in the USDA–ARS National Plant Germplasm System

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Plant explorers have gathered seeds from wild *Malus sieversii* trees in Kazakhstan, which are believed to be one of the major progenitor species of the dessert apple, *Malus ×domestica*. Large field and seed collections from these explorations are maintained at the Plant Genetic Resources Unit (PGRU) in Geneva, NY, as part of the USDA National Plant Germplasm System. Seven highly diverse microsatellite markers were selected to assess the genetic relationships among the trees in the field collections that represent the populations and the collection sites. Resulting population graph networks demonstrate that there is a significant among-site differentiation and that the collection is highly diverse. In addition, we developed core collections that considered molecular and quantitative traits to maximize the diversity of the entire collection within the smallest possible subset. These core collections serve as representative panels of the 949 individuals in the PGRU *M. sieversii* field collection. Breeders and researchers are using these more manageable core collections to screen for desirable new alleles for disease or environmental stress resistance.

Specified source(s) of funding for the work presented in this abstract: Federal competitive

11:15–11:30 am

Evolutionary History of the American *Castanea* Species

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Species in the genus *Castanea* were once widely distributed in the Appalachian forest system before the introduction of chestnut blight at the beginning of the 20th century. This disease reduced the American chestnut (*C. dentata*) to an understory shrub and severely affected the Ozark and Allegheny chinkapins (*C. pumila* var. *ozarkensis* and var. *pumila*). Chloroplast DNA sequence data from five different regions were used to study the biogeographic relationships among American *Castanea* species. High levels of cpDNA diversity detected within *C. pumila* suggest that the species was little effected by glacial cycles, while fragmentation and range expansion, likely by long distance dispersal after the last glacial period have been important factors in the history of the American chestnut. Using sequence analysis of several nuclear regions indicated that *C. pumila* samples can be distinguished from *C. dentata*, but clear discernable intraspecific phylogenetic patterns cannot yet be deduced

Specified source(s) of funding for the work presented in this abstract: Private (Association, Foundation, Industry)

11:30–11:45 am

Screening the Watermelon Germplasm Collection for Resistance to Powdery Mildew Race 2

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Powdery mildew is a new disease of watermelon [*Citrullus lanatus* (Thunb.) Matsum. & Nakai] that is caused by *Podosphaera xanthii*. It causes a loss in yield of about 20%. The disease can be controlled with fungicides, however, it would be more economical and environmentally safe for growers if genetic resistance could be incorporated into commercial cultivars. *P. xanthii* on melon has been classified into seven or more races, and race 2 appears to be causing damage to watermelons in the southeastern United States. Genetic resistance to powdery mildew has been identified in melon lines and has been introgressed into commercial varieties. The objective of this study was to screen the watermelon germplasm collection of 1654 accessions and cultivars for resistance to powdery mildew race 2. The experiment was a randomized complete-block design with eight replications. Each block was planted in the greenhouse with one plant per plot and were inoculated with a spore suspension of 4 × 104 conidia/mL at the first true leaf stage. Plants were rated for disease severity and disease incidence by using a 0 to 9 scale where 0=no disease and 9=plant dead. Accessions that were missing from some replications in the screening study were tested further to provide more complete data. The 65 most resistant and 25 most susceptible lines were retested in both greenhouse and field. Data were analyzed using analysis of variance, with means compared using LSD. Accessions for further research were chosen based on a minimum mean rating for disease severity, low variability over replications, and few missing data. The most resistant accessions were PI 386015, PI 189225, PI 346082, PI 482273, PI 482277, PI 582081, PI 270545 and PI 560020. The most susceptible accessions were PI 172796 and PI 269677.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

11:45 am–12:00 pm

The Inheritance of Resistance to Race 1 Isolates of *Verticillium dahliae* in Lettuce

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Verticillium wilt of lettuce caused by *Verticillium dahliae* is a highly destructive disease of lettuce (*Lactuca sativa*). Resistance to race 1 isolates of *V. dahliae* is available in the cultivar La Brillante. Greenhouse experiments were conducted with F_1, F_2, and F_6 recombinant inbred line (RIL) populations from crosses between 'La Brillante' and susceptible cultivars to determine the inheritance of resistance. Seedlings were germinated in plug trays, and the soil was saturated 2, 3, and 4 weeks after planting with a 3-mL suspension of 2×10^6 conidia/ml of isolate VdLs16. Seedlings were subsequently transplanted to individual pots and rated for wilt symptoms at maturity. The disease incidence (DI) was determined as the percentage of symptomatic plants, and segregation of resistant (non-symptomatic, NS) to susceptible (symptomatic, S) progeny were analyzed with chi-square. F_1 progeny from 'La Brillante' × 'Salinas 88' had 0% DI, while *Ms7* – 'Salinas' × 'La Brillante' had 17% DI. 'Salinas 88' and *Ms7* – 'Salinas' had 92% and 75% DI respectively; 'La Brillante' had 0% DI. F_2 progeny from 'Salinas 88' × 'La Brillante' segregated 190 NS:77 S, and fit a 3 resistant:1 susceptible model for a single dominant gene (χ^2 2.1; $P = 0.15$). F_2 'Tiber' × 'La Brillante' progeny segregated 193 NS:95 S ($\chi^2 = 2.1$; $P = 0.002$). Evaluation of RILs identified 42 NS lines and 53 S lines, and fit a 1 resistant:1 susceptible model for a single segregating gene ($\chi^2 = 1.3$; $P = 0.26$). These data indicate that 'La Brillante' carries a single dominant gene for resistance to race 1 isolates of *V. dahliae*.

Specified source(s) of funding for the work presented in this abstract: Private (Association, Foundation, Industry)

Oral Session 26: Viticulture and Small Fruits 2

Wednesday, July 18 **10:15–12:00 pm**

Room: Rainmakers Ballroom B

Moderator: Kevin Kosola; kkosola@wisc.edu

10:15–10:30 am

Nitrate Use by Cranberry—88 Years of Conflicting Data Resolved?

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The literature on cranberry (*Vaccinium macrocarpon*) response to nitrate contains contradictory evidence. The four studies published between 1919 and 1971 were carried out with ericoid mycorrhizal (ERM) cranberries, and found increased cranberry growth in nitrate-fertilized plants compared to controls. The two experiments carried out since 1971 with nonmycorrhizal rooted cuttings found that ammonium was essential for good cranberry growth. We found that cranberry nitrate influx capacity was profoundly different in the presence and absence of ERM. Rooted cuttings of grown in hydroponics without ERM inoculum had very low capacity to take up nitrate, and apparently were lacking a high affinity nitrate transport system. Inoculation with the ERM fungus *Rhizoscyphus ericae* increased nitrate influx approximately 8-fold, with saturable influx kinetics. We found additional evidence for the ability of mycorrhizal cranberry to utilize nitrate during analysis of cranberry leaf natural abundance ^{15}N from a cranberry farm utilizing nitrate-contaminated irrigation water. The irrigation water N had an elevated ^{15}N (^{15}N about 5); where there were leaks in the irrigation pipe, cranberry growth was greatest, yield was lowest, and cranberry leaf ^{15}N was highest. Given the ubiquitous presence of ERM colonization in cultivated and wild cranberry, these data suggest that mycorrhizal colonization acts to increase capacity for nitrate utilization in these agroecosystems. The contradictions in the literature on cranberry nitrate utilization appear to be due to differences in mycorrhizal status of the experimental plants.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

10:30–10:45 am

Determining the Correct Phosphorus Rate for Productive Cranberries

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Cranberries (*Vaccinium marcrocarpon* Ait.) are grown in wetland settings. Environmental concerns have led to a need for nutrient management planning by cranberry farmers. In particular, phosphorus (P) has been identified as a potential environmental pollutant in cranberry

systems discharging to inland water bodies. Cranberry is an acidophilic plant, routinely grown in soils of pH 4.0–5.5. In consequence, P is often immobilized in the soil. This has led to difficulties in interpreting standard soil tests, particularly for P. In addition, as cranberry is a perennial crop, nutrient carry-over must be taken into account when planning nutrient management. If cranberry P management were based on soil tests, as is the common practice for other crops, most growers would receive a recommendation to use no P fertilizer. However, previous research has shown that cranberry production increases with the addition of P fertilizer, even when soil test values are high. As a result, field research was initiated in WI and MA to further examine P rate requirements and soil test methodologies. While nitrogen and potassium applications were held constant, P rates varied from 0 to 34 kg P/ha. After up to 6 years of treatment, there was no significant effect of fertilizer rate on yield. While tissue P levels were lowest in the unfertilized plots, all treatments showed P tissue values above the 0.1% (dry weight) critical level, which may account for the lack of yield effects. Peat-based cranberry beds appear to be more buffered against change in tissue P with change in practice when compared to sand-based beds. Based on this and previous research, the current recommendation is to limit P applications to no more than 22 kg P/ha per season, particularly for peat-based plantings.

Specified source(s) of funding for the work presented in this abstract: Private (Association, Foundation, Industry)

10:45–11:00 am

Using Anion Exchange Membranes to Monitor Soil-available Phosphorus for Cranberries

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Phosphorus is usually the primary limitation to algal growth in fresh water bodies. Cranberry production is intimately linked to surface waters and phosphorus is routinely applied to cranberry beds. Our objective is to minimize phosphorus movement from cranberry beds to associated surface waters. As part of a project studying phosphorus dynamics in cranberry systems, we examined the suitability of anion exchange membranes (AEM) for estimating plant available phosphorus in cranberry soils. Because cranberry soils are low pH and have high iron and aluminum concentrations traditional chemical soil tests do not accurately reflect plant available phosphorus. A time course in sand and peat soils showed a biphasic response with exchangeable phosphorus on AEM dropping by half after 7 days compared to initial values. Soil pH had no effect except in relation to availability of soil solution aluminum and iron ions as a function of pH. AEM showed a linear response to phosphorus concentration. In 2004 and 2005 at weekly intervals we placed AEM in plots in a commercial cranberry bed fertilized with 0 to 33.7 kg P per hectare. Exchangeable phosphorus was always proportional to rate of fertilizer. The week following fertilizer application exchangeable phosphorus tripled, but was back to ambient levels by 2 weeks. AEM appear to reflect plant available phosphorus in cranberry soils and may prove a suitable replacement for chemical soil testing.

Specified source(s) of funding for the work presented in this abstract: Private (Association, Foundation, Industry)

11:00–11:15 am

Evaluation of Two Organic Fertilizer Blends for Highbush Blueberry Production in Oregon

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The effects of two organic fertilizer blends on the growth and production of three highbush blueberry (*Vaccinium corymbosum* L.) cultivars ('Bluecrop', 'Duke', and 'Elliott') were evaluated over two growing seasons. The two organic fertilizer blends were a mix of commercial fish waste products and a mix of protein-based products. Organic fertilizers were applied in late spring 2005. The nitrogen rate applied was 100 lb/acre and 150 lb/acre in 2005 and 2006, respectively. No interactions between organic fertilizer treatment and cultivar were observed on any of the plant-related parameters measured during the growing season. Differences in plant growth and yield were all cultivar effects. The growth of 'Elliott' and 'Bluecrop' responded similarly to the fertilizer treatments, while 'Duke' showed visual symptoms of nitrogen stress both years. Foliar nitrogen analysis in all three cultivars indicated nitrogen was deficient at the nitrogen rate applied. Berry firmness and Brix was not affected by fertilizer treatments. Soil pH was decreased more by the fish waste-based fertilizer than by the protein-based fertilizer at some sampling dates.

Specified source(s) of funding for the work presented in this abstract: Private (Association, Foundation, Industry)

11:15–11:30 am

A Century of Strawberry Breeding in the Northeastern United States

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The commercial strawberry industry in the United States dates back to the late 1800s and has since become a multibillion dollar industry. At the heart of the industry's success has been the development of cultivars adapted to specific regions and production systems. Despite the vast number of available cultivars developed over the last 100 years, the genetic diversity is quite narrow. A physiological evaluation of cultivars developed over the last century can be a useful tool to inform breeders about potential limitations in the germplasm and possible breeding strategies for the next century. For this study, 20 cultivars (*F.* ×*ananassa*), released over the last century in the northeastern US, two *F. chiloensis*, and two *F. virginiana* genotypes were obtained from the National Germplasm Repository and commercial nurseries. Runners were collected and planst established and grown for 6 months in the greenhouse. Plants were deflowered and derunnered while in the greenhouse. After cold acclimating the plants, they were cold stored for 6 weeks to allow for dormancy requirements to be met and then moved to the field. In the field trial, plants were evaluated for canopy and leaf architecture, photosynthesis and yield. Analysis of the changes that have occurred will allow discussion about possible limitation and opportunities to increasing the productivity of the strawberry.

11:30–11:45 am

Variation and Inheritance of Vegetative and Reproductive Traits in Black Raspberry (*Rubus occidentalis* L.)

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Chad Finn, USDA–ARS (HCRL), Corvallis, OR, finnc@hort.oregonstate.edu

In recent years, there has been renewed interest in black raspberry (*Rubus occidentalis* L.) breeding. This has been spurred by an increase in black raspberry consumption due to studies that have shown them to be particularly high in anthocyanin content indicating high levels of antioxidants. Present cultivars are ill adapted to the biotic and abiotic stresses of the Pacific Northwest where the commercial black raspberry industry is centered, and fields must be replanted after 3–5 seasons. An incomplete, partial diallel consisting of 10 parents and

26 sibling families was constructed for the study of variation and inheritance of vegetative and reproductive traits in black raspberry. Sibling families of one to eight plants were planted at the Oregon State Univ. Lewis Brown Farm in Corvallis, and were arranged as a randomized complete-block design with four blocks. Phenological development and vegetative measurements were recorded for each plant in 2005 and 2006. In addition, 25 berry samples of ripe fruit were collected from each plant, and pooled within replications by family, to study variation in fruit chemistry properties including pH, titratable acids, soluble solids, anthocyanin profiles, and total anthocyanins. Although there were many striking similarities, strong trends in phenotype based on pedigree were observed for most traits indicating a strong genetic component. Estimates of heritability as well as General Combining Ability (GCA) and Specific Combining Ability (SCA) will be presented.

Specified source(s) of funding for the work presented in this abstract: Federal competitive

11:45 am–12:00 pm

Chlorine Dioxide to Control Postharvest Decay and Extend Shelf Life of Berries

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Fungal pathogens cause considerable loss and shorten the shelf-life of strawberries, raspberries and blueberries. Chlorine dioxide (ClO_2) gas is an effective sanitizer that can reduce bacterial, yeast, and fungal populations on produce. We studied whether ClO_2 can reduce postharvest decay and prolonging storage of blueberries, raspberries, and strawberries. A convenient system that generates gas by mixing two dry reactants (ICA TriNova, LLC Forest Park, GA) was used. Known weights of fresh berries and reactants were placed in 20-L plastic buckets equipped with small mixing fans. Fruit were removed after 12–14 hours and evaluated for rot incidence and ClO_2 injury (pigment loss). Levels of gas high enough to reduce decay in naturally infected berries generally caused unacceptable levels of damage. However, ClO_2 reduced rot in blueberries that were inoculated with spore suspensions of *Colletotrichum acutatum* (anthracnose) and then held at 18 °C for 24 hours before gas treatment, suggesting that ClO_2 may reduce infections resulting from postharvest exposure to inoculum.

