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measured by plant volume. The plant volume was presumably due to an increase in shoot length, number of leaves, an increase in leaf size, or a combination of these factors which were not measured individually. For rose, ProVide decreased the number of flowering shoots in comparison to the control in mid-summer, but this difference was not significant by the end of the season. At the end of the season, MaxCel treated plants were shorter and smaller (as measured by volume) than the control, and had the lowest increase in plant volume over the season than all the other treatments. Studies of the effect of these plant growth regulators at higher rates and on branching of unpinched plants is warranted.

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(388) Photosynthetic Characterization and Water-use Efficiency of *Hibiscus rosa-sinensis*

Amy Fulcher*, Univ. of Kentucky, Lexington, KY, afulcher@uky.edu

Robert Geneve, Univ. of Kentucky, Lexington, KY, rgeneve@uky.edu

Joey Norikane, Univ. of Kentucky, Lexington, KY, jnorikane@bae.uky.edu

Photosynthesis was characterized for *Hibiscus rosa-sinensis* with the goal of developing an irrigation model that maintains a high photosynthetic rate while minimizing water use. Light response curves were generated using a LI-COR 6400 with CO₂ at 400ppm to determine the maximum photosynthetic rate at saturating light conditions (19.4 $\mu\text{moles CO}_2 \text{ m}^{-2} \text{ s}^{-1}$), quantum yield (0.063 moles of photons absorbed per moles of CO₂ fixed), dark respiration rate (1.81 $\mu\text{moles CO}_2 \text{ m}^{-2} \text{ s}^{-1}$), and the light compensation point (28.7 $\mu\text{mol} \cdot \text{m}^{-2} \cdot \text{s}^{-1}$ of light). Plants were subjected to a drought period during which photosynthesis was measured at saturating light conditions (1500 $\mu\text{mol} \cdot \text{m}^{-2} \cdot \text{s}^{-1}$ of light) for a range of increasingly drier volumetric water contents (VWC). A second order regression equation ($r^2 = 0.54$) described the relationship between maximum photosynthetic rate and maximum substrate water content. Based on this model, *Hibiscus* plants were produced in the greenhouse with irrigation set points for substrate moisture levels that correlate to 100%, 90%, 80%, and 70% of maximum photosynthesis. Substrate moisture levels are determined and controlled using ECHO-TE dielectric probes connected to a Campbell CR1000 datalogger with AM16/32 multiplexer. Photosynthesis measured periodically prior to an irrigation event, as well plant growth and biomass will be used to determine water use efficiency and validate the appropriateness of the irrigation model.

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

(389) Salinity Tolerance of Cacti and Succulents

Ursula K. Schuch*, Univ. of Arizona, Tucson, AZ, ukschuch@ag.arizona.edu

Jack J. Kelly, Univ. of Arizona, Tucson, AZ, jkelly@ag.arizona.edu

Deteriorating water quality exposes cacti and succulents in urban landscapes to increasing salinity conditions. Although large numbers of cacti and succulents are already established in Southwest landscapes little is known about their salinity tolerance. The salinity tolerance of golden barrel cactus (*Echinocactus grusonii*), ocotillo (*Fouquieria splendens*), saguaro cactus (*Carnegiea gigantea*), and Gentry's agave (*Agave parryi truncata*) was tested. Plants were transplanted into 2-gallon containers with a mix of sand and pumice (50/50 vol.) and were grown outdoors in full sun in Tucson, Arizona from May to November 2006. Plants were irrigated with a fertilizer solution that was augmented with a 3:1 ratio of sodium chloride and calcium chloride to obtain salinity levels of EC 0.6, 5.0, 10.0, and 15.0 dS/m. Duration of treatments were 18 weeks for saguaro and 26 weeks for the other three species. In general, fresh weight, dry weight, and moisture content decreased with increasing salinity levels, with the exception of saguaro dry weight which was not affected by the treatments, and ocotillo moisture content which increased with increasing salinity. Runoff was collected three times during the

experiment and indicated that ion uptake was higher for barrel cactus than the other three species. EC of runoff averaged for all dates and species was 0.7 dS/m, 7.7 dS/m, 14.6 dS/m, and 24.6 dS/m for the salinity treatments of 0.6, 5.0, 10.0, and 15.0 dS/m, respectively.

