PROCEEDINGS OF
PAPERS PRESENTED

The National Floriculture Forum (NFF) is an educational meeting of university professors, graduate students, government scientists, and industry leaders in floriculture that has been held annually for over a decade. This meeting brings together the floricultural community to: (1) address issues of importance to the floriculture industry, (2) form collaborative relationships, and (3) learn more about the floriculture industry and from each other.

March 10, 2011

Dallas, Texas

Maximizing industry benefit through cooperation between federal, state and private-sector floricultural research efforts.

James Locke[1] and Jonathan Frantz[2]

[1]USDA-ARS, Greenhouse Production Research Group, Toledo, OH 43606

[2]USDA-ARS, New England Plant, Soil, and Water Laboratory, Orono, ME 04469

jim.locke@ars.usda.gov

Index Words: greenhouse production, Virtual Grower software, plant nutrition, silicon interaction

The USDA-ARS Greenhouse Production Research Group was established to provide a federally funded research emphasis on greenhouse crop production. It has focused on broad production issues (nutrition, water management, and energy conservation) by coordinating research between in-house researchers, University of Toledo cooperators, and existing centers of floricultural expertise. The group has served to bring together efforts on the development of the "Virtual Grower" software package, plant nutrition studies, and silicon evaluations. The project looks to continue developing interactions with local, regional, national, and international expertise, private sector interests, and stakeholder groups to maximize the use of limited resources.

From the initiation of this federally-mandated project eight years ago, the USDA-ARS Greenhouse Production Research Group has sought cooperation with in-house (USDA) researchers as well as university and extension collaborators on projects related to protected horticulture production. USDA has invested resources in the project to support: two research scientists, six technical support personnel (three permanent, three term), a post-doc, and intermittent support help (student workers); analytical instrumentation to do complete tissue, water and soil analyses, lab equipment and controlled environment facilities (growth chambers and greenhouse) to support pathology, hydroponic, nutrition, and growth medium studies; and computer/IT capabilities to develop software, video, electronic and hard copy materials. Recognizing that these resources provide the capacity to conduct research activities beyond the scope of the resident staff, cooperations have been established to multiply the research output from this effort. The University of Toledo, serving as the cooperating partner and host institution, has provided the opportunity to partner with faculty members in the Departments of Biological Sciences and Environmental Sciences, Departments in the College of Engineering, as well as to be a collaborator in the Plant Science Research Center which is housed in the same building complex. Other local partnerships include: The Toledo Botanical Garden, The Toledo Area Flower & Vegetable Growers Association, and the Maumee Valley Growers Association. Proximity to other major universities involved in horticultural research; Ohio State, Michigan State, and Purdue, has provided opportunity for exchange visits and interaction on projects of mutual interest. The USDA Floral and Nursery Research Initiative has linked this project with other researchers through administering Specific Cooperative Agreement funding to several university-based projects as well as the Ornamental Plant Germplasm Center. Other partnerships have been established at the University of Toledo, to primarily provide access to facilities and expertise, which have expanded the capabilities of the USDA project. These partnerships include involvement in the Plant Science Research Center which brings together research projects in the plant sciences and the Center for Materials and Sensor Characterization, based in the College of Engineering, with whom we currently share analytical (ie. ICP-MS) and microscope equipment (ie. SEM) and expertise.

Scope of Research Projects:

The initial stated mission of the project was to conduct fundamental and developmental research on production technologies, diseases, pests, and abiotic stresses for the greenhouse ornamental industry and to transfer that technology to the industry. After surveying the regional production industry to determine the priority researchable needs, the project began to focus on 1) plant nutritional requirements to optimize production and enhance quality, 2) developing new and/or improved methods to detect, quantify, and manage biotic and abiotic stresses in crop culture and, 3) evaluating existing and alternative growth medium components to enhance crop growth. Research undertaken to date has included studies on determining optimal nutrition requirements of selected bedding plants, the potential role of silicon in combating plant stresses, modification of cultural practices such as fertilization practice and substrate components, development of technology to non-destructively determine nutrient and pathogen stress, and development of software to optimize production systems through more informed economic decision making. These studies have been carried out through a combination of in-house and cooperative approaches drawing upon the expertise of numerous researchers. In some cases this has included the partial support of graduate students whose research has contributed to the overall research objectives. Deliverables to the floricultural industry have included traditional peer-reviewed publications, presentations in various venues, and production of grower-friendly diagnostic and recommendation guides. The Group maintains a comprehensive web page (http://greenhousescience.net/) which tracks research and outreach activities as well as links to research publications and the Virtual Grower software.

Selected Results and Outcomes:

<u>Nutritional studies</u>

Initial nutritional studies conducted in-house evaluated the effect of nitrogen concentration on growth and development parameters of two important flowering pot crops, Elatior begonia and New Guinea impatiens, and the interaction of nitrogen level on susceptibility to grey mold (*Botrytis cinerea*). The optimal level for nitrogen, based on appearance, growth and development, as well as susceptibility to *Botrytis* was found to be lower than is generally utilized in commercial production. The conclusion was that elevated, but non-toxic levels of nitrogen can lead to significant growth effects on these crops (12). Using geranium as the model, a comprehensive nutrient deficiency study was conducted on a nutrient by nutrient basis summarizing the role of each nutrient, corrective measures, and providing a diagnostic key and color plates to illustrate each nutrient deficiency (3). This project also resulted in a grower manual that was utilized in grower workshops. Because of their importance to the bedding/pot plant industry, geraniums were selected to conduct studies to determine the role of various factors on substrate acidification. This collaboration was carried out with North Carolina State University (NCSU) and demonstrated that 1) high temperature can induce acidification (15), 2) high light intensity may suppress phosphorus uptake which may contribute to substrate acidification if phosphorus becomes limiting (16), and 3) changes in cation and anion uptake and the associated increase in H^+ extrusion under phosphorus-stress can contribute to acidification (17). In another collaboration with NCSU, upper and lower nutritional limits were established for each nutrient over cropping time in gerbera by analyzing plant growth. The optimal nutrient ranges were narrower than previously published recommendations for containerized gerbera (8). Currently, studies are being conducted with popular bedding plant crops to determine the period of time that a plant can be deficient of a specific nutrient and still be recovered as a marketable plant. This information is targeted at assisting a grower in determining when it would be more cost effective to “dump” a crop showing a deficiency as opposed to correcting the deficiency.