Oral Session 27: Ornamentals/Landscape and Turf 2

Wednesday, July 18 **11:00–12:00 pm**

Room: Kirkland

Moderator: Garry V. McDonald; g-mcdonald@tamu.edu

11:00–11:15 am

Ozone Efficacy of *Phytophthora capsici* in Recirculated Irrigation Water

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An isolate of *Phytophthora capsici* Leonian was cultured to induce sporulation. Spore dilutions of 1×10^5 μL^{-1} were placed in aliquots of reverse osmosis water and bubbled with ozone gas to peak concentrations of 0, 0.5, 1.0, or 1.5 $mg \cdot L^{-1}$. Ozonated samples were plated and observed for colony forming units (CFU). Increasing ozone concentrations reduced the number of CFU with no CFU formation at 1.5 $mg \cdot L^{-1}$ O_3. Turbidity effects on ozone efficacy were tested using bentonite clay at 0, 0.5, 1.0, 1.5, and 2.0 nephelometric turbidity units (NTU) and ozone concentrations of 0, 0.5, 1.0, or 1.5 $mg \cdot L^{-1}$. Increasing bentonite did not effect efficacy of increasing ozone concentrations on reducing CFU to 0 at 1.5 $mg \cdot L^{-1}$ O_3. A bioassay testing *Phytophthora* virulence on *Capsicum annuum* L. seedlings confirmed pathogenicity during repeated culture. Reverse osmosis water containing a soluble complete fertilizer at 0, 50, and 300 $mg \cdot L^{-1}$ N was ozonated to concentrations of 0, 0.5, 1.0, and 1.5 $mg \cdot L^{-1}$and used to irrigate *Chrysanthemum* ×*morifolium* Ramat. Increasing ozone concentrations did not interact with increasing fertilizer levels to affect final growth parameters. Additional fertilizer solutions were ozonated to peak ozone concentrations of 0, 0.5, 1.0, and 1.5 $mg \cdot L^{-1}$ and analyzed for nutrient content. Increasing ozone levels did not interact with fertilizers to affect nitrogen, phosphorus, or potassium. Increasing ozone interacted with the iron content at a high fertilizer concentration reducing the total iron content to 0 at 1.5 $mg \cdot L^{-1}$ O_3.

11:15–11:30 am

Developing a Knowledge Center for Water and Nutrient Management for the Nursery and Greenhouse Industry

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Research and extension specialists from six eastern states are developing a web-based Knowledge Center for water and nutrient management and conservation, for the nursery and greenhouse industries. We are taking an extensive approach to provide information on best management practices, integrating diverse disciplines such as engineering, technology, regulatory and environmental planning, together with the more traditional issues of cultural management. This Knowledge Center will provide on-line access to more than 25 learning modules covering topics on substrate, irrigation and surface water management and nutrient and pathogen management. Modules also include information on irrigation system audits, nutrient management planning, site layout and water control structures, to provide industry professionals and students with a comprehensive information and learning resource. As information developers, we are using this knowledge base to identify gaps in our research programs that will feed back directly into our extension programs for growers. One example of our current group research interest is in coupling sensing substrates and aerial environmental data for more precise irrigation scheduling, by using robust wireless network capabilities. Another example is integrating surface water management issues, to provide growers with better information on seasonal and spatial pathogen dynamics in containment ponds, which is a major concern for those operations that recycle irrigation water. Our presentation will illustrate how we are structuring and developing this project, with examples of the educational modules and tools that will become a part of the Knowledge Center.

Specified source(s) of funding for the work presented in this abstract: Federal competitive

11:30–11:45 am

Ecophysiological Performance of Three Novel Woody Species under Water Stress: *Calycanthus occidentalis*, *Fraxinus anomala*, and *Pinckneya pubens*

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Frequent episodes of water stress in managed landscapes has led the nursery industry to look for attractive woody species that perform well under extreme conditions of drought and flooding. We chose to evaluate three taxa that grow wild in confined areas of the United States, (north-central California), *Fraxinus anomala* (northeastern Utah), and *Pinckneya pubens* (northeastern Florida), each of which may merit further use under cultivated conditions beyond their respective ranges. While widespread cultivation of each taxon may not be possible due to limitations related to cold hardiness, we hypothesized that each species can tolerate extremes in soil moisture availability more so than their native habitats imply. Our objective was to characterize, under greenhouse conditions, how soil water affects gas exchange of potted plants of each species. Conditions ranged from complete submersion to severe drought. Complete submersion killed plants of *C. occidentalis* and *F. anomala*. While partially flooded *C. occidentalis* photosynthesized similarly to that of control-treated plants, plants under drought and severe-drought conditions fixed carbon at low levels. Mean photosynthetic levels of severe-drought-, drought-, and control-treated *F. anomala* were similar. While severe-drought-treated plants of *P. pubens* had low levels of photosynthesis compared to that of control-treated plants, there were no differences between that of control-treated plants and those in the drought, partially flooded, and complete-submersion treatments. We conclude that while use of *F. anomala* and *P. pubens* in landscapes is warranted if invasiveness and other potential problems are not identified, *C. occidentalis* appears to not be suitable for cultivation beyond moist conditions.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

11:45 am–12:00 pm

Growth and Nutrient Partitioning of Containerized *Malus trilobata* Schneid. and *Acer syriacum* Boiss. and Gaill. under Two Fertigation Regimes

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This study was conducted to determine if *Malus trilobata* (Schneid.)and *Acer syriacum* (Boiss. and Gaill.), two native Lebanese trees, were amenable to container production. Therefore, these species' growth, N, P, K uptake efficiency and distribution under two fertilizer rates were studied. *Malus trilobata* seedlings were obtained from seeds colleted from two mother trees, while *Acer syriacum* seeds were collected from a single tree. Two-year-old seedlings raised from these seeds were planted in 11-L containers in a 3:1 pine bark:compost substrate. Half of the seedlings within each source and species were assigned to either 25 or 100 mg N L^{-1} from 21N–3.1P–5.9K water soluble fertilizer treatments. Growth, mineral nutrient uptake or nutrient use efficiency of *Acer syriacum* seedlings were not affected by fertilizer rate. Seedlings of both *Malus trilobata* sources grown under 25 mg N L^{-1} were taller than those grown at 100 mg N L^{-1}. Nitrogen loading occurred in plants of *Malus trilobata* under the high fertilizer rate, although total plant N, P, and K content was not affected by fertilizer rate, as larger seedlings had lower nutrient concentrations. There were significant differences in growth among the two *Malus trilobata* seed sources, but there were no differences in mineral nutrient uptake or nutrient use efficiency. *Malus trilobata* and *Acer syriacum* seedlings are amenable to container production. Using container production for these species with subsequent transplanting into managed landscapes appears to be a viable ex-situ conservation method; it also represents an additional genetic conservation method and a method for reducing dependence on exotic taxa for landscaping use.

Oral Session 28: Commercial Horticulture (High Tunnels)

Wednesday, July 18 **11:15–12:00 pm**

Room: Rainmakers Ballroom C

Moderator: Carol Miles; milesc@wsu.edu

11:15–11:30 am

Soil Quality in High Tunnels: Producer Perception and Reality in the Central Great Plains

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Eighty producers using high tunnels in Kansas, Missouri, Nebraska, and Iowa completed a written survey asking for information on their production practices and perceptions related to soil quality in high tunnels. The age of high tunnels owned by the producers surveyed ranged from new to 17 years on location. Compilation of survey responses gave information about crop production practices and producer perceptions of soil quality changes over time. Sixty farms with high tunnels at least two years old were visited and soil samples collected in high tunnels and adjacent fields. Soil was also sampled from4-year-old replicated high tunnel and adjacent field plots at the Kansas State Univ. Horticulture Research and Extension Center, Olathe. Indicators of soil quality were analyzed to determine if soil quality alters under the high tunnel over time. Surface salt accumulation was perceived as a problem by some producers. This was investigated and it was shown that though influenced by the high tunnel microclimate, most producers manage salts so that surface accumulation need not be a hindrance to production in high tunnels. Soil structure stability was generally not altered in high tunnels over time. Organic matter size fractions may alter over time under high tunnels. This information may be useful to producers and horticulture extension personnel making management decisions for crop production in high tunnels.

11:30–11:45 am

Alternatives to Plastic Mulch in Vegetable Production Systems

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Plastic mulch is a standard practice used by farmers to control weeds, conserve moisture, and shorten time to harvest. An effective, affordable, degradable alternative to plastic mulch would contribute the same production benefits and in addition would reduce non-recyclable waste. Ideally, farmers would like to plow down the mulch at the end of the season, thereby eliminating removal as well as disposal costs. At Washington State Univ. we conducted a field study in 2005 and 2006 to evaluate degradable plastic (Envirocare, TDPATM), paper and cornstarch mulches as alternatives to plastic mulch. Field trials included four different vegetable crops (lettuce, broccoli, bell pepper, and icebox watermelon), each with a different time to maturity and optimum temperature regime. Results show that both Envirocare mulches were as durable as black plastic; quality of these products declined only slightly over the course of the growing season. In 2005, paper and cornstarch mulches were significantly less durable than black plastic. In 2006, one paper mulch (LF5) was almost as durable as black plastic and a second paper mulch (Planters Paper) was significantly more durable than in 2005. Mulch products significantly affected vegetable crop yields each year. In 2005, yields in all paper plots were significantly lower due to the general degradation of these

mulch products and the subsequent weed growth in those plots. Yield of lettuce was least impacted by mulch product due to its short time to harvest, and paper or cornstarch products may be most suitable for similar short season crops.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

11:45–12:00 am

Strategies for Germinating Lettuce with Drip Irrigation

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The acreage of lettuce under drip irrigation in the Salinas Valley has rapidly expanded during the past 10 years but overhead sprinklers are primarily used for stand establishment. Although some growers are using drip irrigation to germinate lettuce, emergence rates can be low at some locations within a field if moisture does not adequately move from the drip tape to the seed line. We evaluated strategies to increase the lateral movement of moisture and germination under drip irrigation, including optimizing the depth of the drip tape, spacing of emitters, discharge rate of emitters, compacting bed tops through rolling, and adding polyacrylamide polymer to the irrigation water. We also compared water use, nitrate leaching, and germination between sprinkler and drip-germinated lettuce in commercial fields. Results of a replicated trial on a Chualar loam soil demonstrated that gravimetric moisture in the seedline was highest when the drip tape was buried shallowly, bed tops were compacted by rolling, and the discharge rate of the tape was low. However, only depth of tape significantly affected gravimetric moisture in the seedline during subsequent irrigations and there were no significant differences in germination among the practices evaluated. The injection of polyacrylamide into the drip system did not significantly improve the lateral movement of moisture or increase germination. An additional trial comparing drip with sprinkler germinated lettuce showed higher germination under both buried and surface drip compared to sprinklers using similar amount of applied water (8 cm). In commercial fields, water-use for germination ranged from 4 to 21-cm for drip irrigation and 11 to 18-cm for overhead sprinklers. Nitrate leaching losses were comparable among sprinkler and drip germinated fields. Also, germination rates were not consistently different between drip and sprinkler irrigated fields.

Specified source(s) of funding for the work presented in this abstract: Private (Association, Foundation, Industry)

Oral Session 29: Ornamental Plant Breeding

Wednesday, July 18 **3:30–5:00 pm**

Room: Rainmakers Ballroom C

Moderator: Cynthia McKenney; Cynthia.McKenney@ttu.edu

3:30–3:45 pm

‘Blue Myth’, a Novel New *Trichostema*

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The genus *Trichostema* (L.), in the family Lamiaceae, consists of 16 species. The genus, found throughout North America, is divided into four sections containing both annuals and perennials. Natural hybrids have been reported, where geographical distributions overlap; however, this is the first report of an artificial cross between two species in the genus *Trichostema*. A controlled cross between *Trichostema lanatum* Benth. in section *Chromocephalum* F.H. Lewis and *Trichostema arizonicum* A. Gray in section *Paniculatum* F.H. Lewis produced a selection named ‘Blue Myth’. For the hybrid, plant organ sizes were typically intermediate between the parents; however, the stamen, lip, and growth habit resembled *T. arizonicum*, and the pistil and petals resembled *T. lanatum*. In the greenhouse, this hybrid produced no seed for two consecutive summers despite attempts to self and sib-cross the hybrid. Microscopic examination of the pollen revealed that the pollen on the hybrid was roughly half the size of the pollen seen in either parent and had a flaccid appearance likely contributing to the sterility. Propagation of this hybrid was successful using both softwood cuttings and plant tissue culture. This hybrid has the benefits of not setting seed, propagating easily, flowering for a long period of time, and remaining compact. It has survived outdoors for a single winter in Fayetteville, AR (USDA Zone 6b/7a).

3:45–4:00 pm

‘Raider Azure’ Mealy Blue Sage, a New Salvia for Semiarid Landscapes

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Salvia farinacea Benth. is commonly known as mealy sage, mealy blue sage or mealy-cup sage due to its felty calyces. This Texas native is common to rocky outcroppings and limestone prairies in Texas, New Mexico and northeastern Mexico. It has violet-blue flowers displayed on multiple spikes and white farinose pubescent leaves and stems, resulting in the specific epithet. Mealy sage is one of the more frequent native plants to be utilized in the urban landscape due to its long floral display. This native is often found in low maintenance gardens or in areas where resistance to damage from deer and rabbits is important. ‘Raider Azure’ was selected from an open pollination breeding program of nine accessions of *Salvia farinacea* collected throughout Texas. Criteria for selection included large, intensely-colored flower spikes, upright growth habit, limited late season lodging and a prolonged blooming period. ‘Raider Azure’ grows about 45 cm in height and has a more upright character than the commercial unnamed cultivar from Wildseed Farms, the nation’s largest wildflower farm. The flower spikes of ‘Raider Azure’ average 28 cm in length while the commercial comparison average 17 cm. This 40% increase in spike length on the same size plants provides a dramatic color impact. Over time, it will develop a woodier stem providing it a perennial nature superior to many of the hybrid *Salvias* currently on the market. In addition, these sturdy stems allow ‘Raider Azure’ to have significantly less late season lodging than the commercial comparison.

4:00–4:15 pm

Breeding Intra- and Interspecific *Cornus* Species

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Flowering dogwood (*Cornus florida* L.) and kousa dogwood (*C. kousa* Hance.) are popular species of dogwood used in the ornamental

industry. Both trees are valued for their beautiful floral display and their four season appeal. Dogwood anthracnose and powdery mildew have severely impacted the popularity of flowering dogwood. Many cultivars of the kousa dogwood have natural resistance both diseases. Intra- and inter-specific cultivars allow the combination of disease resistance with specific ornamental traits. Development of improved cultivars requires controlled crosses that are usually made manually, has high time requirements and is often unsuccessful. The inflorescence of flowering and kousa dogwood consists of 20–30 flowers that are self-incompatible. This self-incompatibility allows the breeding process to proceed without having to emasculate flowers. We have coupled the self-incompatibility of dogwood with the natural ability of honey bees to perform controlled pollinations of flowering and kousa dogwood. By using a feeding pheromone and sugar solution to attract honey bees to the flowers, a non-traditional breeding approach is being used to create intra- and inter-specific hybrids that have resistance to both disease as well as horticultural traits. Self- and cross-pollinations of *C. florida* cultivars Appalachian Spring and Cherokee Brave and *C. kousa* cultivars Blue Shadow and Galilean were conducted in Spring 2006. All inflorescences (n=526) self-pollinated produced no seed. For intra- and inter-specific crosses, 1041 inflorescences were pollinated, resulting in the production 406 seeds and 154 seedlings.