(390) Irrigation Application According to Plant Demand for Container Nurseries

Aaron Warsaw*, Michigan State Univ., Lansing, MI, warsaw@msu.edu

Tom Fernandez, Michigan State University, East Lansing, MI, fernan15@msu.edu

Bert Cregg, Michigan State Univ., East Lansing, MI, cregg@msu.edu

Jeff Andresen, Michigan State University, East Lansing, MI, andresen@msu.edu

The objective of this experiment was to determine if irrigating at or below daily water requirement (DWR) can lead to increased water conservation versus a traditional irrigation amount without negatively affecting plant growth. DWR was calculated as the difference in volumetric soil moisture content measured by a theta-probe Type ML2x, one hour after irrigation and prior to irrigation the following day. Ten taxa in #3 containers were evaluated under four irrigation treatments: 1. 19 mm per day as a control, 2. 100% DWR per day, 3. alternating 100% DWR with 75% DWR, and 4. alternating 100% DWR one day with the next two days at 75% DWR. Treatments ran from June 14 through October 13, 2006 at the Michigan State Univ. Horticulture Teaching and Research Center in Holt, Michigan. Taxa response to treatments was measured by monthly growth index (GI), bimonthly net photosynthesis, internode length, and leaf area. Taxa were grouped into water use classifications (low, medium, and high) according to average DWR. Treatment 2 resulted in water savings of 69.5%, 60.7%, and 31.6% for the low, medium, and high water classifications versus the control with increased savings for treatments 3 and 4. GI varied among treatments 2, 3, and 4 which for all taxa, except one, had GI values higher than control. Differences were observed for all except two taxa, one of which included the only case where control had a higher GI value than any other treatment. Means were separated using Duncan multiple range test ($P = 0.05$). Irrigating at or below DWR conserved water and increased plant size for most of the plants during this study.

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

(391) Univ. of California Program to Protect Water Quality in Greenhouses and Nurseries

Julie Newman, Univ. of California Cooperative Extension, Ventura, CA, jpneman@ucdavis.edu

Donald Merhaut*, UC Riverside, Riverside, CA, donald.merhaut@ucr.edu

Salvatore Mangiafico, Univ. of California Riverside/Cooperative Extension Ventura County, Ventura, CA, salvatore.mangiafico@yahoo.com

Amy Ellis, UCCE Ventura County, Ventura, CA, allellis@ucdavis.edu

Dale Zurawski, UCCE Ventura County, Ventura, CA, dezurawski@ucdavis.edu

Kristine Gilbert, UCCE Ventura County, Ventura, CA, kdgilbert@ucdavis.edu

Jay Gan, Univ. of California, Riverside, Riverside, CA, jgan@ucr.edu

Laosheng Wu, Univ. of California, Riverside, Riverside, CA, laosheng.wu@ucr.edu

Richard Evans, Univ. of California, Davis, Davis, CA, ryevas@ucdavis.edu

Ben Faber, UCCE, Ventura County, Ventura, CA, bafaber@ucdavis.edu

Nineteen California nurseries in Ventura and Los Angeles Counties received funds to implement 36 improvement projects to reduce runoff from a 1.2 million dollar cost-share program we initiated. We monitored flow and water quality in wet and dry seasons before and after the improvements were installed to assess their effectiveness in reducing runoff and loading. The highest nutrient loads were from nursery sites where planned improvements included the installation of recycling systems or detention basins. For each of these sites, there

was no measurable runoff carrying nutrients and pesticides leaving the property from irrigation events once these projects were completed. The median water savings by recycling systems was 136,000 gallons/acre/year. Irrigation upgrade projects increased the uniformity of irrigation water application by 10 to 50 percent. We also conducted an on-site evaluation of management practices to improve water quality implemented at 67 nursery operations. Growers completed a 142-question self-assessment to evaluate current nursery operations and areas in need of improvements. Questions included irrigation management, erosion and runoff management, soil/media management, fertilizer management, integrated pest management, and property management. After attending a minimum of one year of training by participating in our quarterly educational program and in staff evaluations of management practices, the growers then filled out the same questionnaire. A comparison of pre-survey and post-survey results showed that by attending our educational meetings over the course of the project, nurseries increased the number of positive management practices implemented in every area.

Poster Session 11: Plant Biotechnology—Tissue Culture 1
Monday, July 16 1:15–2:00 pm

(203) Plant Regeneration of *Viburnum dentatum* From In Vitro Leaf Tissues

Wenhao Dai*, North Dakota State Univ., Fargo, ND, wenhao.dai@ndsu.edu
Cielo Castillo, North Dakota State Univ., Fargo, ND, cielo.castillo@ndsu.edu

Plants were regenerated from in vitro leaf tissues of *Viburnum dentatum*, a popular shrub species for landscape use. Regeneration of adventitious shoots from two cultivars, *V. dentatum* 'Synnesvedt' and *V. dentatum* 'Arrow wood', was achieved when leaf tissues were cultured on Woody Plant Medium (WPM) supplemented with either benzyladenine (BA) or thidiazuron (TDZ). Effects of cytokinin concentration, indole-3-butyric acid (IBA), and dark treatment on shoot regeneration were investigated. Dark treatment of in vitro tissues in the regeneration medium for the first four weeks significantly increased regeneration rate. Without dark treatment, less than 10% of explants developed shoots. The maximum regeneration rate occurred on 4–8 micro molar TDZ- or 5–20 micro molar BA-containing medium with an average of 70% and 55% of explants forming shoots, respectively. The third cultivar failed to regenerate in the same medium showed that *Viburnum* regeneration is genotype dependent. Addition of IBA slightly enhanced shoot regeneration. Regenerated shoots were transferred to Murashige and Skoog (MS) medium supplemented 0–5 micro molar BA for proliferation and shoot elongation. Elongated shoots (> 1.5 cm) were subjected to rooting in half strength MS medium containing 0–10 micro molar IBA or naphthalene acetic acid (NAA). Rooted plants will be then transferred to potting medium and grown to maturity in the greenhouse.