Silicon studies

Research on the potential role of silicon (Si) in greenhouse crop production was initiated early on as a component of this project (1). A survey of over 50 crops was conducted to determine which ones take up and accumulate Si from the substrate and where it is accumulated. A few crops accumulate Si in tissue at levels greater than nitrogen or potassium and all crops that have detectible Si accumulate at concentrations greater than the micronutrients boron, copper, and zinc (7). To assist in this determination, methodology for Si analysis was reviewed and compared to develop the most effective and useable method for our purposes (5). Several areas of potential benefit of Si are being explored both in-house and through cooperators representing various disciplines. The use of supplemental Si has been shown to reduce/delay the development of powdery mildew on several crops in greenhouse culture when supplied either by direct drench application to the growing medium or through release from Si-containing materials, both organic and inorganic, incorporated into the medium. In cooperation with our Wooster, OH colleagues, an effect on aphid populations on zinnia was demonstrated but it was not of a commercially acceptable level to warrant further exploration (13). In cooperation with UT researchers, Si was shown to provide a reduced level of copper (Cu) toxicity and this lead is being pursued with other crops which might be sensitive to Cu applied either as sanitizers or pesticides in commercial production (10). Since soilless growing media contain lower amounts of Si than mineral soils, one of the objectives of our soil amendment studies (see later section) is to determine if Si can be delivered via these materials at sufficient levels to affect benefits in responsive crops to biotic and abiotic stresses.

Cultural practices

A major effort has been placed on evaluation of the soilless growing medium that dominates production of these crops and the problems and opportunities that these growing media provide our research effort. Components utilized as amendments to the basic peat-lite mixes, as well as yet untapped sources of organic matter, are being evaluated with emphasis on peat and bark replacements, Si sources, and water management materials (ie. hydrogels). Water management was initially determined to be a major research priority within the growing community and due to the variety of soilless media recipes, container and crop sizes, as well as irrigation technologies being employed, some baseline determinations were needed to better understand what the producers were encountering (2). In cooperation with researchers in the Engineering school, determinations of hydrogel absorption and retention properties along with horticultural aspects involving water quality, fertilizer interaction, and plant growth were evaluated to assess value-added aspects of utilization. These studies showed that improved properties need to be developed to meet horticultural requirements (9). Evaluation of combinations of media in hanging pouch culture provided fundamental information on how container geometry and soil moisture retention can influence water management decisions (4). An ongoing evaluation of non-traditional materials is being conducted for creating alternative growing media options (11).

Virtual Grower

The Virtual Grower software program was created to provide a grower-friendly means to calculate greenhouse heating costs associated with management options faced during the cropping season. It utilizes a weather database of typical hourly temperature, light, and wind information collected at 230 sites (6). With the development of updated versions, all of which can be downloaded free of charge, it can serve as a platform to integrate many other features such as plant growth and scheduling and it can

be set up to mimic any existing or planned structure (14). It recently has been translated into a Spanish version and a French version is under development. Future versions will be posted to our website.

Literature Cited:

1. Frantz, J.M., Pitchay, D.S., Locke, J.C., Horst, L.E., and Krause, C.R. 2005. Silicon is deposited in leaves of New Guinea Impatiens. Plant Health Progress. Online. Doi:10.1094/PHP-2005-0217-01-RS.
2. Frantz, J.M., Pitchay, D.S., Locke, J.C., and Krause, C.R. 2005. Actual performance versus theoretical advantages of polyacrylamide hydrogel throughout bedding plant production. HortScience 40:2040-2046.
3. Frantz, J.M., Pitchay, D., and Locke, J.C. 2006. Geranium nutrient deficiencies. OFA Bulletin 894:1, 9-15.
4. Frantz, J.M., Locke, J.C., and Pitchay, D.S. 2007. Improving the growth of calibrachoa in hanging pouches. HortTechnology 17:199-204.
5. Frantz, J.M., Locke, J.C., Datnoff, L., Omer, M., Widrig, A., Sturtz, D., Horst, L., and Krause, C.R. 2008. Detection, distribution, and quantification of silicon in floricultural crops utilizing three distinct analytical methods. Comm. Soil Sci. Plant Analysis 39:2734-2751.
6. Frantz, J.M., Hand, B., Buckingham, L., and Ghose, S. 2010. Virtual Grower: Software to calculate heating costs of greenhouse production in the U.S. HortTechnology 20:778-785.
7. Frantz, J.M., Locke, J.C., and Mattson, N. 2010. Does silicon have a role in ornamental crop production? OFA Bulletin 924:17-18.
8. Jeong, K.Y., Whipker, B., McCall, I., and Frantz, J.M. 2009. Gerbera leaf tissue nutrient sufficiency ranges by chronological age. Acta Hort. 843:183-190.
9. Kim, S., Inyer, G., Nadarajah, A., Sponberg, A., and Frantz, J.M. 2010. Polyacrylamide hydrogel properties for horticultural applications. International Journal of Polymer Analysis and Characterization. *In press.*
10. Li, J., Leisner, S., and Frantz, J.M. 2008. Alleviation of copper toxicity in *Arabidopsis thaliana* by silicon addition to hydroponic solutions. J. Amer. Soc. Hort. Sci. 133:670-677.
11. Pasian, C. and Frantz, J.M. 2009. Evaluating performance and stability of polyethylene terephthalate (PET) and cellulose polymer as soilless mix components. Acta Hort. 843:289-295.
12. Pitchay, D.S., Frantz, J.M., Locke, J.C., Krause, C.R., and Fernandez, G.C.J. 2007. Impact of applied nitrogen concentration on growth of Elatior begonia and New Guinea impatiens, and susceptibility of begonia to *Botrytis cinerea.* J. Amer. Soc. Hort. Sci. 132:193-201.
13. Ranger, C., Singh, A.P., Frantz, J.M., Canas, L., Locke, J.C., Reding, M.E., and Vorsa, N. 2009. Influence of silicon on resistance of *Zinnia elegans* to *Myzus persicae* (Hemiptera: Aphididae). Env. Entomol. 38:129-136.
14. Runkle, E. and Frantz, J. 2009. Why use Virtual Grower? Greenhouse Product News. 9(10):50.
15. Taylor, M., Nelson, P., and Frantz, J.M. 2008. Substrate acidification by geranium (*Pelargoniium x hortorum)*: Temperature effects. J. Amer. Soc. Hort. Sci. 133:508-514.
16. Taylor, M., Nelson, P., and Frantz, J.M. 2008. Substrate acidification by geranium (*Pelargonium x hortorum*): Light effects and phosphorus uptake. J. Amer. Soc. Hort. Sci. 133:515-520.
17. Taylor, M., Nelson, P., Frantz, J.M., and Rufty, T. 2010. Effect of phosphorus deficiency and high temperature on ammonium and nitrate uptake by Pelargonium. J. Plant Nut. 33:701-712.

The AG*IDEA Alliance and Horticulture Graduate Certificate Programs

Ellen T. Paparozzi[1], Kimberly A. Williams[2], Robert Geneve[3], Harlene Hatterman-Valenti[4], Cynthia Haynes[5], Helen Kraus[6], Cynthia Mc Kenney [7] and Joelle Pitts[8]

[1]Department of Agronomy and Horticulture, University of Nebraska-Lincoln, Lincoln, NE 68583-0724
[2]Department of Horticulture, Forestry, and Recreation Resources, Kansas State University, Manhattan, KS 66506-5506
[3]Department of Horticulture, University of Kentucky, Lexington, KY, 40546
[4]Department of Plant Sciences, North Dakota State University, Fargo, ND 58108-6050
[5]Department of Horticulture, Iowa State University, Ames, Iowa 50011
[6] Department of Horticulture, North Carolina State University, Raleigh, NC 27695
[7] Department of Plant and Soil Science, Texas Tech University, Lubbock, TX 79409-2122
[8]Kansas State University Libraries, Manhattan, KS 66506

Contact: etp1@unl.edu

Index words: distance education, Master of Science, online courses, students

Significance to the Industry: As times change, so must education change--particularly its availability. Gone are classes taught solely in a traditional lecture style with the professor pontificating to a group of 18 to 22 year-old students. The advent of the internet, smart phones and electronic book readers, coupled with technology-hungry and savvy consumers, has led to a significant change in the ways in which courses are delivered. Information–accurate and inaccurate--is available with a few key strokes. These advances in technology, coupled with an economic downturn and a reduction in university teaching resources, has made it clear that the paradigm must shift. To attract students and still deliver a quality education in horticulture, expertise and resources must be shared. The AG*IDEA alliance provides shared access to undergraduate and graduate level courses in horticulture and related disciplines for students enrolled through the member universities. The alliance also provides the opportunity for students to pursue three graduate certificates in horticulture. In this way, current students as well as industry members and others have the opportunity for life-long learning in horticulture via distance.

Nature of the Work: Graduate level distance courses in horticulture have been shared and offered across institutions since at least the late 1990's (Williams and Paparozzi, 2002), but only recently has demand significantly increased. During the last two years, representatives from several universities have been meeting monthly to develop horticulture graduate certificates through AG*IDEA (Agriculture Interactive Distance Education Alliance).

AG*IDEA is the agricultural arm of the Great Plains Interactive Distance Education Program (http://www.gpidea.org/index.html). GP*IDEA was formed by the Human Sciences colleges located in the Great Plains region of the US. Later, an alliance for agriculture was initiated by Nebraska, Kansas, Missouri and Iowa. This alliance joined

GP*IDEA, expanded membership beyond the Great Plains region and chose the moniker of AG*IDEA (www.agidea.org). Agriculture joined this group because of the belief in the common founding principles. These principles state that all institutions will: behave as equals, respect institutional differences and simplify student navigation to access courses and certificate/degree programs. Institutions pay a one-time fee to belong (in order to support the overall project coordinator). The current composition of AG*IDEA includes 18 universities with full membership from all regions of the U.S. Over the monthly conference calls of our horticulture group, attendance has varied in composition and as a result a core group has arisen from that interaction. This core group includes: UNL, KSU, Texas Tech, NCSU, ISU (Iowa), UKY, and NDSU. The faculty chairperson of the group is drawn from these universities. This individual serves a one-year rotating term.