4:15–4:30 pm

Resistance to Western Flower Thrips Feeding Damage in Commercially Available Impatiens Cultivars

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Western flower thrips (WFT), *Frankliniella occidentalis* (Pergande), is a pest of greenhouse grown floriculture crops worldwide. Eighteen commercial cultivars and five unnamed breeding lines of impatiens, *Impatiens wallerana* Hook. f., were evaluated to determine if resistance to feeding by WFT varied. Ten insect-free plants of each genotype were exposed to more than 3000 laboratory-reared WFT. Thrips were allowed to choose and feed on individual plants for 3 weeks followed by visual evaluations to estimate feeding damage. Feeding damage varied among cultivars. Six genotypes had feeding damage levels similar to the susceptible control, '01-IL-0179', while 16 entries were significantly more resistant than the susceptible control. Of the 16 genotypes with some level of resistance, six genotypes, 'Dazzler White', 'Cajun Carmine', 'Cajun Deep Pink', 'Cajun Lavender Blue', 'Super Elfin Scarlet', and '04-IL-1408', were commercially acceptable having mean visual ratings below 4.0 on a 1 to 9 evaluation scale. These genotypes have the potential for improving impatiens resistance to WFT through breeding and selection. The development of breeding lines with improved levels of resistance and commercially acceptable traits for hybridization is ongoing.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

4:30–4:45 pm

Induction of Tetraploidy in Japanese Barberry (*Berberis thunbergii* DC.) Seedlings through Exposure to Colchicine and Oryzalin

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Japanese barberry (*Berberis thunbergii* DC.) is an invasive shrub widely naturalized across the United States whose numerous cultivars remain an important horticultural commodity. Maintaining this crop for the future necessitates the development of sterile clones. Exposure to the mitotic inhibitors colchicine and oryzalin is a traditional method for inducing tetraploidy in breeding lines as a precursor to raising sterile genotypes. Our trials utilized pre-stratified seeds collected from a group of *B. thunbergii* var. *atropurpurea* known to produce high rates of ornamental purple progeny. Forty-two seeds per treatment were immersed in aqueous solutions of colchicine (0%, 0.02%, 0.05%, 0.1% and 0.2%) and oryzalin dissolved in DMSO (0%, 0.002%, 0.005%, 0.01%, 0.02%) for 6-, 12- and 24-hour durations. Upon removal from treatment the seeds were washed thoroughly in water and planted in a RCBD in greenhouse flats. Ploidy level was determined via flow cytometry. Oryzalin proved to be a more lethal agent by yielding a total of 203 viable seedling lines for all treatments vs. 487 for colchicine. An inverse relationship between duration of chemical immersion and number of lines produced was observed for both mitotic inhibitors. Almost 70% of all lines produced through exposure to oryzalin tested tetraploid as opposed to 33% for colchicine. The greatest number of tetraploid lines (56) was produced by a colchicine concentration of 0.05% and an oryzalin concentration of 0.002% (60) across all immersion durations. Exposure to 0.05% colchicine for 24 hours yielded 27 tetraploid lines and was overall the most productive treatment combination. Both colchicine and oryzalin proved to be effective agents for inducing tetraploidy in Japanese barberry seedlings.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

4:45–5:00 pm

Construction of a Microsatellite Based Genetic Map for the Diploid Rose

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Simple sequence repeat (SSR) markers developed in rose and the Rosaceae family were used to construct a genetic linkage map and determine map positions of the loci controlling important phenotypic traits. The population studied is a rose backcross population of diploid WOB26 hybrid (2n=2x=14) (*Rose wichurana* 'Basye's thornless' and *Rose chinensis* 'Old Blush') backcrossed to 'Old Blush'. 'Basye's thornless' is a once blooming, ground cover type rose with single white flowers, no prickles on the stem and high resistance to black spot. 'Old Blush' is a recurrent blooming, upright growing bush with double, pink flowers, prickles on the stem and susceptibility to black spot, and the F_1 hybrid, WOB26, is a once blooming, low growing rose with single light pink flowers, few prickles on the stem and moderate resistance to black spot. The three parents and nine progeny were screened for polymorphisms with 133 SSR markers (75 from INRA, France; 26 from Plant Research International, Netherlands; 32 from Clemson Univ., Clemson, SC). Approximately 90 SSR markers were identified as polymorphic in the initial screening. One hundred and sixty progeny of the backcross population and the three parents will be characterized with these 90 markers using Metaphor agarose gels. Molecular data will be combined with the morphological characterization (black spot resistance, blooming type, prickles presence and number, flower type, flower color, petal number and size, and leaflet number and size, plant growth habit) to construct a genetic map that will be consolidated with maps previously developed in the USA, France, and Germany.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

Oral Session 30: Plant Nutrient Management

Wednesday, July 18 **3:30–5:00 pm**

Room: Kirkland

Moderator: Lailiang Cheng; LC89@Cornell.edu

3:30–3:45 pm

Fertilization Affects Western Flower Thrips Abundance, Total Phenolics, and Growth Characteristics in *Gerbera jamesonii*

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This research focused on the influence of fertilization on plant growth and development, overall quality, western flower thrips (WFT) abundance, and host plant resistance characteristics of gerbera (*Gerbera jamesonii* 'Festival Salmon'). We tested three fertility levels that consisted of 0%, 30%, or 100% (200 mg·L^{-1} N) the recommended fertilization rate for gerbera. Each pot, with one established seedling, was enclosed in a large acetate cylindrical cage and half were inoculated with five adult female WFT [*Frankliniella occidentalis* (Pergande)]. WFT abundance was severely reduced on the lowest fertility plants—which received only the fertilizer charge present in the media. Plants receiving high and moderate fertilization had similar WFT abundance. Plant growth and development was not affected by WFT feeding as determined by vegetative and reproductive dry mass (DM). Higher rates of fertilization increased plant quality, chlorophyll content, vegetative DM, total aboveground DM, photosynthesis, stomatal conductance, and leaf area. Flower production was similar for high and moderate fertility regimes, but much lower for plants receiving low fertilization. WFTs reduced the overall plant quality of gerberas receiving high and moderate fertilization, but had no apparent affect on photosynthesis or stomatal conductance. WFT-free plants had increased specific leaf area (i.e., thinner leaves). Phenolics are constitutive secondary metabolites that have been shown to negatively affect insect feeding. Total phenolics increased as fertilization was reduced, while WFT feeding did not affect phenolic content. The accumulation of the phytohormone jasmonic acid—which is known to regulate many inducible defenses against insect herbivory—will also be discussed.

Specified source(s) of funding for the work presented in this abstract: Federal competitive

3:45–4:00 pm

Transitional Responses of Adult Pear to a Split Nitrogen Fertigation and Drip Irrigation System

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Transitional responses of adult pear to the split N fertigation and drip irrigation system have not been documented in Oregon. A field experiment was conducted on adult pear at Hood River, OR, in 2005 and 2006. Two N and water management systems (split N fertigation and drip irrigation system, broadcast application of dry N fertilizer to the soil surface and micro sprinkler irrigation system) were compared on pear cultivars Bartlett and Golden Russet Bosc, and rootstocks of OHF97 and OHF87. The transitional responses of these cultivars and rootstocks to the split N fertigation and drip irrigation system were similar. The split N fertigation and drip irrigation system reduced irrigation water use by over 70% and N fertilizer use by 20% during the entire season compared with the current N and water management system— broadcast application of dry N fertilizer to the soil surface and micro sprinkler irrigation system averaged over the four cultivar and rootstock combinations. Fruit yield was statistically similar for the split N fertigation and drip irrigation system and the broadcast application of dry N fertilizer to the soil surface and microsprinkler irrigation system. Differences in fruit size and color were negligible between the two N and water management systems. Overall, our results suggest that shift from the current broadcast application of dry N fertilizer to the soil surface and micro sprinkler irrigation system to the split N fertigation and drip irrigation system does not cause significant reduction in yield or quality of adult pear; the split N fertigation and drip irrigation system could be used as a profitable and environmentally sound N and water management replacement on adult pear orchards.

4:00–4:15 pm

Yield Variability in Pistachio: A Case Study in Precision Horticulture

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Pistachio's alternate bearing habit induces management inefficiencies, resulting in economic loss and environmental degradation. This project couples horticultural systems dynamics with ecological modeling to examine this spatio-temporal phenomenon at two scales. For the previous five seasons, we have conducted a precision harvesting experiment, documenting yields for approximately 10,000 individual trees, and recently, growers have provided historical yield data at the field level. Results from individual tree yield data show highly variable yields both within and between years, displaying low levels of synchronization. Furthermore, initial spatial analysis suggests significant autocorrelation of yields, most significantly to a distance of approximately 80 feet. Temporal serial dependence of yield is non-uniform, with most individuals alternating between on and off years, but many trees display positive autocorrelation with the previous year's yield. These patterns not only indicate two probable mechanisms inducing alternate bearing, carbon dynamics and pollen exchange, but also highlight statistical and experimental design hurdles yet to be considered in many tree crops. In the future, we will use field level data to examine state-wide synchronization and productivity in response to environmental variables. We will also combine these two data sources with data from manipulative field into a model of alternate bearing.

4:15–4:30 pm

A Review of Phosphorus Use in the Ornamental Horticultural Industry

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In the past 20 years many studies have investigated the phosphorus (P) requirements of plants growing in organic potting media commonly used in greenhouse and above-ground plant production. The results of these studies have shown conclusively, that P has been over applied in these growing systems. Since fertilization rates are typically based on nitrogen (N), what are the optimum N:P ratios for fertilizing plants? Can we rely on just one fertility regime or should we adjust N:P ratios during production to accommodate different growth periods (e.g., vegetative growth vs. flowering)? Reductions in P use is a important issue in nursery and greenhouse production, since P is conserved in the environment, and is the key limiting nutrient in fresh-water systems. There is still widespread belief in the ornamental horticultural industry that fertilizers containing P rates at or near equimolar ratios to

N promote root growth (and/or floral quality?). Some recent research has attempted to debunk this claim. High phosphorus fertilizers like superphosphate are still being recommended by some, even though it has been shown this form of P leaches quickly from soilless substrates. Nutrient applications are, of course, dependent upon the production environment, growth rate and the species in question. We will review the literature, giving examples from various studies to explore these issues and questions, and provide more definite recommendations for the nursery and greenhouse industry for phosphorus use.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

4:30–4:45 pm

Nitrogen Demand–Supply Relationship of High-density 'Gala' Apple Trees

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Six-year-old 'Gala'/M.26 trees grown in sand culture (1.05 × 3.3m) received a total of 30 g nitrogen per tree as ^{15}N-ammonium nitrate in Hoagland's solution via fertigation in a pre-determined optimal regime. Cropload was adjusted to 8.2 fruit per centimeter square trunk cross-sectional area at 10 mm king fruit by hand-thinning. At each of the seven key developmental stages throughout the annual growth cycle, four trees were destructively harvested. Each tree was partitioned to spurs, shoots, spur leaves, shoot leaves, fruit, branches, central leader, shank and roots for total N and ^{15}N analyses. The average fruit yield was 18.8 kg per tree with an average fruit size of 181 g. Both leaf and fruit N status fell within the recommended optimal range. Total tree N increased only slightly from budbreak to bloom, and then very rapidly from bloom to the end of shoot growth, followed by a slower but steady increase to fruit harvest. At fruit harvest, reserve N and current season's uptake of N each contributed about 50% to the total tree N. Total N in shoots and leaves increased very rapidly from bloom to the end of shoot growth, and then leveled off. In contrast, total N in fruit increased gradually from bloom to the end of shoot growth, and then increased rapidly till fruit harvest. Most of the N demand by the new growth at bloom is provided by reserve N that has been remobilized from the perennial parts of the tree. Shoots and leaves are the main sink for both reserve N and fertilizer N before the end of shoot growth whereas fruit becomes the main sink after the end of shoot growth. At fruit harvest, fertilizer N and reserve N contributed 60% and 40% to the total N in shoots and leaves, respectively, whereas they contributed approximately equal amount to the total N in fruit.

4:45–5:00 pm

Vegetative Growth, Fruiting ,and Fruit Size of 'Gala' Trees in Response to Nitrogen Supply

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'Gala' fruit being too small has been a concern for apple growers in New York and inconsistent results have been observed in the effect of nitrogen fertilization on fruit size in field trials. The objective of this study was to determine how nitrogen supply affects vegetative growth and fruiting, dry matter production and partitioning, and fruit size of 'Gala'/M.26 trees. Five-year-old 'Gala'/M.26 that were grown in sand culture and trained in tall spindle received a total of 3.3, 10.0, 20.0, or 40 g actual nitrogen via fertigation using a complete nutrient solution from early May till 3 weeks before harvest. The cropload of these trees was adjusted to 6.5 fruit per cm^2 trunk cross-sectional area by hand-thinning at 10 mm king fruit. As N supply increased, the total leaf area of long shoots in the canopy increased whereas the total leaf area of short shoots or spurs remained unchanged. The net dry matter accumulation from budbreak to fruit harvest almost doubled from the lowest N supply to the highest N supply, which corresponded well with whole canopy net carbon exchange rate measured at the end of shoot growth. The partitioning of dry matter to fruit decreased as N supply increased. Average fruit size increased from 130 to180 g, and a linear relationship was found between leaf area to fruit ratio and fruit size. As N supply increased, fruit soluble solids increased whereas fruit firmness decreased slightly. These results indicate that 1) within the range of N supply used, increasing N supply improves leaf N status, leaf and canopy photosynthesis, and leaf area to fruit ratio, leading to larger fruit and higher soluble solids; and 2) good size 'Gala' corresponds to a leaf N of 2.0 to 2.2% and a leaf area to fruit ratio of 550 cm^2 per fruit.

Oral Session 31: Biotechnology for Horticultural Crops

Wednesday, July 18 **3:30–5:15 pm**

Room: Greenway A/B

Moderator: Hazel Wetzstein; hywetz@uga.edu

3:30–3:45 pm

Functional Characterization of Novel Rosaceae Genes in *Arabidopsis* and Strawberry

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The Rosaceae family contains diverse fruit, nut, wood, and ornamental plant species, including apple, peach, rose, and strawberry. Independent evolution and heavy cultivation have almost certainly generated a diverse transcript set when compared to well-described model species. It is likely that a subset of these transcripts represents unique modifiers of rosaceous crop form and function; transcripts selected because of their utility toward production in this $7 billion dollar crop family. A parsing of the Rosaceae EST databases indicates the presence of many transcripts (~10%) with no known homologs outside of the family. This project leverages our available strawberry EST library resources, innovative methods in EST sequence capture with 454 technology, the agility of Gateway cloning and the efficient transformation capacities of *Arabidopsis* and strawberry to functionally characterize novel transcripts from rosaceous crops. In a pilot study of 46 unique transcripts encoding predicted pioneer proteins, many presented conspicuous phenotypes when overexpressed in *Arabidopsis*. Phenotypes include effects on flowering, a loss of trichomes, alterations of leaf morphology and effects on fertility. Loss and gain-of-function studies are underway in strawberry with goal of discerning functionality in the crop itself. Since strawberry is a readily transformable member of the Rosaceae and studies of coding regions indicate conservation between genes across the family, strawberry is the most appropriate surrogate to initially describe the biological roles of these novel genes for all rosaceous crops. The findings generated in this study stand to expand model-system-derived paradigms and potentially add new resolution to existing pathways originally deciphered from study of model plant systems.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

3:45–4:00 pm

Gametophytic Self-incompatibility in Japanese Plum (*Prunus salicina*)

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Japanese plum (*Prunus salicina* Lindl.) carries the S-RNase-mediated gametophytic self-incompatibility (GSI) and therefore depends on cross pollination. For obtaining satisfactory yield it is essential that the cultivar couples which serve as pollinators of each other will flower synchronously, will be genetically compatibile and that suitable beehive management will be applied. In Israel, which is a sub-optimal region for Japanese plum cultivation, more than 50 plum varieties are grown. However, some of them produce low yields. In this project, it was questioned whether the low yield could be explained by pollination and/or fertilization deficiencies. Traditionally, compatibility between plum cultivars was determined by field experiments. This analysis, suffers from inaccuracy because agrotechnical and environmental factors affect fruit-set. With the build up in understanding of the GSI system, it was evident that GSI is governed by a multi-allelic S-locus and that pollen rejection occurs when the S-haplotype of the pollen matches one of the two S-haplotypes in the pistil. Genes of the pistil part and of the pollen part of the system were cloned and molecular based analysis, of S-haplotype were developed. Thus the S-content of each cultivar can be identified. A 4-year study that included S-haplotyping of cultivars, hand and open pollination experiments and different bee hive management regimes was carried out. It was found that in many cases low yield could be explained by semi-compatibility between cultivar couples and that multi-introductions of the honeybee colonies improved pollination without raising the number of hives. These finding could be relevant for other sub-optimal regions for pollination and fertilization of Japanese plum.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

4:00–4:15 pm

The Development of 'HoneySweet'— A Transgenic Plum Pox Virus (PPV)-resistant Plum and the Application of Intron-hairpin (ihp) RNA Technology for PPV Resistance in Stone Fruits

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Genetic engineering (GE) has the potential to revolutionize fruit tree breeding and is an important addition to the fruit breeder's "toolbox." It is an approach that can specifically target genetic improvements and allow for the development of novel, useful traits. In spite of the potential utility of GE for fruit tree improvement, the technology has not, to date, been widely exploited in these species and no GE temperate fruit species have been released. Plum pox virus (PPV) is a major pathogen of stone fruits that entered the U.S. in 1999 and is the subject of a quarantine and eradication program. We have developed a GE plum clone C5 (cv. HoneySweet) that is highly resistant to PPV through the mechanism of post-transcriptional gene silencing (PTGS), also termed RNA silencing. 'HoneySweet' is an example of GE that can be of significant benefit to growers and consumers, one that can also provide unique genetic material for use in conventional breeding programs. The development and testing, including long-term field test data from several countries, and current regulatory status in the U.S. of 'HoneySweet' will be presented. Based on the success with 'HoneySweet' we used self-complementary PPV coat protein sequences separated by an intron to produce a "hairpin" RNA (ihpRNA) structure. The ihpRNA construct was used to elicit PTGS to confer resistance to PPV in transgenic *Nicotiana benthamiana* where we confirmed the high capacity of ihpRNA constructs for inducing RNA silencing with more than 75% of transformants displaying PTGS. Utilizing ihpRNA technology on plum we developed a number of GE lines that produced small interfering RNA which are diagnostic for RNA silencing. One plum line has been evaluated and is resistant to PPV demonstrating the direct application of ihpRNA technology for developing virus resistance in woody perennial species.