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(204) Micropropagation of Some *Acacia* spp. Growing Wildly in Saudi Arabia

Khadiga Alharbi*, Scientific Department, Botany Division, Girls College, P.O. Box 10789, Riyadh 11433, e-mail: akhr100@yahoo.com

Abdelrahman S. AL-Wasel, Department of Plant Production and Protection, College of Agriculture and Veterinary med., Qassim Univ., P.O. Box 1482, Saudi Arabia, e-mail: awasel@yahoo.com

Seedling shoot tips of germinated seeds of *Acacia victoria* and *Acacia ampliceps* on growth regulator-free Murashige and Skoog (MS) medium were used as explants for in vitro propagation. Seeds were disinfected with different concentrations of Clorox (5.25% Sodium hypochlorite) and 90% Ethanol. The concentration of 5% and 10% Clorox and 60% of Ethanol for 10 minutes gave the lowest contamination percentage (0%) in both *Acacia* cultivars. The two cultivars showed different response

to the salt level of MS medium and growth regulator concentrations in terms of shoot multiplication and rooting. The highest multiplication rate (13.4 shoots/explant) for the *A. Victoria* was on half salt strength of MS medium supplemented with 1 $\mu\text{M}\cdot\text{L}^{-1}$ of both 6-benzyladenine (BA) and naphthalene acetic acid (NAA), whereas *A. ampliceps* gave multiplication rate (16 shoots/explant) on full strength of MS medium with 3 $\mu\text{M}\cdot\text{L}^{-1}$ (BA) only. Half salt strength of MS medium supplemented with 3 $\mu\text{M}\cdot\text{L}^{-1}$ NAA was promoted shoot rooting for *A. victoria*, and gave the highest root percentage (70%) and average root number (2.5 roots/shoot), whereas full strength of MS with 1 $\mu\text{M}\cdot\text{L}^{-1}$ NAA induced the highest rooting percentage (88.88%) and average root number (2.1 roots/shoot) in *A. ampliceps*.

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

(205) High Efficiency Somatic Embryogenesis and Plant Regeneration in Suspension Cultures of an Ornamental Ginger Hybrid (*Hedychium muluense* × cv 'Starburst')

Hamidou F. Sakhanokho*, USDA–ARS, Poplarville, MS, hsakhanokho@msa-stoneville.ars.usda.gov

Rowena Y. Kelley, Mississippi State, Mississippi State, MS, RKelley@msa-stoneville.ars.usda.gov

Kanniah Rajasekaran, USDA–ARS, New Orleans, LA, krajah@src.ars.usda.gov

Plants were successfully regenerated via somatic embryogenesis from shoot apex-derived callus of an ornamental ginger hybrid, *Hedychium muluense* × cv. 'Starburst'. *H. muluense* is a dwarf species and 'Starburst' is a hybrid cultivar with white and very fragrant flowers in a circular, wheel-like arrangement around small spikes. Friable embryogenic callus induced on a modified Murashige and Skoog (MS) medium supplemented with 9.05 μM 2-4, D and 4.6 μM kinetin was selectively transferred into a suspension culture medium consisting of MS basal salts and Gamborg's vitamins and supplemented with 0.6 μM thidiazuron (TDZ) and 8.9 μM 6-benzylaminopurine (BA) and shaken for four weeks. The cultures were then transferred to an embryo development medium containing 0.6 μM TDZ and 8.9 μM BA. After four weeks, somatic embryos produced on this medium were successfully converted into rooted plantlets on a medium supplemented with 0.6 μM 3-indoleacetic acid (IAA). The plantlets were readily acclimatized before transfer to the greenhouse. This work establishes a very efficient in vitro regeneration system for a possible mass production and genetic manipulation of this ornamental ginger hybrid line.

(206) Using Amino-purine Cytokinins to Optimize Microshoot Production of Bigtooth Maples

Clare Bowen-O'Connor*, New Mexico State Univ., Las Cruces, NM, clareb@nmsu.edu

Cynthia Killough, New Mexico State Univ., Las Cruces, NM, bacac@nmsu.edu

Dawn VanLeeuwen, New Mexico State Univ., Las Cruces, NM, vanleeuw@nmsu.edu

Rolston St. Hilaire, New Mexico State Univ., Las Cruces, NM, rsthilai@nmsu.edu

Two-node shoots of bigtooth maple (*Acer grandidentatum* Nutt.) were placed on Driver-Kuniyuki Walnut (DKW) tissue culture media containing either benzylamionopurine (BAP), isopentyladenine (2iP), 1 *H*-purine-6-amine (kinetin) or (E)-2-methyl-4-(1 *H*-purin-6-yl-amino)-2-buten-1-ol (zeatin) at 10 μM . Shoots represented two genotypes from Guadalupe Mountains, Texas and one genotype from Lost Maples State Natural Area, Texas. At 180 days, microshoot proliferation was similar ($P = 0.5997$) among the four media. Shoots exposed to zeatin proliferated the most shoots, four shoots per explant. So, exposure to cytokinins other than zeatin did not cause higher shoot proliferation in bigtooth maples. Additionally, shoots were exposed to