Within this group, each faculty member had a different reason for participating. For some it was curiosity, for some coercion. For others it was the promised monetary reward for teaching distance courses (75% of tuition revenue returns to the home institution) and others sought to supplement undergraduate and graduate course and curricular offerings. Today, horticulturists and horticulture programs cannot be all things to all people. So, common among all participants is the belief that the structure of current and future horticulture educational programs needs to change. Literature strongly supports the opportunity for comparable and even enhanced student learning when well-designed and implemented coursework is delivered via distance technologies (e.g. Allen et al., 2002). 'Knowledge' is already flowing freely among the public. So the choice became simple: be part of the change to contribute to collaborative distance-learning programs or continue to stand alone.

Unlike the Human Science's programs where each university created a course or two and taught them exclusively, horticulture decided to rely on existing online courses across institutions to create three graduate certificates (Figure 1). The group felt horticulture, being an integrated science as well as an art, needed to also rely on the disciplines of entomology, plant pathology, agronomy and business in order to offer a meaningful graduate experience and meet the interests of a wide range of potential student-customers. Where there was course duplication, a rotation among universities offering the courses was agreed upon (e.g. Table 1). The same can be said for the scope and the requirements within each certificate.

Constructing the curriculum associated with the certificates is what faculty enjoy most and do best. Unfortunately, then comes the sales job, in three installments: convincing local colleagues to participate and submit an appropriate learning outcomes-based syllabus, creating /submitting/getting the approval of a business plan by the Executive Committee of AG*IDEA Board of Directors and then finally, running the gauntlet of approvals necessary to implement the program at each of the participating institutions. Frustration at each installment varied, but was omnipresent. Delays for final approval at some institutions are running as long as one year.

While each faculty member handles the particulars of moving the certificate(s) through their system, how the group will implement the certificates is being handled by the Alliance. The horticulture group is working from a Faculty Operating Handbook and a detailed assessment plan. GP*IDEA conducts a student entrance and exit survey as part of the program assessment, if faculty provide program-specific questions. As individual faculty evaluations cannot be shared across state lines, the use of PRISM through Colorado State University is planned to act as an assessment environment that can be accessed by all members of the alliance.

Results and Discussion

Three certificates were created by the group. They are: Advanced Horticulture; Floriculture and Nursery Production Management and Ornamentals, Landscape and Turf (Figure 1). Participating institutions are selecting courses which best meet their horticulture program's needs and then taking one or all of the certificates through their university's approval process. The target audiences for these certificates include: horticulture agents for extension programs across the country, golf course superintendents, city parks and recreation employees, landscape maintenance practitioners, nursery, greenhouse and garden center industry professionals, as well as horticultural enthusiasts, such as Master Gardeners. Additionally, undergraduate and graduate horticulture courses are available in a course share across institutions which will allow students to take one or more classes to enhance their career or augment their current undergraduate or graduate program. Additional distance courses and institutions interested in participating in the program are always welcome.

Literature Cited

Allen, M., J. Bourhis, and N. Burrell. 2002. Comparing student satisfaction with distance education to traditional classrooms in higher education: a meta-analysis. Amer. J. Distance Education 16(2):83-97.

Williams, K. A. and E. T. Paparozzi. 2002. Model to develop a synchronous, inter-institutional course using distance technologies. NACTA Journal 46:28-33.

Figure 1. Horticulture Graduate Certificates

The abbreviation for the institution offering the course and the number of credits hours are in parentheses

Advanced Horticulture Certificate

(12-15 credit hours)

Select from:

Environmental Nursery Production (3 cr. NCSU)
Advanced Arboriculture (3 cr. TTU)
Floral Crops Production (2 cr KSU) or Advanced Greenhouse Management (4 cr. TTU)
Fruit Quality (3 cr. NCSU)
General Viticulture (3 cr. NCSU)
Advanced Interiorscaping (3 cr. TTU)
Business Management of Agricultural Enterprises (3 cr. UNL, TTU)
Plant Nutrition (3 cr. UNL, NCSU, TTU)
Plant Physiology (3 cr. UNL), Plant Water Relations (3 cr. TTU) or Water Issues in Lawn and Landscape (3 cr. KSU)

Floriculture and Nursery Production Management Certificate

(12-15 credit hours)

Core Courses: Select one course from each category for a minimum of 5 hours:

- Plant Nutrition (3 cr.UNL, NCSU, TTU), Plant Physiology (3 cr. UNL) or Plant Water Relations (3 cr. TTU)
- Floral Crops Production (2 cr. KSU) or Advanced Greenhouse Management (4 cr. TTU) or Environmental Nursery Production (3 cr. NCSU)

Electives: Select a minimum of 7 hours:

Environmental Stress Physiology (1 cr. NCSU)
Management of Horticulture Insects (3 cr. UNL), Entomology and Pest Management (3 cr. UNL), Insect Toxicology (3 cr. UNL) or Biological Control of Pests (3 cr. UNL)
Business Management of Agricultural Enterprises (3 cr. UNL, TTU)
Seed Science (3 cr. TTU)
Pesticide Resistance Management (2 cr. UNL), Plant Pathology (3 cr. UNL) or Plant Resistance to Abiotic and Biotic Stressors (3 cr. UNL)
Advanced Interiorscaping (3 cr. TTU)

Ornamentals, Landscape and Turf Certificate

(12- 15 credit hours)

Core Courses: Select one course from each category for a minimum of 6 hours:

- Plant Nutrition (3 cr. UNL), Plant Physiology (3 cr. UNL(UNK)), Plant Water Relations (3 cr. TTU) or Water Issues in Lawn and Landscape (3 cr. KSU)
- Advanced Arboriculture (3 cr. TTU)

Electives: Select a minimum of 6 hours:

Turf Disease Management (1 cr. UNL)
Weed Science (4 cr. TTU) or Turf and Landscape Weed Management (1 cr. UNL)
Herbicides and Weed Management Systems (4 cr. TTU)
Management of Horticulture Insects (3 cr. UNL), Entomology and Pest Management (3 cr. UNL), Insect Toxicology (3 cr. UNL) or Biological Control of Pests (3 cr. UNL)
Pesticide Resistance Management (2 cr. UNL), Plant Pathology (3 cr. UNL) or Plant Resistance to Abiotic and Biotic Stressors (3 cr. UNL)
Modified Rootzones (1 cr. UNL) or Soil Chemistry (3 cr. TTU)
Business Management of Agricultural Enterprises (3 cr. UNL)
Environmental Stress Physiology (1 cr. NCSU)

Table 1. Example of course rotation for the Floriculture and Nursery Production Management Certificate. The rotation ensures that students have access to courses when they need them and that all universities participate in the offerings.

COURSE TITLE	HRS	INST OFFERING	SEMESTER OFFERED
Plant Nutrition	3	NCSU	Spring, odd years
Plant Nutrition	3	Texas Tech	Fall
Plant Nutrition & Nutrient Management	3	UNL	Spring, even years
Plant Physiology	3	Texas Tech	Fall, odd years
Plant Physiology	3	UNL	Fall, even years
Floral Crops Production	2	Kansas State	Spring, even years
Advanced Greenhouse Management	4	Texas Tech	Spring, odd years
Business Management of Hort Enterprises	3	UNL	Fall
Advanced Nursery Management	3	Texas Tech	Spring, odd years
Plant Water Relations	3	Texas Tech	Spring, even years
Environmental Nursery Production	3	NCSU	Spring, odd years
Environmental Stress Physiology	1	NCSU	Spring every year; Fall, even years
Management of Horticultural Insects	3	UNL	Spring, even years
Entomology & Pest Management	3	UNL	Summer, odd years
Insect Toxicology	3	UNL	Fall, odd years
Biological Control of Pests	3	UNL	Spring, even years
Seed Science	3	Texas Tech	Spring, even years
Pest Resistance Management	2	UNL	Spring, even years
Plant Pathology	3	UNL	Spring, even years
Plant Resistance to Abiotic/Biotic Stressors	3	UNL	Spring, even years
Advanced Interiorscaping	3	Texas Tech	Spring, even years

Floriculture Sustainability Research Coalition: Bringing the Latest Sustainability Research to the Industry

Stephanie Burnett[1], Neil Mattson[2], Brian Krug[3], and Roberto Lopez[4]

[1]University of Maine, Department of Plant, Soil, and Environmental Sciences, Orono, ME 04469

[2]Cornell University, Department of Horticulture, Ithaca, NY, 14853

[3]University of New Hampshire Cooperative Extension, Durham, NH, 03824

[4]Purdue University, West Lafayette, IN 47907

sburnett@maine.edu

Index Words: greenhouse heating, non-chemical growth retardants, organic fertilizers

Significance to Industry:

Consumer interest in environmentally-friendly products has increased greenhouse Growers' interest in sustainable production techniques (Lopez et al., 2011). It is estimated that consumers would spend up to 15% more for sustainable floricultural products than conventional produced products, and purchasers of herbaceous or floricultural plant products tend to be more eco-friendly than those who purchase woody plant materials (Behe et al., 2010; Hawkins et al., 2011). In 2008, the Floriculture Sustainability Research Coalition formed to provide information regarding sustainable production techniques for growers. Forming a coalition has allowed the group to broaden our expertise in order to have a more meaningful impact on growers' production practices.

Nature of Work:

The Floriculture Sustainability Research Coalition (FSRC) began in 2008 at the National Floriculture Forum. Member universities are: Purdue University, the University of New Hampshire, Cornell University, and the University of Maine. Our group Goal is to develop central sustainability themes for our outreach and research programs that synergistically build off of individual strengths to form knowledge and outreach materials to benefit our audiences. Alone, it is difficult to have much of an impact on such a large topic. But, as a group, we could potentially have more impact – not only topically, but also regionally.

Results and Discussion:

Over the past three years, the FSRC has provided research based information to help growers produce plants more sustainably. Recent initiatives have included exploring

techniques for sustainably heating greenhouses, reducing stretch without the use of chemical growth retardants, and developing protocols for using organic fertilizers.

Conserving energy is a priority for greenhouse growers throughout the United States; a survey of greenhouse growers indicates that 55% of growers are currently using some sort of energy conserving technology, and an additional 8% would like to have technology in their greenhouse that saves energy (Dennis et al., 2010). Our group has published several articles on novel techniques to reduce energy. For example, Lopez and Krug (2009) reported that growing medium vigor poinsettia cultivars at an average daily temperature of 60 °F does not reduce crop quality. This reduction in temperature set points in the fall would reduce fuel usage for greenhouse growers. At Cornell, bedding plants, including 'Safari Orange' Marigold, 'Delta Formula Mix' Pansy, 'Dreams Midnight' Petunia, 'Montego Mix' Snapdragon, and 'Dreamland Mix' Zinnia were grown in an unheated high tunnel. These plants finished only slightly later than plants grown in a heated greenhouse that were planted at the same time (Mattson, unpublished data; Table 1 and 2). Part of our efforts in this area have focused on Extension and outreach to support growers who are transitioning to more sustainable heating technologies. In trade publications, we have highlighted innovative growers who may inspire others by example (Burnett et al., 2010). Currently, Purdue University is working on a national grant to develop Light Emitting Diodes as supplemental lighting for greenhouses.