4:15–4:30 pm

Microsatellite Genotyping of Seedlings from Somatic Hybrid and 'Tetrazyg' Citrus Rootstock Candidates to Determine Maternal or Zygotic Origin

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The traditional method for propagating citrus rootstocks is by nucellar seed, resulting in uniform seedlings with the same genotype as the original rootstock. Nurseries prefer that new rootstocks be amenable to seed propagation. In some cases, zygotic seedlings appear morphologically similar to nucellar seedlings, and cannot be efficiently rogued by visual evaluation.We have been producing and testing allotetraploid somatic hybrid rootstocks for many years, and more recently initiated a conventional rootstock breeding program at the tetraploid level, using the best somatic hybrids as parents. We have coined the word "Tetrazyg" to identify hybrids produced from such crosses. Seed trees of somatic hybrid rootstocks showing promise for tree-size control, and tetrazyg hybrids selected in greenhouse studies for various traits including soil adaptation and resistance to the *Diaprepes*/*Phyophthora* complex are now fruiting. Following the determination of seediness, DNA was isolated from a sub-population of seedlings from each hybrid being evaluated, along with corresponding parents. To determine the type of seedlings produced by each hybrid, microsatellite genotyping of each seedling population were conducted using four EST microsatellites CX0010, CX0035, CX2007, and CX2021, synthesized by Operon Technologies (Huntsville, AL). The primer labeling, PCR program, and preparation of PCR products to load onto the Genetic Analyzer 3130xl (Applied Biosystems Inc., Foster City, CA) were previously described in detail (Chen et al. 2006). The generated ABI proprietary files with the chromatographic trace data were analyzed using GeneMark (Soft Genetics LLC) to produce an allele table. Any alleles found in a seedling differing from that of the seed parent indicate zygotic origin.

4:30–4:45 pm

Ectopic Expression of an Arabidopsis CAX2 Variant Facilitates the Growth of Both Bottle Gourd and the Scion Grafted onto the Transgenic Rootstock

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Bottle gourd (*Lagenaria siceraria* Standl.) has been commonly used as

a source of rootstock for watermelon. To improve its performance as a rootstock without adverse effects on the scion, the bottle gourd was genetically engineered using a chimeric *Arabidopsis* sCAX2B gene which encodes a variant transporter, N-terminus truncated form of CAX2 (sCAX2) containing the B domain of CAX1. The variant transporter was known to moderately enhance Ca^{2+} substrate specificity and to lose the excessive Mn^{2+} transport capability of sCAX2. Our results indicated that the transgenic bottle gourd expressing the sCAX2B was more vigorous than its wild type counterpart, and neither the transgenic bottle gourd seedlings showed any phenotypic abnormalities during the whole growth period. Several cucurbit crops were test-grafted onto the transgenic bottle gourd to determine its effect on the scions. The growth of both the transgenic bottle gourd and the grafted watermelon was faster than the control when estimated to be 35 days after greenhouse transplanting as evident from their growth indices like shoot length. Both grafting combinations also showed normal growth and development until fruit setting stage. Watermelon fruits with the watermelon/transgenic bottle gourd combination recorded higher osmotic pressure and more soluble solids than those with the wild type combination. The same procedure was also done for the oriental melon and melon which are incompatible with a bottle gourd. Such findings suggest that sCAX2B expression in the transformed bottle gourd rootstock can facilitate growth of the scion toward producing better quality fruits in terms of an accumulation of more photosynthetic products.

4:45–5:00 pm

Factors Affecting In Vitro Regeneration of *Buddleia* Species

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The effect of genotype, basal medium, plant growth regulator (PGR), dark treatment, and antibiotics on shoot regeneration of two *Buddleia* cultivars, *B. davidii* 'Potters Purple' and *Buddleia* 'Lochinch' was investigated. In vitro shoots were regenerated from leaf tissues in either Murashige and Skoog (MS) or woody plant medium (WPM) media supplemented with different concentrations of benzyladenine (BA) and/or indole-3-butyric acid (IBA) or naphthalene acetic acid (NAA) with different durations of dark treatment. Different responses to theses factors were found in these two species. In general, more shoots were regenerated in WPM medium than in MS medium. Dark treatment for 3–5 weeks dramatically increased shoot regeneration. Addition of IBA or NAA significantly enhanced the regeneration rate and shoots of each explant. The maximum regeneration rate of *B. davidii* 'Potters Purple' was achieved by being cultured in WPM containing 5 μM BA plus 0.5–5 μM IBA or 0.5–1 μM NAA, while *Buddleia* 'Lochinch' gave rise to the maximum regeneration rate in WPM supplemented with 20 micro molar BA plus 0.5–1 micromolar IBA or 0.5 micromolar NAA. Carbenicillin at 250 or 500 mg·L^{-1} and cefotaxime at 125 or 250 mg·L^{-1}, solely or combined positively affected shoot regeneration. Interactions between genotype and medium or PGRs were found. In vitro shoots can be easily rooted in one-half strength MS medium with or without NAA. Rooted plants were transferred to potting mix and grown in the green house. This research will facilitate improvement of *Buddleia* species using biotechnology such as in vitro mutation and transformation.

Specified source(s) of funding for the work presented in this abstract: Private (Association, Foundation, Industry)

5:00–5:15 pm

In Vitro Culture for the Propagation and Conservation of Georgia Plume, *Elliottia racemosa*

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Georgia plume, *Elliottia racemosa*, is a deciduous small tree or shrub endemic to Georgia. Its name is derived from the appearance of beautiful plume-like inflorescences composed of fragrant flowers. Rare throughout its limited range, Georgia plume is a protected plant listed as a state threatened species. Propagation by seed or cuttings has been generally ineffective. Tissue culture methods were evaluated as an approach for the mass propagation and conservation of this species. Methods for the initiation and establishment of aseptic cultures, and protocols for efficient plant regeneration via adventitious shoot proliferation were developed. Experiments were conducted comparing the effects of explant type and age, induction media, and photoperiod on shoot proliferation. Young leaf explants induced on a medium with 10 μM thidiazuron and 5 μM indoleacetic acid effectively induced adventitious buds. Transfer of cultures to a secondary medium with 25 μM 2-isopenyladenine promoted shoot elongation and proliferation. Shoots exhibited high rooting percentages of over 80% with both in vitro and ex vitro methods. Acclimatized plants were successfully transferred into the greenhouse.

Oral Session 32: Postharvest 3

Thursday, July 19 **8:00–9:30 am**

Room: Powell A/B

Moderator: Tom Davenport; tldav@ufl.edu

8:00–8:15 am

Storage of Ripe Mango (*Mangifera indica* L.) Fruits in Elevated Carbon Dioxide

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Mango (*Mangifera indica* L.) is known as king of the fruits due to its excellent flavor, delicious taste, and high nutritive values. The 'Alphanso' cultivar is especially preferred for export to many countries from Pakistan and India. Fresh mango fruits have a short storage life at ambient temperature and can also suffer low temperature injury (chilling injury) during refrigerated storage; therefore, sometimes the fruit can not reach the ultimate consumer and high losses occur. So, controlled atmosphere (CA) storage of mango fruit cv. Alphonso was studied in Cranfield Univ., Silsoe, UK, to investigate the optimum controlled atmosphere storage of mango cv. Alphonso for extending its shelf life without detrimental affect on fruit quality. Fully ripe mangoes were stored in 3% O_2 along with 0%, 3%, 6%, 9%, 12%, and 15% levels of CO_2 and compared with fruit stored at 21% O_2 and 0% CO_2 as a control at 10 °C and 80% to 85% RH. Another control treatment was added by placing some fruit on a shelf in normal air at the same temperature in the same room. Fruits were removed 21 days after storage and different quality parameters were measured chemically and by sensory evaluations. It was observed that the rate of weight loss decreased with an increase of CO_2 in the storage atmosphere. Fruits stored in controlled atmosphere storage showed better retention of freshness, color, firmness, TSS, and flavor compared to the fruit stored in the air. Panelists preferred treatment in which fruits were stored in 3% O_2 with 6% CO_2 over other treatments. Control fruits held in the air were highly unacceptable due to off-flavor and fermentation. Controlled atmosphere conditions of 3% O_2 with 6% CO_2 emerged as optimal atmospheric conditions for the storage of eating ripe mangoes cv. Alphonso for 21 days.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

8:15–8:30 am

Effect of Preharvest Micronutrient Foliar Sprays on Postharvest Vase Life of Gladiolus (*Gladiolus grandiflorus*)

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Gladiolus is an important ornamental plant referred to as queen of bulbous flowers. It occupies fourth position in the international cut flower trade. The limited shelf life of cut gladioli spike has been a concern to the cut flower industry. Hence, an investigation was carried out for two consecutive years with cv. Traderhorn to unveil the response of preharvest micronutrient foliar sprays of $FeSO_4$, $ZnSO_4$ and the postharvest vase chemicals on keeping quality of cut gladiolus spikes for relatively longer time. Spikes harvested from preharvest treatment crop were kept in vase solutions comprising NaOCl, $Al_2(SO_4)_3$ and Silverthiosulphate (STS) at different concentration combinations. The experiment with 10 treatments in three replications was executed in complete randomized design at ambient laboratory conditions using distilled water as control. The responses for individual flowers on the spike for their vase life were curvilinear to increase in preharvest foliar spray concentration of $FeSO_4$ up to 1% dissolution rate. The postharvest vase solution containing 2% sucrose with different concentrations of metal salts was effective in prolonging vase life of flowers. The findings indicated shelf life of each of six flowers in the spike can be increased to one and half day over control by preharvest foliar micronutrient nourishment of 1% $FeSO_4$ and 0.5% $ZnSO_4$, followed by putting cut ends of harvested spikes in vase solution of sucrose 2% with 25 ppm NaOCl or 100 ppm Silverthiosulphate or 400 ppm $Al_2(SO_4)_3$.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

8:30–8:45 am

Intact and Postharvest Behavior of Tropical Fruit Stomata

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Whereas the behavior of stomata in leaves is well documented, little is known about their behavior in intact fruit or of their postharvest behavior. We were interested in testing the hypothesis that low CO_2 concentrations in a hypobaric storage container maintains stomata open in the dark by evaluating the behavior of tropical fruit stomata when placed in 15 mm Hg and one expanded air exchange per hour at 13 °C compared to standard storage at the same temperature. Preliminary results determined that fruit stomata did not behave in consistent ways or in ways anticipated from the behavior of those on the surface of leaves. In order to determine when we should harvest fruit with open or closed stomata for postharvest testing, we examined the opening and closing times of stomata over two 48-hour periods in intact fruit and leaves in two varieties of banana, guava, three species of citrus, and carambola. Whereas leaf stomata of all species and varieties opened in direct reaction to incident light during the day, the opening and closings of stomata of intact fruit was totally independent of incident light. The stomatal behavior of fruit from each variety or species was unique and consistent, ranging from continuously open in carambola to opening or closings at all hours of the day or night in the other species. Fruit stomatal behavior over time after harvest and in conditions at two temperatures and pressures also varied from species to species. Details of stomatal behavior of each species will be presented.

8:45–9:00 am

Optimizing Pre- and Post-storage Ripening Protocol and Determining Packaging Effects on Mango (*Mangifera indica* L.) Fruit Ripening

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In Pakistan, CaC_2 is the most commercially used mango fruit-ripening chemical as it is cheap, easily available, and no technical knowledge is considered necessary for its anomalous use. But its use is being discouraged worldwide due to its hazardous impact on human health, danger, of explosion, and carryover of toxic materials like As and P. Therefore, search for an alternative ripening agent is imperative. Moreover, over 90% handling and transportation of mango fruits within Pakistan is being done in wood packaging (WP) made of unprocessed raw wood from unknown and potentially contaminated sources, which cause serious physical injury to fruits and become the source for introduction/spread of pests. Although corrugated cardboard packaging (CBP) is being used for mango fruit export, post-storage ripening abnormalities are reported. Two experiments were conducted to evaluate effect of packaging and ripening methods on pre- and post-storage fruit ripening of mango cv. Chaunsa to achieve uniform ripening. Mature mango fruits were packed in WP and CBP. In the first experiment, fruits were treated with CaC_2 (2 g/kg of fruit) or C_2H_4 (100 ppm, 20 °C, 48 hours) and ripened at ambient temperature. In the second experiment, fruits were stored (13 ± 1 °C and 85% to 90% RH) for 15 days with pre- and post-storage application of C_2H_4 (100 ppm, 25 and 30 °C, 48 hours). Significant development in fruit color, softness, TSS (31.3 °Brix), total sugars (23.1%), and total carotenoids (133.5 μg/g) while lower ascorbic acid (27.8 mg/100 g) and TTA (0.11%) in WP fruits revealed that WP promotes fruit ripening as compared to CBP. However, higher fresh fruit weight loss (8.7% to 12.5%) in WP is a demerit. CBP was found more suitable for extending shelf life of fruits. Exogenous C_2H_4 application seems to be dependent on concentration, exposure time, and temperature while post-storage ripening and uniform color development of mango fruits remains a critical issue.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

9:00–9:15 am

Physio-biochemical and Genetic Changes in Stored Pea (*Pisum sativum* L.) Seeds

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Studies were carried out to evaluate the physiological and biochemical changes in pea seeds (cv. Meteor) stored at 5 °C ± 1 and ambient temperature 25 °C ± 2. RAPD makers were used to identify any genetic dissimilarity in pea seeds stored up to two years under different storage

environment. Maximum germination (98.33%) was recorded in seeds from freshly harvest seeds and minimum was 90% in 2-year-old seed stored at 5 °C ± 1. the decline in vigor was rapid in 1-year-old seed stored under ordinary condition compared to other storage environment. The alpha- and beta-amylase activity was higher in recent harvest seeds compared to stored seeds. The storage period showed significant affect on alpha- and beta-amylase activity and a decreasing trend was observed as the storage period prolonged. Similarly, peroxidase and catalase activity was also higher in fresh seeds in contrast to alpha- and beta-amylases. Genetic analysis (RAPD) showed 2% dissimilarity in genetic profile amongst the seed lots. However, the seeds stored for longer period regardless the storage environment, have more genetic damage. The physio-biochemical and genetic changes could be helpful in understanding the mechanism of pea seed deterioration.

9:15–9:30 am

Fruit Quality Characteristics of Antisense ACC-oxidase 'Galia' F_1 Hybrid Melons (*Cucumis melo* L. var. *reticulatus* Ser.)