Table 1. Average, minimum, and maximum temperature of a greenhouse environment (70 F day and 60 F day heating thresholds), unheated high tunnel and outdoor environement in Ithaca, NY from April 1 to May 15, 2010.

	Average	Minimum	Maximum
Greenhouse	66°	55°	89°
High Tunnel	61°	30°	107°
Outside	51°	26°	85°

Table 2. Average finish date (flower date) and plant size of five bedding plants in response to growth environment. Greenhouse plants had heating temperature thresholds as described in Table 1.

	Flower date		Plant size (Fresh Wt in grams)	
	Greenhouse	High Tunnel	Greenhouse	High Tunnel
Petunia 'Dreams Midnight'	Apr 28	May 5	46.6 g	47.0 g
Snapdragon 'Montego Mix'	May 5	May 10	20.6	25.4
Zinnia 'Dreamland Mix'	May 5	May 7	13.5	15.0
Marigold 'Safari Orange'	Apr 27	May 2	15.5	17.8
Pansy 'Delta Mix'	May 9	May 10	14.3	12.1

Another highlight of our work with sustainable production has focused on finding alternatives to chemical growth retardants. Our approach to reducing stretch without chemical growth retardants has been to recommend that growers adjust the greenhouse environment, growing conditions, crop schedule, or plant materials. Lopez and Krug have presented nationally and regionally to growers on this topic representing our group. Some techniques we have successfully used include reducing water to reduce turgor in a controlled manner may reduce plant height, but will also reduce branching (Burnett and van Iersel, 2008). Growing plants at the appropriate light level (i.e. reducing shading) will reduce stretch as well.

Our work with organic fertilizers has provided guidance for the growing organic greenhouse industry in the United States. Since 2004, there has been an 83% increase in the acreage of organic greenhouses (USDA, 2006). Vegetable transplants sold to consumers have become an increasingly important sector of the industry as well; in 2008, $92 million in vegetable transplants was sold to consumers (USDA-NASS, 2009). This was a 22% increase compared to 2007. Organic growers face many challenges, but they consider managing fertility and substrates to be the greatest barrier preventing transition to organic production (Burnett and Stack, 2009).

Thus far, our collective research has indicated that liquid organic fertilizers such as Drammatic and Pinnacle will produce high quality crops, however, they are up to five times more expensive than conventional fertilizers (Mattson, 2010). For this reason, organic growers should consider using pre-plant incorporated fertilizers in addition to liquid fertilizers. Future research for our group will focus on resolving fertility issues for organic greenhouse growers. One issue they face, in addition to the cost of liquid organic fertilizers, is the lack of consistency in pre-plant incorporated materials. For example, plants grown in two out of four New England composts (1 compost: 1 peat: 1 perlite) were equivalent in dry weight to those grown in substrates with a starter fertilizer (Hawkins and Burnett, unpublished data). But, compost alone does not provide adequate fertility (Bugbee and Frink, 1989; Chaney et al., 1980; Falahi-Ardakani et al., 1987), and some materials have high sodium or electrical conductivity making them difficult to manage in greenhouses. Further, all organic sources of fertility release slowly, which can be challenging when managing crops with quick turnover. Our group is submitting a collaborative grant to NIFA-OREI to further our research in this area.

In the future, we plan to continue our current sustainability initiatives and further help growers who wish to grow plants in a more environmentally friendly manner. We are also developing a website, in collaboration with OFA (An Association of Horticultural Professionals) which will be a central place for posting articles and information related to sustainable greenhouse production (www.sustainablegreenhouse.org).

Literature Cited:

Behe, B.K., B.L. Campbell, J.H. Dennis, C.R. Hall, R.G. Lopez, and C. Yue. 2010. Gardening consumer segments vary in ecopractices. HortScience 45:1475-1479.

Burnett, S., B. Krug, N. Mattson, R. Lopez, and Currey, C. 2010. Sustainable heating solutions. Grower Talks 74:64-69.

Burnett, S.E., R.G. Lopez, and N.S. Mattson. 2009. Evaluate your greenhouse to save energy. Greenhouse Management and Production. 29(9):20,22,23,24,26.

Burnett, S. and L. Stack. 2009. Survey of the research needs of the potential organic ornamental bedding plant industry in Maine. HortTechnology 19:743-747.

Burnett and van Iersel, 2008. Morphology and irrigation efficiency of *Gaura lindhiemeri* grown with capacitance sensor-controlled irrigation. HortScience 43:1555-1560.

Dennis, J.H., R.G. Lopez, B.K. Behe, C.R. Hall, C. Yue, and B.L. Campbell. 2010. Sustainable production practices adopted by greenhouse and nursery plant growers. HortScience. 45:1232-1237.

Hall, T., J.H. Dennis, R.G. Lopez, B.A. Krug, and S.E. Burnett. 2008. How to market sustainability to consumers (3rd in a 3-part series). Greenhouse Management and Production. 28(12):27, 28.

Hawkins, G., S.E Burnett, and L.B Stack. 2011. Survey of consumer interest in organic, sustainable, and local bedding plants in Maine. HortTechnology (In Press).

Krug, B.A., S.E. Burnett, J.H. Dennis, and R.G. Lopez. 2008. Growers look at operating a sustainable greenhouse (1st in a 3-part series). Greenhouse Management and Production. 28(10):43-45.