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Renowned for their flavor, 'Galia' (*Cucumis melo* L. var. *reticulatus* Ser.) melons have a reduced shelf-life compared to newer 'Galia'-type cultivars, which often lack the flavor of the original 'Galia'. The objective of this research was to develop a true 'Galia' hybrid with a longer shelf-life while maintaining flavor. The 'Galia' male parental line was previously transformed (Nunez-Palenius et al., 2006) with an antisense ACC-oxidase gene (CMACO-1). Lines of antisense (AS) male parents were selfed and selected for the delayed ripening phenotype and a backcross 4 (AS BC_4) female population was also produced. The AS T_4 male and AS BC_4 lines were crossed (AS x WT, WT x AS, AS x AS) and AS 'Galia' F_1 hybrid seed was produced in Spring 2006. During fall 2006, AS 'Galia' F_1 melons were grown and evaluated with the original wild-type (WT) 'Galia' and a 'Galia'-type ('MG10183') cultivar. Fruits were harvested at four stages of growth: stage 1) zero-slip, green (ZG); 2) zero-slip, yellow-green (ZYG); 3) half-slip (HS); and 4) full-slip (FS). Data were recorded for days to harvest, fruit weight, size, flesh thickness, soluble solids content (SSC), firmness, ethylene and respiration (CO_2). At stage ZG, all AS melons were similar in size, quality, ethylene and CO_2 production to WT 'Galia'. At stage ZYG, AS x AS and AS x WT melons were significantly firmer than WT 'Galia', produced less ethylene and had no difference in SSC than WT 'Galia'. AS x AS, WT x AS, AS x WT melons remained on the vine an average of 6, 4, and 5 days longer than WT 'Galia and were similar in quality, ethylene and CO_2 to WT 'Galia' at the HS and FS stages. The differences seen in lines AS x AS and AS x WT at stage ZYG indicate a potential that a longer shelf-life 'Galia' melon may be achieved if harvested in stage ZYG.

Oral Session 33: Fruit and Nut Production 2

Thursday, July 19 **8:00–10:00 am**

Room: Greenway A/B

Moderator: Duane Greene; dgreene@pssci.umass.edu

8:00–8:15 am

Characterizing the Interaction Between NAA and BA on Fruit Growth in Different Apple Cultivars

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Inhibition of fruit growth in 'Delicious', leading to excessively small (<65 mm) or pygmy (<25 mm) fruit development, has been associated with late applications (>15 mm king fruit diameter, KFD) or high concentrations (>15 mg·L^{-1}) of NAA and post-petal fall applications of NAAm. This problem has become more pronounced with the introduction of BA products, used for fruit thinning and improving fruit form and size, when both NAA and BA have been used on the same trees in the same season. In this report we characterize the interaction between NAA and BA on fruit development in selected apple cultivars (n=6). NAAm (50 mg·L^{-1}) applied at petal fall to 'Redchief Delicious' trees previously treated with Promalin (473 mL/acre, 80% bloom) resulted in a 3.3- to 5.2-fold increase in small fruit than in the absence of BA. Similar results (2.5- to 5.1-fold) were obtained with NAA applied at 10 mm KFD. Delaying the NAA application to 18 mm KFD resulted in significantly less small fruit (≈60% reduction) compared to treatment at 10 mm KFD. If NAA was applied to the same trees before BA (i.e., NAA at 6 mm, BA at 12 mm KFD) compared to after BA (BA at 6 mm, NAA at 12 mm), the development of small fruit was reduced from 46% to 26%, respectively. The induction of small fruit by NAA+BA was not related to crop load. The BA concentration response curve from 0 to 150 mg·L^{-1} in the presence of NAA (15 mg·L^{-1}) increased linearly up to 100 mg·L^{-1} and then plateaued. When NAA and BA were applied (10 to 12 mm KFD) to the same 'Fuji' trees, a similar increase in small fruit formation was found as observed in 'Delicious'. However, no significant development of small fruit was observed in 'Empire', 'Elstar', 'Golden Delicious', and 'Jonagold' when BA was over-sprayed with NAA at 10 to 12 mm KFD.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

8:15–8:30 am

Influence of Tergitol TMN-6 as a New Blossom Thinner on Stone Fruit and Apple Fruit Set and Quality

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Tergitol TMN-6 at 0.75% to 1.25% effectively reduced fruit set and needs for hand thinning in peaches, nectarines, and plums when applied at 75% to 80% bloom in several locations in the Pacific Northwest. For stone fruits, a double application was usually more effective than a single application. When peach blooms were at advanced stages (90% to 100% blooms open), it required a higher rate of Tergitol TMN-6 to result in a satisfactory level of blossom thinning in peaches. With all Tergitol TMN-6 concentrations, application at 1870.8 L·ha^{-1} was more effective in fruit set reduction and fruit size increase in 'August Lady' peach than at 935.4 L·ha^{-1}. Preliminary tests show that Tergitol TMN-6 is also an effective blossom thinner for cherries. Tergitol TMN-6 never caused any fruit russetting on peaches and 'Empress' plums. In nectarines, although Tergitol TMN-6 did not cause any fruit russetting on 'July Flame', it cased some russet ting on 'Diamond Ray'. Tergitol-TMN-6 at lower than 0.25% rates resulted in effective thinning in 'Red Spur Delicious', 'Rome Beauty', and 'Fuji' apples. However, it caused severe russet ting on 'Delicious' and 'Fuji' but not on 'Rome Beauty' apple fruits. Tergitol TMN-6 was found to be a more effective blossom thinner than fish oil and lime sulfur.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

8:30–8:45 am

Effects of NAA, AVG, and Sprayable 1-MCP on Ethylene Biosynthesis, Preharvest Fruit Drop, Fruit Maturity, and Quality of 'Red Delicious' Apples

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Effects of naphthaleneacetic acid (NAA), aminoethoxyvinylglycine (AVG), and sprayable 1-methylcyclopropene (1-MCP) alone or in combination, applied 1 or 2 weeks before anticipated optimum harvest dates, on fruit ethylene production, preharvest fruit drop, fruit quality, and fruit maturation were examined in 'Red Delicious' apples (*Malus ×domestica* Borkh.). AVG at 125 mg·L^{-1} and 1-MCP at 160 or 320 mg·L^{-1} effectively inhibited fruit ethylene production, whereas NAA at 20 mg·L^{-1} enhanced fruit ethylene production. 1-MCP and the combination of one application of AVG and two applications of NAA had much lower preharvest fruit drop than did NAA or AVG alone. 1-MCP and AVG delayed fruit ripening while NAA increased fruit ripening as determined by fruit firmness and starch. Both 1-MCP and AVG had no effect on fruit color development. Temporal and spatial expression patterns of genes encoding 1-aminocyclopropane-1-carboxylate (ACC) synthase (MdACS1, MdACS2, MdACS3, MdACS5A, and MdACS5B) and ACC oxidase (ACO) were also examined.

Specified source(s) of funding for the work presented in this abstract: Private (Association, Foundation, Industry)

8:45–9:00 am

Differentially Reducing Growth in the Upper Canopy of Apple Trees with Naphthalene Acetic Acid and Prohexadione-Ca

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At early bloom, 4-year-old 'BeniShogun Fuji'/B.9, 'Rising Sun Fuji'/B.9, 'September Wonder Fuji'/B.9, 'Early Auvil Fuji'/B.9, and 'Macoun'/B.9 apple trees (at Rutgers Snyder Research and Extension Farm, Pittstown, NJ) were treated with naphthalene acetic acid (NAA, 1.5% in interior white latex paint or Tanglefoot Tree Wound, Pruning Sealer, or Tree Sealer) in a 7.5-cm band completely around the central leader at the base of 1-year-old wood. An additional group of 'BeniShogun Fuji' and 'Macoun' trees were treated above the base of 1-yr-old wood with prohexadione-Ca (125 ppm, with surfactant and ammonium sulfate, on 26 Apr. and 22 May). NAA carrier did not affect the response. NAA reduced leader growth by 26%, number of laterals above the application by 47%, average length of laterals by 25%, and total growth above the application by 51%. Prohexadione-Ca reduced leader growth by 48%, average length of laterals by 42%, and total growth by 45% but did not affect number of laterals. At petal fall, 1-year-old 'Macoun'/M.9 (at Tougas Farm, Northboro, MA) were treated with NAA at 1.5% in the same carriers and in the same manner as noted above. At the same time, prohexadione-Ca (250 ppm, with surfactant and ammonium sulfate) was applied to one group of trees above the base of 1-year-old wood. Carriers did not alter the effects of NAA or affect growth themselves. NAA application reduced leader growth by 41%, number of laterals above the application by 35%, average length laterals by 54%, and total shoot growth above the application by 51%. Prohexadione-Ca reduced leader growth by 78%, average length of laterals by 62%, and total shoot growth by 70% but did not affect the number of laterals. NAA and prohexadione-Ca may be viable commercial tools to differentially reduce growth in apple trees.

9:00–9:15 am

Effect of Abscisic Acid (ABA) and Benzyladenine (BA) on Fruit Set and Fruit Quality of 'McIntosh' Apples

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Experiments were conducted over a 3-year period to evaluate the influence of abscisic acid (ABA) as a chemical thinner on apples. In 2003 and 2004, ABA at 300 and 75 ppm benzyladenine (BA) were applied alone and in combination to mature 'McIntosh'/M.9 trees at the 10-mm stage of fruit development. In 2005, ABA at 1000 ppm was applied to different trees at full bloom (FB), petal fall (PF), or at 10-mm fruit size stage. BA was applied alone at 100 ppm at the 10-mm stage and also on trees that previously received the ABA at the 3 times of application. BA effectively thinned in all 3 years. ABA thinned in 2 of the 3 years. There was an ABA × BA interaction for thinning. ABA increased the thinning activity of BA in one year, in another year it reduced the thinning activity of BA and in a third when there was no thinner interaction and ABA had no effect on the thinning activity of BA. ABA thinned comparably when applied at FB, PF or at the 10-mm stage. ABA increased fruit weight in 2 of the 3 years applied and it increased red coloring in 1 year. ABA had no influence on flesh firmness or soluble solids at harvest. ABA caused leaf yellowing and chlorosis, usually within 6 days of application. Yellowing that could be either drastically reduced or eliminated if BA was applied with ABA. ABA either reduced or had no influence on return bloom. The usefulness of ABA alone and in combinations with BA as a thinner with apples will be discussed.

9:15–9:30 am

Carbohydrate Availability and Sorbitol Metabolism in Apple Buds and Fruit from Bud Swell to Fruit Drop

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Prior work has elucidated the activity of sorbitol dehydrogenase (SDH) during fruit set and development, but SDH activity leading up to flowering and in abscising fruit a few weeks after bloom has not been characterized. The present work has revealed that SDH is increasingly active in developing apple flower buds to levels consistent with SDH activity in cortex of fruit following fruit set. This indicates that a sink for sorbitol has been established preceding bloom and that it does not 'start' or increase in the cortex after fruit set. A comparison of SDH activity in seed and cortex of fruit that were clearly abscising during natural fruit drop to those that were persisting indicated no significant differences in SDH activity between the two types. The results showed that SDH activity presented an initial increase during bud development followed by a relatively constant level of activity in bud tissue and fruit cortex from prebloom to at least 6 weeks after bloom. The lack of change in SDH activity in dropping fruit indicates that the capacity to utilize sorbitol may not be limiting. A preliminary study of expressed sap from shoots subtending flower buds and fruit indicated that sorbitol concentration was much greater than that of sucrose, and that the sorbitol level declined appreciably in the 2- to 3-week period

preceding natural fruit drop. Analysis of the expressed sap by HPLC confirmed that sorbitol was the most abundant carbohydrate followed by glucose, fructose, sucrose, myoinositol, galactose, raffinose, and stachyose. The levels of sorbitol, glucose, and sucrose dropped the most of all the carbohydrates in the period preceding natural fruit drop. Thus, considering both SDH activity and carbohydrate availability, natural fruit drop may be due to declining availability of carbohydrates and not to an inability to utilize them.

9:30–9:45 am

Comparison between the Sunburned Peel and the Non-sunburned Peel of 'Gala' Apple in Terms of Photooxidation and Photoprotection

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Sun-exposed peel samples of sunburned and non-sunburned 'Gala' fruit were taken from the west and the east side of the tree canopy (with the same light exposure) respectively after a natural heat event in late July to compared the two peel types in terms of photoprotection and photooxidation. The content of chlorophyll (Chl), carotenoids, lutein, and xanthophyll cycle pool size [violaxanthin (V) + antheraxanthin (A) + zeaxanthin (Z)] expressed on a peel area was lower in the sunburned peel than in the non-sunburned one, whereas Chl a/b, the content of carotenoids, lutein and V + A + Z expressed on a Chl basis was higher in the sunburned peel. Significant loss of ?-carotene and neoxanthin was observed relative to Chl. Net photosynthetic oxygen evolution rate and activities of several key enzymes in the Calvin cycle were lower in the sunburned peel than in the non-sunburned peel, but the activities of these photosynthetic enzymes decreased to a lesser extent than the photosynthetic oxygen evolution rate. The sunburned peel had higher activities of ascorbate peroxidase, monodehydroascorbate reductase, dehydroascorbate reductase, and glutathione reductase and higher levels of ascorbate pool, glutathione pool, and reduced glutathione. However, hydrogen peroxide and malondialdehyde contents were significantly higher in the sunburned peel than in the non-sunburned peel. We conclude that the decrease in photosynthetic oxygen evolution capacity in the sunburned peel is primarily due to photooxidative damage to the PSII complexes rather than the decrease in the activities of the Calvin enzymes. Although the antioxidant system was up-regulated in the sunburned peel, this up-regulation did not provide enough protection to the sunburned peel against the photooxidative damage.

9:45–10:00 am

Development of Apple Integrated Pest Management in Korea

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Pest control in apple has been heavily pesticide dependent until the past two decades. Pesticides excessively have been sprayed 15–16 times a year in conventional farming apple orchards, which are operated on a calendar-based fixed-spray schedule. To solve these problems, apple IPM research has been conducted since the late 1980s. These studies provided basic information for apple IPM, such as development of spray schedule programs, apple insect pest status, composition of natural enemy species and ecology of some of them, sex pheromones of major *Lepidopteran* apple pests (*Grapholita molesta, Carposina sasakii,* and *Phyllonorycter ringoniella*, etc.) and monitoring methods, etc. Also, to transmit results developed by investigators, the Apple Lover's Society was founded with Apple Experiment Station (AES) from a computer communication meeting in 1995. In Oct. 2000, we opened an Internet website (http://www.iloveappl.co.kr/), with members now over 4566 people. An understanding of apple IPM concepts by the apple cultivating farmers through the Internet (Apple Lover's Society) has played an important role in these accomplishments. They share information on apple production via the Internet. They published several manuals and books related to apple IPM, apple production technology, and diagnostic books for apple pests, etc., with the aid of AES. Thus, biologically based apple IPM is now implemented based on the following guidelines by AES: 1) adoption of spraying programs for apple IPM; 2) regular monitoring and mating disruption of *Lepidopteran* pests using sex pheromones; 3) conserving natural enemies by use of selective pesticides and growing with cover weeds under the canopy; 4) resistance management; and 5) growers should be experts by training and education.

Oral Session 34: Propagation

Thursday, July 19 **2:00–3:00 pm**

Room: Lowell A/B

Moderator: to be announced

2:00–2:15 pm

Effect of Light and Stem Banding Treatments on Rooting in *Quercus bicolor* Willd., *Quercus robur* L., and *Quercus macrocarpa* Michx. cuttings.

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The effect of light and etiolation with or without stem banding on rooting in *Quercus robur*, *Q. macrocarpa*, and *Q. bicolor* cuttings were investigated. Cuttings used in all three experiments were taken from 4-cm stumps. In the greenhouse, light or etiolation and stem banding pretreatments had no significant effect on rooting ability, number of roots per cuttings (NRPC) or length of longest root (LLRT). In all cases, rooting in *Q. bicolor* and *Q. robur* cuttings averaged 84.9% and 63.8%, respectively. A second experiment using field-grown stockplants investigated the effect of light and etiolation and stem banding pretreatments on rooting in *Q. bicolor* cuttings as shoots aged from 3 to 9 weeks in stockplants. Cuttings were taken at 3-week intervals from four treatment groups (light only, light-banded, etiolated only, or etiolated-banded). Percent rooting in *Q. bicolor* cuttings decreased ($P < 0.001$) with increasing cutting age, with an overall rooting percentage of 64.9% at 3 weeks, decreasing to 13.8% at 6 weeks, and 4.7% by 9 weeks. Cutting age had no significant effect on the NRPC or the LLRT. Etiolation significantly enhanced percent rooting ($P < 0.01$) and NRPC ($P < 0.05$) over the 9-week treatment period. In a later experiment using field-grown stock plants, the effect of light and etiolation and stem banding pretreatments on rooting as shoots aged from 2 to 4 weeks in *Q. bicolor* and *Q. macrocarpa* was investigated. Rooting percentage again decreased with increasing cutting age in *Q. bicolor* and *Q. macrocarpa* cuttings. Etiolation significantly increased percent rooting ($P < 0.001$) and NRPC ($P < 0.01$) in *Q. macrocarpa* cuttings.

Specified source(s) of funding for the work presented in this abstract: Federal competitive

2:15–2:30 pm

Effect of Medium, Date, and Node Position on Rooting of *Miscanthus ×giganteus* Stem Cuttings

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Miscanthus ×giganteus, a large perennial ornamental grass, is of interest as a biomass fuel source. Extensive work has been done in Europe and Great Britain in production and utilization of this plant as a renewable energy source. *Miscanthus ×giganteus* is male sterile and has never been known to set seed. Propagation is typically from crown and root divisions. Limited information is known about grass propagation from stem cuttings. Culm or stem cuttings were taken from established *M. ×giganteus* plants on 27 July and 31 Aug. 2006 at the Minnesota Landscape Arboretum, Chaska. Two-inch cuttings were made from the four most basal nodes. Peat, perlite, vermiculite, and peat:perlite were used for rooting media. Roots developed well from the July cuttings, but rooting percentages decreased in the August propagules. Rooting percentage in July was significantly higher in the basal node and decreased as node position increased from the crown. However, there was no significant difference between the first basal node and the second node in rooting of the August cuttings. Some July cuttings from the first node position initiated primary and secondary shoots. Shoots in peat and peat:perlite were longer than those in perlite or vermiculite; and root dry weights in peat and peat:perlite were proportionately heavier. Rooting percentages of the July cuttings were higher in peat or vermiculite than in perlite but the difference was minimal. However, different rooting media significantly affected the number of roots, the longest root length, and root dry weight. This was reversed in the August cuttings. The number of roots and root dry weight were low in perlite and vermiculite from the July cuttings; but in August cuttings, roots, and root dry weight were high in perlite and vermiculite.

2:30–2:45 pm

Gibberellin Requirement for *Coreopsis* Species Seed Germination

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The gibberellin requirement of two wildflowers, *Coreopsis floridana* and *C. lanceolata* for seed germination at 20 °C was investigated. Seeds were incubated in the dark or light with or without gibberellic acid (GA) and cold (5 °C) moist chilling (stratification). Seeds were also germinated in various concentrations of ABA (antagonizes gibberellin action) and tetcyclacis (blocks conversion of *ent*-kaurene to *ent*-kaurenoic acid in the GA biosynthesis pathway). Both species exhibited disparate responses to gibberellin and light. *Coreopsis floridana* seeds had an absolute light requirement for germination, whereas *C. lanceolata* seeds displayed a facultative response. Brief (5 minutes) exposure to white light improved germination of *C. floridana*, but not *C. lanceolata* seeds. The GA forms (GA_3 or GA_{4+7}) had the same efficacy to promote seed germination. Tetcyclacis reduced seed germination of both species in a dose dependent manner, and the addition of exogenous GA_{4+7} to seeds incubated in tetcyclacis restored germination. Stratification improved dark germination of *C. floridana* seeds but inhibited seed germination of *C. lanceolata* even under white light. Abscisic acid reduced seed germination of both species in a similar way to that of tetcyclacis. The results suggest that stratification, light and gibberellic acid promote the germination of *C. floridana* seeds, whereas *C. lanceolata* seeds had reduced germination after stratification and an indifferent response to both light and exogenous GA. Gibberellic acid and light requirement for seed germination was found to be species dependent.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

2:45–3:00 pm

Day-length during Seed Development Affects Size, Germinability, and Storability of Lettuce Seeds

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Seed quality is determined in part by the environment under which the seeds are produced. The objective of this study was to determine how day-length of the mother plant environment affects lettuce seed quality. Seeds of cv. Tango were produced in growth chambers under one of two treatments: 1) short day (SD), consisting of 8 hours of fluorescent light (~310 $\mu mol \cdot m^{-2} \cdot s^{-1}$) plus 16 hours of darkness daily, and 2) long day (LD), consisting of 8 hours of fluorescent light plus 8 hours of incandescent light (~21 $\mu mol \cdot m^{-2} \cdot s^{-1}$) and 8 hours of darkness daily. In both treatments the temperature was 23 °C, constant. The LD treatment produced significantly heavier seeds; however, germination at optimal conditions (20 °C, light) was similar for both treatments. At suboptimal conditions (30 °C, 20 °C with different external ABA concentrations, or dark), seed germinability (% and rates) from SD treatment was higher. After accelerated aging (41 °C, ~100% RH, 72 hours) germination of normal seedlings was higher for seeds from LD. Seed germination was also evaluated after 2, 4, and 6 months of storage at 30 °C, 74% RH. Stored seed presented a progressive and significant reduction of germinability for both treatments; however, seeds from SD were more affected. The results indicated that day-length during seed development affected lettuce seed weight, germinability, and storability. In this case, germinability and storability were inversely related. The critical moment for day-length effects was also studied. Seed size showed to be determined earlier during seed development (first 6 days). Conversely, seed germinability and storability were determined at the end of seed development, after physiological maturity, which occurred ~11 days after flowering. Possible mechanisms involved in these effects will be discussed.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

Oral Session 35: Ornamentals/Landscape and Turf 3

Thursday, July 19 **2:00–3:30 pm**

Room: Rainmakers Ballroom A

Moderator: Roger Kjelgren; rkjel@usu.edu

2:00–2:15 pm

Water Relations of Three Species Growing as Street Trees in Bangkok, Thailand, during the Monsoonal Dry Season

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The city of Bangkok, Thailand, manually irrigates over 200,000 street trees during 6 months of seasonal drought. We investigated water relations of three species of commonly used street trees: *Pterocarpus indicus* (PI), *Lagerstroemia loudonii* (LL), and *Swietiena macrophylla* (SM) from mid-to-late monsoonal dry season. Six mature trees of each species were selected, and three were not irrigated, and three were allowed by be irrigated as per normal city practices. Midday stomatal conductance (Gs) and predawn leaf water potential (LWP) was measured weekly. Trunk diameter and crown diameter, as well as soil pit area and infiltration rate were also measured. Small tree

well sizes, slightly less than 1 m^2 for LL and SM, but 3 m^2 for PI, and trunk diameters up to 300 mm, appeared to limit the surface area for infiltration of high volume manual irrigations. Limited irrigation effectiveness was evident in no detectable differences in tree Gs or LWP between treatments within any species during the entire study period. Differences in water relations were much greater among species. The evergreen SM and PI had about half the Gs rate of the deciduous LL, and while PI and LL predawn LWP remained below 0.5 MPa through the study period, consistently half that of SM. The responses of SM and LL, while very different from each other, were consistent with those observed in evergreen and deciduous, respectively, tropical tree species well adapted to the monsoonal dry season, and PI's behavior fell between the two extremes. Given their intrinsic drought adaptations and the logistical difficulty of applying enough water to their small tree wells, manual irrigation of these three species by the city of Bangkok does not appear to be a cost-effective management practice.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

2:15–2:30 pm

Impact of Saline Water Irrigation on Growth and Garden Performance of Ten Herbaceous Perennials and Groundcovers

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An outdoor study was conducted to quantifying the impact of saline water irrigation on growth and garden performance of 10 herbaceous perennials and groundcovers. Plants were grown in raised flower beds from June to September in a dry, hot desert environment and irrigated with synthesized saline solutions at electrical conductivity of 0.8 (tap water), 3.2, or 5.4 dS/m. Regardless of treatment, plants were irrigated at approximately 100% potential evapotranspiration throughout the experiment. Plant height and two perpendicular widths were taken monthly to calculate growth index. Garden performance was assessed by visual scores. Salinity did not affect the visual scores in *Achillea millefolium* L., *Gaillardia aristata* Pursh, *Lantana* 'New Gold', *Lonicera haliana* L. 'Halls', and *Rosmarinus officinalis* 'Huntington Carpet'. Among the three *Verbena* species, *V. canadensis* (L.) Britt. 'Homestead Purple' performed better than the other two, *V. hybrida* and *V. macdougalii* Heller. *Lantana camara* L. had significantly lower visual scores at 5.4 dS/m compared to the control and 3.2 dS/m. Most plants of *Rudbeckia hirta* L. did not survive when irrigated at elevated salinity levels. Shoot biomass of *A. millefolium*, *G. aristata*, *L.* 'New Gold', *L. halliana*, *R. officinalis*, and *V. macdougalii* was not influenced by salinity of irrigation water. Therefore, *A. millefolium*, *G. aristata*, *L.* 'New Gold', *L. halliana*, and *R. officinalis* can be irrigated with non-potable water at salinity up to 5.4 dS/m with little reduction in growth and aesthetic appearance.

2:30–2:45 pm

Effect of Provenance on Drought Tolerance of *Taxodium distichum*

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Seedlings from 15 open-pollinated families of *Taxodium distichum* (L.) Rich. from the Gulf Coast, central and south Texas, and Mexico were evaluated for drought tolerance in both greenhouse and a field conditions. Greenhouse screenings evaluated responses to both chronic and acute drought stress, as well as pressure-volume analysis. Plants were evaluated based on growth, relative water content, and xylem water potentials. Survival percentages over two years were evaluated based on 40 seedlings per family in the field. Cluster analysis based on greenhouse screening data suggests that there is a geographic component to variation in drought tolerance of *Taxodium distichum*. The families from Mexico and south Texas performed the best under water deficit conditions, followed by those from central Texas and then those from the Gulf Coast in the greenhouse trials. Mexican genotypes had a higher water content per unit dry mass, were able to survive at lower substrate volumetric water contents, were better at controlling water loss from their shoots, and were able to extract more water from the substrate. Survival in the field under drought conditions revealed a similar pattern, with western populations surviving better than eastern genotypes. These studies suggest that when selecting plant material for a xeric site, Mexican and south Texas genotypes should be preferred, followed by those from central Texas.

2:45–3:00 pm

Characterizing the Runoff from Single-family Residential Landscapes

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Runoff from residential landscapes is currently being collected and analyzed from four drainsheds in Sacramento County and four in Orange County, CA. There are two main objectives of this project: 1) characterizing the runoff from these residential drainsheds; and 2) determining the effect of intensive outreach activities to reduce runoff volumes and the pollutants that may be generated from landscape maintenance activities. The drainsheds consist of at least 100 homes and were selected because they consist primarily of single family residences. Weekly samples of dry weather runoff have been collected since July 2006 in Sacramento and Oct. 2006 in Orange County. Storm water runoff was also collected from the first few flush events. The following parameters were continuously measured at the sampling locations: runoff velocity and depth, water temperature, pH, and EC. Runoff samples were analyzed to determine levels of: 1) various pathogens; 2) nutrients; 3) drinking water quality parameters, such as organic carbon and turbidity; and 4) commonly used pesticides, including the increasingly more popular ant control insecticide fipronil. A "treatment" consisting of outreach to promote the implementation of sustainable gardening methods will be initiated in Spring 2008 with the assistance of the Master Gardener programs at twoof the drainsheds in Sacramento County and two drainsheds in Orange County. Outreach activities include workshops, on-site demonstrations, and economic incentives.

3:00–3:15 pm

Production of Lotus (Nelumbo) in Containers

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Lotus (nelumbo) is a well-known aquatic plant. Literature describes thousands of years of history where man has used lotus as a vegetable,

and for medicine, ornamental, and environment protection purposes. Lotus production in ponds has been much studied in Asian countries, especially in China, however little information is available on production of lotus in containers. Lotus production in containers was investigated to evaluate response of plants to container size, soil level, and fertilizer at Auburn Univ. Most of the small bowl or teacup lotus bloomed well in 11.4-L (3 gal) containers, but no or very few flowers developed in 28.4-L (7 gal) containers for large cultivars. Plant growth indices were minimally influenced by soil level based on comparison of soil levels at 1/2 and 3/4 height of the container. Lotus is a vigorously growing and fertilizer-consuming plant. Fertilization treatments significantly increased plant indices (plant height, underground biomass, leaves, flowers, and propagules) compared with the control. Plant growth was also significantly influenced by the types and rates of fertilizers. The rate of fertilizer was dependent on container size, cultivar and growth season. Application of 8 g of Pro·Sol 20–10–20 every 20 days was generally sufficient for good growth in 28.4-L containers. Fertilizer selection should be dependent on the purpose of production. Performance of lotus was better in the treatments of fertilizers with N, P and K than in the treatment of urea with N alone. Soluble fertilizers are much better than Pursell Polyon (18–6–12) controlled release fertilizer for lotus growth but the latter prolonged leaf life for about 2 weeks. Higher concentrations of P and K are more beneficial for production of rhizomes and propagules.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

3:15–3:30 pm

Guidelines for Describing Ornamental Peach

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Ornamental peach [*Prunus persica* (L.) Batsch.] originates from China and has been widely cultivated in temperate regions. To date, more than 200 cultivars have been developed in the world. Without guidelines for ornamental peach, it is difficult to assess the cultivars. Based on the guidelines for fruit peach, 58 morphological characteristics for ornamental peach description were included. Growth habit, flower type, and time of beginning of flowering were three major grouping varieties under the criteria of ornamental peach classification. The growth habit for ornamental peach included upright, fastigiated, dwarf, and weeping. The flower types of ornamental peach were single, meiflower, rose, peony, and chrysanthemum instead of only showy or not showy flower for fruit peach. With different breeding purposes between ornamental and fruit peaches, description for flower were increased to 21 features, which have nine more traits than those of fruit peach, such as flowering bud shape and color, flower size, etc. However, fruit characteristics for fruit peach, such as fruit sweetness and acidity, were not applicable to ornamental peach, which were reduced 13 features. Explanations on the complementary characteristics were elaborated and illustrated. Molecular markers were first introduced into the ornamental peach guidelines. DNA fingerprintings of 51 ornamental peach taxa generated using six AFLP EcoRI/ MseI primer pairs, had been analyzed. Unique bands and band patterns could be used to generate DNA profiles for each taxon, which could be powerful tools for cross-referencing the late introductions and nomenclatural irregularity. These guidelines should facilitate international agreement on ornamental peach descriptions.

Note: Donglin Zhang is also a guest professor at Central South University of Forestry and Technology, Changsha, Hunan, China.

Oral Session 36: Fruit and Nut Production 3

Thursday, July 19 **2:00–3:45 pm**

Room: Powell A/B

Moderator: Glenn Wright, gwright@ag.arizona.edu

2:00–2:15 pm

A Review of the Spanish Olive Industry and Potential Market Development in the United States

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Olive oil consumption in the United States is approximately 6% of the world total, increasing 20% annually, but with only one percent of the oil consumed produced domestically. Current trends in the United States may promote olive (*Olea europeae*) from its rank as a minor fruit crop to major market status, with substantial value-added potential for growers. To this end, much can be learned from olive production and markets in the European Union, which export olive oil to the United States at a value of over $500 million annually. Spain, Italy, and Greece are the largest producers of olive oil in the world, with Spain leading the ranks. This report concerns the olive industry of Catalonia, Spain, including olive cultivation and olive oil processing, with particular attention to environmental and economic sustainability issues involved in further developing Spain's olive industry. Current olive research in Catalonia is reviewed, including evaluations of 31 rootstock genotypes under the common scion 'Arbequina i-18'. Implications for rootstock dwarfing and disease resistance will be discussed; fruit characteristics and processing techniques determining the "extra virgin," "virgin," "ordinary," and "lampant" labeling standards will be explained; and the Catalonian industry will be compared and contrasted with the California industry.