Lopez, R.G., S.E. Burnett, B.A. Krug, and J.H. Dennis. 2008. 8 steps to take to become sustainable (2nd in a 3-part series). Greenhouse Management and Production. 28(11):26, 28, 29, 50.

Lopez, R., J. Dennis, B. Behe, C. Hall, C. Yue, and B. Campbell. 2011. What are growers doing about sustainability? Greenhouse Grower (In Press).

Lopez, R.G. and B.A. Krug. 2009. Cold finishing up north. Greenhouse Grower 27:88-94.

Mattson, N.S. 2010. What's your fertilizer cost? GrowerTalks Magazine. 74(2):62-67.

U.S. Department of Agriculture. 2006. Data sets: Organic production. 26 March 2007. http://www.ers.usda.gov/Data/Organic/.

U.S. Department of Agriculture. 2009. 2009 Census of Horticultural Specialties. 25 January 2011. http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/Census_of_Horticulture/index.asp

Increasing the overwintering survival of container-grown perennials

William K. Harris, Joyce G. Latimer, John Freeborn and Holly L. Scoggins, Department of Horticulture, Virginia Tech, Blacksburg, VA 24060

wkharris@vt.edu

Index Words: Vernalization, *Pennisetum alopecuroides*, *Pennisetum* 'Hameln' *Pennisetum* 'Little Bunny'

Significance to Industry: Many nurseries and greenhouses in the state of Virginia include container-grown perennials in their product mix. According to USDA survey conducted in 2009, perennial production had grown 10% between 2000 and 2005 (Barrett, 2010). Many perennials require vernalization, a period when a plant is subjected to low, typically winter, temperatures. Many species will not flower unless they have had their vernalization requirement fulfilled. According to Runkle (2007), satisfying vernalization requirements for plants is critical because this helps to initiate or accelerate flowering. In addition to vernalization, overwintering a plant can provide the additional growing time needed for the plant to fill out the pot or establish well enough for spring sales (Walters Gardens, 2010). Overwintering is keeping a plant alive but not growing during winter dormancy. As vital as this may be, some perennial plants cannot survive low overwintering temperatures and conditions (Bilderback and Bir, 2007). Results from a survey of 37 growers conducted at the Ohio Florists'Association conference (OFA) in 2010 found growers lost 10%-20% of their original plant material, some of which they attributed to overwintering issues (Harris, 2010).

Nature of Work: Plant species and the ability of roots to withstand cold temperatures partially dictates the overwintering technique used (Smith, 2004), as well as the producer's capabilities and budget. Overwintering can take place in unheated or minimally heated coldframe structures, or under no structure at all. When using no structure or unheated coldframes, overwintering covers are used to provide plants protection. Options include thermal blankets, polyethylene plastic and a combination of plastic and straw. Thermal blankets go by the trade names such as Frost Protek™ (Hill Street Home, Inc., Fort Collins, CO) and Dewitt N-Sulate™ (DeWitt Company, Inc., Sikeston, MO) and are made of polypropylene or spun-bound polyester, respectively. Survey results previously noted showed that thermal blankets and/or polyethylene plastic were the most common overwintering practices by growers (Harris, 2010). Research has shown that using thermal blankets can result in high quality of overwintered plants (Hicklenton, 1982).

Growers throughout the mid-Atlantic experience significant percentages of plant losses during winter dormancy for certain species. Ornamental grasses such as Pennisetum seemed to be especially problematic. Virginia growers approached Virginia Tech floriculture faculty for strategies to help to minimize the losses. From these inquiries, a partnership between industry and research arose. Beginning in the fall of 2009 and continuing through 2011, Virginia Tech has worked with the nursery industry to study potential factors responsible for overwintering losses. Speculation as to why these losses occurred include: low temperatures, high substrate moisture levels, improper fertilization, and wide temperature fluctuations.

Low temperatures can be detrimental to some perennials because of their specific cold hardiness. Cold hardiness is a plant's ability to acclimate, due to metabolic changes in the plant, to freezing temperatures; this is determined genetically (Rose, 2001). Cold hardiness can be defined as the lowest winter temperature that plant tissue can endure without freeze damage (Rose, 2001). The roots of plants are the least hardy portion of the plant; research has shown that roots cannot acclimate to low temperatures as quickly as shoots (Rose, 2001). Research in Oklahoma has shown that the temperature of the root ball, in an unprotected container, can approach that of the ambient air (Smith, 2004). Our study seeks to quantify low temperature effects on plant survival by evaluating different overwintering covers and plants grown in two different USDA hardiness zones.

Dry soil freezes much quicker when compared to wet soil because water releases heat as it changes from the liquid to the solid phase (Smith, 2004). This heat helps to protect roots from freezing during low temperature cycles. Thus, watering plants prior to overwintering is essential to plant survivability because the water is used by the plants as a source of heat. However, high moisture levels should be avoided because plants kept too wet could develop diseases such as root rots (Smith, 2004). Our study seeks to evaluate moisture levels effects on overwintered plants by maintain the substrate at two volumetric water contents.

Fertilization of container grown perennials provides nutrients to plants and is essential to plant health and growth during a production cycle. Plants which are receiving adequate levels of nutrients will potentially stand a better chance to survive over the winter (Bilderback and Bir, 2007). However, fertilizer applied prior to overwintering could cause lush growth, potentially prevent hardening-off. This could lead to wintertime losses (Bilderback and Bir, 2007). Our study will evaluate the effects of fertilization on overwintered plants by incorporating or topdressing containers with controlled release fertilizer at different rates.