2:15–2:30 pm

Green Pruning of Mazzard-grafted 'Sweetheart' Sweet Cherry Produces Small Pedestrian Trees and Excellent Quality Crops

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Green pruning (GP; pruning during the growing season) is a technique that reduces tree vigor and promotes cropping of fruit trees. Mazzard (seedling *P. avium* L.) rootstock produces large, non-precocious trees and light crops, but fruit of excellent quality. 'Sweetheart' is a productive self-fertile cultivar that is commonly grafted onto mazzard rootstock and dormant pruned, resulting in large trees. We have achieved small productive trees of 'Sweetheart' on mazzard rootstock by annual GP starting at an early tree age. We evaluated combinations of timing and severity of GP in young trees planted in 2002. GP was initiated in Summer 2004. Trees had 3 to 4 scaffolds with about 20 current season shoots. Controls were dormant pruned and trained to steep leaders. All trees began commercial production in 2006. We obtained small productive trees by selectively heading current season shoots (leaving 20 to 30 cm) every year during early summer. Excess shoots were thinned in mid summer to optimize light and air penetration. No dormant pruning, branch tying or spreading, or crop thinning were performed. GP between 24 June and 9 Aug. 2004 produced compact trees <2.7 m tall with less than half the canopy volume of controls and an initial

average yield of 5.7 kg/tree. Controls were >3.5 m tall and produced 6.6 kg/tree. GP trees required no ladders for harvesting or pruning. GP trees produced high quality fruit (similar to controls: average 8 g and at least 50% with >28-mm diameter). GP is systematic, simple, rapid, and safe. GP produced small, productive trees suitable for high density pedestrian orchards. Canopy management for sustained tree size control and high quality cropping will be discussed.

2:30–2:45 pm

Exploring the Potential of New Promising Mango (*Mangifera indica* L.) Hybrid cv. Faiz Kareem

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The mango industry of Pakistan revolves around a few ancient cultivars like 'Anwar Ratole', 'Chaunsa', 'Dusehri', and 'Sindhri'. Efforts are under way to develop new commercial cultivars to avoid any epidemic and diversify industry, to be globally competitive. So far, no triumph has been reported except for a hybrid 'Faiz Kareem' ('Anwar Ratole' x 'Chaunsa'), developed by an amateur mango grower. This paper reports the parentage of new hybrid using randomly amplified polymorphic DNA (RAPD) fingerprinting technology along with exploiting its postharvest potential and quality attributes. Twenty deca-mer RAPD markers produced 150 fragments ranging from 220 to 2100 bp. Genetic similarity calculated by Euclidean distance matrix confirmed parentage of 'Faiz Kareem' (FK), with its fairly high similarity of 86.67% and 88.63% with 'Anwar Ratole' and 'Chaunsa', respectively. For postharvest studies, mature fruits of each cultivar were harvested and stored at 10, 12, and 14 °C (80% to 85%). Analysis for physico-chemical characteristics, fruit firmness, and digital color values were done weekly. Studies revealed comparatively lower values of total sugars, total soluble solids, titratable acidity, extended shelf life, better fruit quality and low chilling injury for hybrid cultivar (FK) as compared to its parents. Low sugars for FK can be an advantage for extended storage and sugar conscious consumers. Electronic color data revealed higher L* (57.83), b* (29.99), C* (31.22), and hue angle (73.82) values for FK as compared to its parents. Organoleptic studies also showed clear preference for FK followed by 'Chaunsa' and 'Anwar Ratole'. Results of the study will help to understand the potential of new hybrid FK in comparison with the two leading commercial cultivars of Pakistan for its suitability for domestic and export markets.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

2:45–3:00 pm

Impact of Anthracnose on Avocado on Production in Kenya

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Avocado is the leading horticultural export in Kenya. In 2003, Kenya exported about 19,000 metric tons compared to 23 tons in 1970. Most of the fruit is exported to the European markets. There are several constraints limiting production of avocado in Kenya, including limited superior varieties or planting material, poor infrastructure, poor market information, and poor tree crop management. Although several diseases infect avocado, the most important are fruit rot pathogens such as anthracnose, *Cercospora*, and scab. However, these diseases and pests have not been important in avocado production in Kenya. Recently (2004), the constraint limiting avocado production in Kenya is anthracnose caused by *Colletotrichum gloeospoirioides*. Little is known in Kenya on the impact of this disease on production and income realized by small- (<1 acre) or large-scale growers. The objectives of this research were to quantify losses attributed to anthracnose in Kenya, determine the current disease control measures, and recommend good agricultural practice in conformance with EUREP-GAP. A survey was conducted in the avocado growing areas to identify and document constraints limiting avocado production in 2004. The highest losses were reported from central Kenya, where exporters reported up to 100% losses. Because all avocado varieties growing in Kenya are susceptible to anthracnose it is recommended that good management, i.e., control of pests and diseases and good postharvest handling of fruit to minimize injury used as an entry point by anthracnose should be enforced.

Specified source(s) of funding for the work presented in this abstract: Private (Association, Foundation, Industry)

3:00–3:15 pm

Recently Released Asian Pear Cultivars in Korea

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The National Horticultural Research Institute (NHRI), Korea, has released 23 high-quality Asian pear cultivars since authentic fruit breeding programs began in 1954. Enhancing fruit quality and resistance to diseases and pests have been the main objectives of pear breeding program in Korea. Newly released Asian pear cultivars from NHRI have the fruit soluble solids content of about 14 °Brix and resistance to black spot. Since 'Niitaka' pears, which ripen in early October in the Naju area, now take up 76% of total pear production in Korea, fresh fruit entering the market are converged in a certain period of time. For spreading the harvest time of pear fruit, NHRI has bred 13 early- and late-summer cultivars. Characteristics of recently released Asian pear cultivars in Korea are as follows; 1) 'Jinhwang' ('Danbae' x 'Kosui', 2004) is a mid-size, juicy, sweet (13.1 °Brix), and bright yellow-brown skinned fruit that ripens in early September. 2) 'Noksu' ('Danbae' x 'Kosui', 2005) is a mid-size, juicy, sweet (11.9 °Brix), and a greenish-skinned pear that ripens in late August. It has plentiful pollen grains but shows incompatibility with 'Jinhwang', whose genotype of self-incompatibility is S_3S_4. 3) 'Sooyoung' ('Niitaka' x 'Soohwangbae', 2006) is a mid-size, sweet (15.0 °Brix), and brown-russet skinned

fruit. It matures in late September. The tree is vigorous and resistant to black spot. 4) 'Manhwang' ('Okusankichi' x 'Chuwhangbae', 2006) is a mid-size, juicy, sweet (14.0 °Brix), and brown-russet skinned pear that ripens in mid October. The tree appears to be moderately resistant to pear scab.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

3:15–3:30 pm

Performance of High-density Peaches in New York State

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A 1.5-ha replicated field trial was planted in 1999 at Olcott, NY, where we compared six peach training systems [open center (384 trees/ha), quad-vee (538 trees/ha), tri-vee (905 trees/ha), perpendicular-vee (1583 trees/ha), central leader (1098 trees/ha), and slender spindle (1922 trees/ha)] on three varieties ['Allstar' (yellow peach), 'Blushingstar' (white peach), and 'Flavortop' (nectarine)] all on Bailey rootstock. Tree size as measured by trunk cross-sectional area after 7 years was negatively correlated with planting density. Trees at the highest density were half the size of those planted at the lowest density. The central leader and the slender spindle systems which had the least pruning at planting had the highest yield in the second year while all of the other four systems, which required severe heading at planting, had very low yield. In the third year, the slender spindle and perpendicular-vee had the highest yield. In the fourth through seventh years, the perpendicular-vee had the highest yield. Cumulative yields and cumulative crop value largely reflected density; however, each of the three V-shaped systems had higher yield and crop value than expected from their density while the two central leader systems had lower cumulative yield and crop value than predicted from their density. Average fruit size was largest for the open center followed by the quad-vee, tri-vee, central leader, slender spindle, and the perpendicular-vee. Predicted profitability over a 15-year orchard life showed an optimum tree density of 1300 trees/ha. Under the moderate growth conditions of New York State, high-density planting systems offer a significant yield advantage over the traditional open center system. Even the highest-density systems were quite manageable in this climate.

3:30–3:45 pm

The Date Industry in the United States

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The commercial date industry in the United States is located primarily in the Sonoran Desert of southeastern California and southwestern Arizona. The industry comprises about 3800 ha, of which 78% is found in California and the rest in Arizona. While date palms were introduced to the United States by the Spaniards, small quantities were imported for experimental purposes beginning in the late 1800s, and commercial quantities were imported in the early 1900s. During this period, most imported offshoots originated in Algeria, Egypt, Tunisia, and Iraq. Important varieties that were imported include 'Deglet Noor', 'Khadrawi', 'Zahidi', 'Hayany', and 'Halawy'. More recently, 'Medjool' from Morocco was introduced. This variety is becoming increasingly popular because of its large size and high sugar content. Date palm operations are moving from areas that are under pressure from urbanization to more remote locales. Low volume drip and microjet irrigation is beginning to replace the tradition flood and basin irrigation methods. Some dates are produced using organic methods because of consumer demand. Farm operations begin in January when the trees are dethorned. Operations that occur later in the year include pollination, training the fruit arms, strand thinning, fruit thinning, supporting the arms, spreading the strands, bagging the developing fruit, and harvest. Individual growers are increasingly forming cooperatives to pack the fruit at a centrally located packinghouse. At the house, fruit are graded, then packed, and placed in storage until shipment. Dates from the region are marketed by individual growers, and by the grower cooperatives, and sold to customers around the world. Palm trees are also sold for landscape purposes to customers across the United States.

Oral Session 37: Genetics and Germplasm 2

Thursday, July 19 **2:00–3:45 pm**

Room: Greenway A/B

Moderator: David Zlesak; zles0001@umn.edu

2:00–2:15 pm

A Plant Breeder's Guide to CSREES, or How to Help CSREES Help You

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This paper summarizes CSREES funding invested in plant breeding. It also includes information on how plant breeders can make best use of CSREES reporting systems—for stronger reporting of plant breeding accomplishments; and most effectively have input in agency planning. Finally, it describes the agency's new integrated programs, which can include plant breeding components. The mission of CSREES is to advance knowledge for agriculture, the environment, human health and well-being, and communities by supporting research, education, and extension in land-grant universities and other partner organizations. CSREES does not perform actual research, education, and extension, but rather helps fund it at the state and local levels, and provides program leadership.

2:15–2:30 pm

Fingerprinting and Genetic Stability of *Rubus* using Molecular Markers

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DNA markers were used in two studies involving germplasm identification of raspberries and blackberries and evaluation of genetic stability in four cryopreserved *Rubus* accessions that were stored for over 12 years in liquid nitrogen. In the first study, 12 genomic simple sequence repeat (SSR) markers and one expressed sequence tag- (EST) SSR were used to fingerprint 48 raspberry and 48 blackberry cultivars stored at the U.S. Department of Agriculture (USDA)–Agricultural Research Service (ARS)–National Clonal Germplasm Repository (NCGR) in Corvallis, OR. The *Rubus* SSR markers were polymorphic and distinguished between the raspberries and blackberries except in 'Logan' and 'Boysen' clones. In the second study, SSRs and amplified fragment length polymorphisms (AFLP) were used to evaluate genetic fidelity of regrown cryopreserved *Rubus* shoot tips stored for 12 years in liquid nitrogen. SSR analysis using 10 markers failed to detect variation in any of the regenerated shoots. AFLP revealed polymorphism in three out of the four *Rubus* genotypes that were subcultured for 7 months, while no polymorphism was detected in those analyzed immediately after recovery from cryopreservation. Such polymorphism might have been generated through somaclonal variation, possibly from callus tissue during propagation. This variation will be investigated using additional morphological and molecular analysis of adult regrown cryopreserved plants.

2:30–2:45 pm

Detecting Cultivar Influence within Invasive Populations of Japanese Barberry (*Berberis thunbergii* DC.) using AFLP

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Japanese barberry (*Berberis thunbergii* DC.) is an important landscape shrub and also an invasive plant. The appearance of ornamental cultivars differs from feral plants and brings into question whether cultivars contribute to invasive populations. Structure and principal coordinates analysis using 180 amplified fragment length polymorphism markers separated four popular ornamental forms, 'Aurea', var. *atropurpurea*, 'Crimson Pygmy', and 'Rose Glow', from 85 plants collected from five naturalized New England populations. One feral plant was similar in appearance to, and clustered with, var. *atropurpurea* plants. All other feral plants clustered together and separately from cultivars. Feral plants in all locations originated from at least two potential lines of ancestry. At two of the locations, five plants sampled possessed *B. vulgaris* morphology and two possessed *B.* ×*ottawensis* morphology. These individuals aligned more closely with known *B. vulgaris* and *B.* ×*ottawensis* plants than *B. thunbergii* plants. Presence of cultivar genetics was not detected from the study sites suggesting these invasions could have been established before the widespread use of ornamental genotypes for landscaping or that landscape cultivars may not be contributing to barberry invasions. Our findings support the emerging hypothesis that barberry invasions became established during the reforestation of abandoned farmlands in the mid-to-late 1800s. This natural process could have facilitated invasion by creating ideal habitats for barberry establishment.

Specified source(s) of funding for the work presented in this abstract: Private (Association, Foundation, Industry)

2:45–3:00 pm

Genetic Diversity of *Fragaria iinumae* and *F. nipponica* Based on Microsatellite Markers

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The U.S. Department of Agriculture (USDA)–Agricultural Research Service (ARS)–National Clonal Germplasm Repository (NCGR) in Corvallis, OR, is a genebank that preserves strawberry genetic resources. The *Fragaria* L. collection consists of 1769 accessions from 17 species and 37 countries. In 2004, two Asian diploid species, *F. iinumae* Makino and *F. nipponica* Makino were collected during an expedition in Hokkaido, Japan. The accessions were collected as seed (extracted from ripe fruit) and runner plants from 22 locations throughout Hokkaido (11 locations for each species). *Fragaria iinumae*, or its ancestor, may be a progenitor of the "B" genome for the cultivated octoploid strawberry, *F.* ×*ananassa* Duschesne. The objectives of this study were to evaluate the diversity of these two Asian species using microsatellite or simple sequence repeat (SSR) markers, and to determine the minimum number of seedlings representative of the diversity found in the parent populations. Twenty-two out of 72 *Fragaria*-derived SSRs amplified in these two species. We will describe the diversity of 81 *F. iinumae* and 63 *F. nipponica* accessions using 22 SSR markers.

3:00–3:15 pm

A Comparative Analysis of Genetic Diversity in Indian Bitter Gourd (*Momordica charantia* L.) Genotypes using RAPD and ISSR Markers

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Bitter gourd (*Momordica charantia* L.) or bitter melon is a cucurbit of major economic importance where it is widely cultivated (India, China, Africa, and South America). The morphology (i.e., growth habit, maturity, and fruit shape, size, color and surface texture) of Indian *M. charantia* germplasm (var. *minima* and *maxima*) is genetically diverse and gynoecious sex forms exist. Genomic differences exist in the Cucurbitaceae, and therefore DNA marker analysis was employed to investigate and compare genetic diversity among 38 elite genotypes, using 29 RAPD and 15 ISSR markers using cluster analysis. Twenty-nine RAPD primers yielded 208 amplicons of which 76 (36.5%) were polymorphic, with an average of 2.6 polymorphisms observed per primer. The number of RAPD amplicons ranged from 3 (OPE-19, OPW-09) to 15 (OPW-05), and varied in size from 200–3000 bp. Fifteen ISSR primers generated a total of 125 bands of which 96 (74.7%) were polymorphic. The number of polymorphic markers ranged from 0 (UBC-841) to 12 (UBC-890) with a mean of 6.3 markers per primer where amplicon sizes ranged from 150 -2700 bp. ISSR markers detected a higher level of polymorphisms (74.7%) in bitter gourd when compared to RAPD markers (36.5%). An evaluation (Mantel test) between two Jaccard's similarity matrices was high (r=0.77), indicating a relatively high correlation between RAPD- and ISSR-based similarities. Cluster groupings of genotypes within sub-groups derived from RAPD and ISSR marker analysis were not similar. In contrast, concordant genotype cluster groups remained were, in the main, the same when ISSR and combined RAPD + ISSR analyses were compared. *Momordica charantia* var. *minima* and *maxima* were distinct.

3:15–3:30 pm

A Dominant Male Sterility Gene, *RSMS1*, Derived from Female *Rosa setigera* Mich. and Its Introgression into Modern Roses

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Rosa setigera is the only dioecious rose species and the only rose species within the section Synstylae native to North America. Each plant has visible female and male organs, but only one gender is functional. Reciprocal crosses were made between sexed *R. setigera* clones (two males and one female) and 95-1, a polyantha rose, and female *R. setigera* and 'Mevrouw Nathalie Nypels'. Hanging drop pollen germination assays were used to determine male fertility or sterility. Unilateral incompatibility was present; seeds formed only when *R. setigera* was the female. All interspecific F_1 seedlings (n=22) were male sterile and possessed limited female fertility. Backcrosses to polyantha roses resulted in eight offspring (4:4; male sterile:fertile). One male sterile backcross seedling was crossed as a female with two different polyantha selections (n=85 seedlings). Segregation fit a 1:1 model for male fertile:sterile offspring. We propose a dominant gene (*RSMS1*) that confers male sterility and is homozygous dominant in our female *R. setigera* clone. In the heterozygous state, it is able to confer male sterility in interspecific F_1 hybrids and two backcross generations. Further characterization of this sterility gene can aid in understanding the evolution of dioecy in *Rosa*. Introgression of this sterility gene

into cultivated roses could serve to modify plant architecture based on altered gender resource allocation, limit gene flow from transgenics, and limit pollen-based allergens.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

3:30–3:45 pm

Development of a Real-time NASBA Assay for Detection of Apple Scar Skin Viroid

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Apple scar skin viroid has been distributed in the Korean peninsula widely since 2001, first reported in Korea. In apples infected with ASSVd, dappling of the fruit appeared and became more intense without symptoms on leaves, stems, and the other organs. Aiming to screen disease-free apple varieties, we have developed an assay for the detection of ASSVd based on nucleic acid sequence based amplification (NASBA) in combination with real-time detection during the amplification process, using a molecular beacon. Design of the ASSVd specific primers for amplification of the viral RNA by NASBA, and a molecular beacon for detecting the viroid, was based on highly conserved regions of several ASSVd isolates. This assay was optimized at 60 mM KCl, 30 μM primers, 10 μM molecular beacon, and 2 mM ITP. Compared with the established RT-PCR method, the real-time NASBA was 100-fold more sensitive than that for ASSVd detection. This study has shown that real-time NASBA provides good sensitivity, robust detection, and high-throughput diagnosis of apple stock materials.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

Oral Session 38: Floriculture 3

Thursday, July 19 **2:00–4:00 pm**

Room: Kirkland

Moderator: Daniel F. Warnock; dwarnock@uiuc.edu

2:00–2:15 pm

Vernalization of Remontant Iris

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Remontant or reblooming iris flower multiple times per growing season. *Iris germanica*, tall bearded iris, have long been used as cut flowers. Reliable reblooming of iris would offer a supply of cut iris over an extended season. Only a few iris cultivars on the market are listed as reliably reblooming and the frequency of reblooming is highly environment and cultivar dependent. The natural growth cycle of iris is to bloom in the spring, grow vegetatively until fall until going dormant through winter before repeating the cycle. The remontant iris often rebloom in the fall before going dormant depending on the local environment. Reblooming is not consistent nor reliable. A study was conducted to determine if a vernalization treatment could synchronize and enhance reblooming in remontant iris. Rhizomes of 'Duo Dandy', 'Imortality', 'Jennifer Rebecca', and 'Total Recall' iris arrived mid-Aug. 2006 and were either packed in moist moss peat and placed in coolers on 26 Aug. for vernalization or potted in Sunshine Mix 1 and allowed to root for 2 weeks before being placed in the cooler for vernalizing. Rhizomes were vernalized for 0, 2, 4, or 6 weeks at 4.5 °C. The case vernalized rhizomes were potted immediately after removal from the cooler. Treatments were replicated 6 times and were arranged in a complete randomized design. Data were collected on a number of inflorescences, number of shoots, and date of first bloom. 'Jennifer Rebecca' was the only variety to be affected by method of vernalization, producing more inflorescences when rooted before cooling. Length of vernalization time had no effect on the number of inflorescences for three of the varieties. 'Jennifer Rebecca' produced more inflorescences when potted, then vernalized for 6 weeks.

2:15–2:30 pm

The Optimum Temperature for Vernalizing *Campanula* 'Birch Hybrid' Depends on the Flowering Response Being Assessed

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The objective of the current study was to characterize the flowering responses of *Campanula* 'Birch Hybrid' to a range vernalizing of temperatures and durations. Clonally propagated *Campanula* 'Birch hybrid plants were exposed to –2.5, 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5 or 20 °C for 0, 3, 5, 7, 9 or 12 weeks and subsequently grown in a greenhouse at 20 °C under 16-hour photoperiod. *Campanula* 'Birch Hybrid' exhibited a near-obligate vernalization requirement for flowering and all flowering responses assessed were influenced by vernalization temperature, duration and their interaction. The minimal and maximal cardinal temperatures for vernalizing *Campanula* 'Birch Hybrid' were <0 °C and between 15 and 17.5 °C, respectively. The range of optimal vernalizing temperature (T_{opt}) varied between 2.5 to 12.5 °C based on the flowering response assessed. For example, T_{opt} for flowering percentage was 0 to 12.5 °C; whereas T_{opt} for rate of progress to flowering was 5 to 7.5 °C. Additionally, T_{opt} for flowering time varied when analyzed as rate of progress to flowering, time to flower from end of temperature treatments, total time to flower measured from the start of temperature treatments and thermal time to flower measured from the initiation of temperature treatments as average daily temperature above the base temperature. For example, following 12-week treatment, T_{opt} for thermal time to flower was 7.5 °C and for time to flower and total time to flower the range of T_{opt} broadened to 2.5 to 12.5 °C. Since the flowering response assessed altered the T_{opt}, this study reiterates the significance of considering all relevant flowering responses while developing and interpreting vernalization models.

2:30–2:45 pm

Cooling Requirement of a Hybrid Nobile Dendrobium for Flowering

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The nobile dendrobium (hybrids of *Dendrobium nobile*) is a relatively new pot orchid that must be exposed to moderate temperatures to induce flowering. The objective of this study was to quantify the cooling requirements for flowering. One-year-old liners of *D. Sea* Mary 'Snow King' were potted in 10-cm pots on 18 Feb. 2006 and fertilized with

15N–2.3P–12.9K at 0.5 g·L^{-1} until being terminated on 1 Sept. Treatments started on 13 Nov. and consisted of four temperatures (10, 13, 15, and 18 °C), each with three durations (2, 3, and 4 weeks) in light. Following treatment, plants were moved to a greenhouse maintained at 25 day/20 °C night. Interactions between temperature and duration were significant on days to anthesis and full flowering, and flower diameter. Regardless of temperature, increasing cooling duration from 2 to 4 weeks decreased the time needed to reach anthesis (49 to 42 days) once plants were moved to a warm greenhouse. For all durations, plants that were cooled at 13 or 15 °C required the least amount of time (43 days) to reach anthesis and full flowering than 10 or 18 °C (48 days) upon the completion of cooling. Plants cooled at 15 or 18 °C for 2 or 3 weeks had larger flowers (6.8~7.0 cm). Plants that received 15 °C or lower temperatures had more nodes with flowers (9.1 to 9.6) and greater total flower counts (27 to 29) than those exposed to 18 °C (8 nodes and 21 flowers). The results suggest that 3 weeks of cooling at 13 or 15 °C produce high quality flowering plants that require less time to reach flowering following cooling.

Specified source(s) of funding for the work presented in this abstract: Private (Association, Foundation, Industry)

2:45–3:00 pm

Preventing Cold-storage-induced Bud Necrosis in 'Mona Lisa' Lilies

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A postharvest bud necrosis problem has been identified in 'Mona Lisa' oriental lilies. It is characterized by sunken, darkened or brownish areas on unopened buds during cold storage after forcing, and especially occurs when plants are finished in hot summer periods. We investigated the conditions that trigger bud necrosis in order to reduce the problem. Plants were grown at 24 °C in a glass greenhouse and moved under to 0%, 55%, or 85% shade in combination with supplementary lighting for 12 hours (8 am to 8 pm) at 1 week before puffy bud stage (the most mature bud of the inflorescence showing full color, but not open). Maximum photosynthetically active radiation (*PAR*) was ranging from 400 to 660 umol·m^{-2}·s^{-1} on the top of unshaded plants. Then plants were transferred directly to 3 °C (98% RH in darkness) or kept at 7 °C cooler for 2 days then moved to 3 °C. The plants showed severe bud necrosis when moved directly to 3 °C cold storage. Heavier shade (85% shade) effectively reduced the development of bud necrosis. When plants were first acclimatized at 7 °C then moved to 3 °C, bud necrosis was greatly inhibited regardless of shade level during production. Therefore, we concluded that bud necrosis is strongly associated with high light during production and that heavy shade alone, or in combination with acclimatizing at 7 °C for 2 days before 3 °C would greatly reduce the bud necrosis problem.

Specified source(s) of funding for the work presented in this abstract: Federal competitive

3:00–3:15 pm

Variation in Chilling Sensitivity among Eight *Dieffenbachia* Cultivars

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This study evaluated the chilling sensitivity of eight popular *Dieffenbachia* cultivars. Tissue-culture liners of the cultivars were potted in 15-cm-diameter pots using Vergo Container Mix A and grown in a greenhouse under 70% light exclusion for 5 months. The plants were then chilled in coolers by exposure to 2, 7, or 12 °C for 6, 12, or 24 hours. Chilled plants were placed back into the greenhouse for chilling injury evaluation. No visual injury was observed among plants chilled at 7 and 12 °C except 'Tropical Honey', which had 25% of leaves injured at 7 °C after either 12 or 24 hours of chilling. However, more injury occurred at 2 °C, and the longer the exposure at this temperature, the greater the injury. Based on the percentage of injured leaves at 2 °C for 24 hours, the sensitivity of the eight cultivars were ranked as follows: 'Tropic Honey' (100%) > 'Sterling' (89% ab) > 'Carina' (84% b) > 'Octopus' (78% b) > 'Camille' (52% c) > 'Camouflage' (48% c) > 'Star Bright' (27% d) > 'Panther' (0% e). Visible symptoms of injury included initial water-soaked patches on leaves, necrotic lesions two days later, in some instance followed by completely dried-out leaves or death of plants. In addition to leaf injury, stems were observed to be water-soaked at the base in some cultivars. Among the cultivars evaluated, 'Panther' was the most tolerant one with no visibly injured leaves. 'Tropic Honey' was the most sensitive cultivar; all plants exposed to 2 °C, even for 6 hours, were completely dead with stem rot and leaf desiccation. This study showed that genetic variation in chilling sensitivity exists among cultivated *Dieffenbachia*. The use of chilling tolerant cultivars may reduce the chance of injury during heating outages and shipping. In addition, their use could also conserve energy used for greenhouse heating.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

3:15–3:30 pm

Abnormal Flower Formation and S-adenosylhomocysteine Hydrolase Gene Expression in Response to High Temperature of Chrysanthemum

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Chrysanthemum [*Dendranthema* ×*grandiflorum* (Ramat) Kitamura] is a major cut flower and produced all over year. During summer, high temperatures (HT) decrease cut flower quality by inducing abnormal flower. In this experiment we observed that the effects of high temperature and day length in abnormal flower formation and tried to find out differentially expressed genes in chrysanthemum cv. Lerbin. Plants were exposed to three different day temperature of 25, 30, or 35 °C from 14 to 27 days after starting short day. Day length of 12 to 14 hours with a 30-minute interval was treated at the same stage. Abnormality, scored based on the ray floret number in floral disc, increased as the day temperature was increased from 25 to 35 °C. Day length above 13 hours induced abnormal flower by increasing ray floret about 2-fold at the flower disc. Abnormal flower formation was considerably affected by period in which plants were exposed to the HT within a day. In spite of the same duration of HT (4 hours), abnormality was severe at 4 hours of HT treatment of just before night. HT at starting day time or midday time did not induce abnormal flower. Differentially expressed genes (DEG) between normal flower inducing treatment of short day (25/20 °C, 12 hours/12 hours) and two abnormal flower inducing treatment of HT (35/20 °C, 12 hours/12 hours) and long day(25/20 °C, 14 hours/10 hours) were screened using the GeneFishingTM DEG kits. Among six DEGs, we selected one putative gene, S-adenosylhomocysteine hydrolase (SAHH), which expression was decreased in abnormal flower inducing treatment of HT and long day. SAHH transcripts of flower buds in 4-hour HT before night showed very faint transcripts. By contrast, SAHH transcripts accumulated in flower bud of non-abnormality inducing condition.

3:30–3:45 pm

Environment Impacts Impatiens Resistance to Western Flower Thrips Feeding Damage

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Western flower thrips (WFT), *Frankliniella occidentalis* (Pergande), is a pest of greenhouse grown floriculture crops worldwide. Plant resistance varies in commercially available cultivars of impatiens, *Impatiens wallerana* Hook. f., with some commercial cultivars exhibiting reduced feeding damage by thrips. To determine if the production environment can be used to enhance resistance, two impatiens cultivars with differential resistance levels were provided low, optimal, and high levels of water, light, and temperature. After environmental treatment application, 10 insect-free plants of each cultivar were exposed to more than 1000 laboratory-reared WFT. Thrips were allowed to choose and feed on individual plants for 3 weeks followed by visual evaluations to estimate feeding damage. Feeding damage varied among treatments and cultivar. The resistant cultivar Cajun Carmine showed decreased resistance under optimal environmental conditions when compared to water stressed conditions. The susceptible cultivar Impulse Lilac Splash remained susceptible regardless of the environmental stresses imposed. The ability to enhance host plant resistance to western flower thrips through cultural manipulation is of interest to commercial greenhouse managers seeking alternative control options for this pest. The combination of host plant resistance and environmental manipulation may reduce insecticide use in commercial greenhouses.

Specified source(s) of funding for the work presented in this abstract: Department, College, State and/or HATCH

3:45–4:00 pm+

Bedding Plant Plugs Suffering from "Stubby Plant Syndrome"

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Pansy, gerbera, and petunia plugs with distorted terminal growth has been a production problem and is thought to be a deficiency of either boron (B) or calcium (Ca). Plants with B or Ca deficiencies both produce symptoms on the newly developing tissue which can cause confusion. Plants were grown hydroponically in a complete modified Hogland's solution, minus B or minus Ca for 5 weeks. Visual symptoms of plants treated with the minus B solution were similar to plants seen in production greenhouses. Boron tissue concentrations were not detected for pansy, gerbera and petunia, compared to the controls, 31.8, 37.4, or 29.7 ppm, respectively. Tissue concentrations of pansy, gerbera and petunia plants treated with minus Ca solution, 0.03%, 0.1%, or 0.05%, respectively, were significantly lower when compared to tissue concentrations in the control plants, 0.97%, 1.1%, or 1.5%, respectively. When comparing symptoms of the two deficiencies, a unique set of visual characteristics stand out to easily differentiate between the problems. Calcium-deficient plants will typically be small and leaves quickly turn necrotic, while B-deficient plants will have distorted growth that remains green.

Specified source(s) of funding for the work presented in this abstract: Private (Association, Foundation, Industry)