Temperature fluctuations can occur frequently while plants are being overwintered. Excessive heat can build up under overwintering covers and inside of overwintering structures during periods of warm weather (Bilderback and Bir, 2007). If this warmth remains, then plants could break dormancy and be injured when the temperatures drop to freezing. Perennials have a finite reserve of carbohydrates that are utilized for winter survival and new growth in the spring. At the time of fall dormancy carbohydrate reserves are at their highest level and then decrease as dormancy continues (Vallentine, 2001). If plants break dormancy prematurely then the remaining carbohydrates will be allocated to maximize growth but chilling temperatures could still occur which could lead to plant death. Also associated with the heating that can occur is the fact that excessive humidity, under blankets or in a coldframe, could develop resulting in root and shoot pathogens such as *Phytophthora* root rot and botrytis if no venting is provided (Smith, 2004).

Materials and Methods: Plants in all trials included *Pennisetum alopecuroides, Pennisetum* 'Hameln' and *Pennisetum* 'Little Bunny.' All were potted into Elite 300 containers (2840 mL) using a bark substrate (85% pine:15% peat v:v). provided by Riverbend Nursery, Inc (Riner, VA). In accordance with previous research and personal communications with growers around the state of Virginia, plants were cut back to 4 inches (10.16 cm) in height once dormant. Plants were irrigated prior to strart of overwintering treatments and a fungicide drench was applied to all [BANROT® 40WP (Scotts-Sierra Horticultural Products Company, Marysville, OH) and Subdue MAXX™ (Syngenta, Basel, Switzerland)] at recommended rates. An extra row of

containers filled with substrate were placed around each block to serve as a "buffer" row. Soil moisture levels were monitored in pots weekly using a WaterScout SM 100 Soil Moisture Meter (Spectrum® Technologies, Inc., Plainfield, IL). The ambient air temperature and substrate media temperatures, under each type of cover and under no cover, were monitored continually, using WatchDog® Data Loggers (Spectrum® Technologies, Inc., Plainfield, IL), throughout the experiment. In the spring of 2010 plants were evaluated on a five point scale based on their survival and vigor. Cunliffe and Meyer (2002) described the scale as: 1 = dead, 2 = diffuse growth and new crown diameter is less than 1/2 the diameter of old crown growth, 3 = expansive growth and new crown diameter is less than 1/2 the diameter of old crown growth, 4 = diffuse growth and new crown diameter is more than 1/2 the diameter of old crown growth and 5 = expansive growth and new crown diameter is more than 1/2 the diameter of old crown growth. In the first trial (covering), conducted at Virginia Tech, different overwintering covers were evaluated for effectiveness. Plugs were potted in September 2009. Treatments (covers) included: no cover, a double layer of Dewitt N-Sulate™ insulation fabric (1.5 ounce weight) and a double layer of Dewitt N-Sulate™ insulation fabric with a single sheet of 4 mil white polyethylene plastic (Ginegar Plastic Products Ltd., Ginegar, Israel) on top of the insulation fabric. In addition to the covers, two fertility levels and two moisture levels were evaluated under each cover. Harrell's Polyon® 15-9-12 (5-6 month release) (Harell's LLC., Lakeland, FL) controlled release fertilizer was incorporated into the substrate at a rate of 3.17 kg (7 lbs) per 2.29 m^3 (1 yd^3) which was used as one fertility rate. Osmocote Plus 15-9-12 (5-6 month release) (The Scotts Company, LLC., Marysville, OH) controlled release fertilizer was added, via incorporation, at a rate of 5.59 kg (12 lbs) per 2.29 m^3 (1 yd^3) to achieve an additional fertility rate. Irrigation was determined by using a WaterScout SM 100 Soil Moisture Meter, and pots were irrigated to container capacity when the average soil moisture of five randomly sampled pots fell below 25% or 15%, which represented wet and dry treatments, respectively.

In the second experiment, the age of the plant was the main parameter of interest. Liners (young plants), donated by Poplar Ridge Nursery (Montross, VA), were potted in September of 2009. Older plants (potted the previous spring and the season prior) were donated by Riverbend nursery, Inc., and included: *Pennisetum alopecuoides* (May 2009), *Pennisetum* 'Hameln' (July 2009) and *Pennisetum* 'Little Bunny' (August 2008). The substrate contained Harrell's Polyon® 15-9-12 controlled release fertilizer incorporated at a rate of 3.17 kg (7 lbs) per 2.29 m^3 (1 yd^3). In addition to plant age, fertility levels and moisture levels were evaluated. Low and high fertility levels were achieved via topdress of Osmocote Plus 15-9-12 at rates of 6 and 15 grams per container. Moisture levels were maintained and monitored the same as in the covering trial. Plants were covered with a double layer of Dewitt N-Sulate™ insulation fabric when temperatures were forecasted to fall below -6.67° C (20°F). This study was conducted at Virginia Tech (USDA zone 6a) and it was replicated at Poplar Ridge Nursery (USDA zone 7a) to provide an additional, warmer climate.

In the third experiment, fertilizer rate was the focus. Older plant material, received from Riverbend Nursery, Inc. was potted at various times listed as follows: *Pennisetum alopecuoides* (May 2009), *Pennisetum* 'Hameln' (July 2009) and *Pennisetum* 'Little Bunny' (August 2008). Media contained Harrell's Polyon® 15-9-12 controlled release fertilizer that was incorporated at a rate of 3.17 kg (7 lbs) per 2.29 m^3 (1 yd^3). Low, moderate, and high fertility levels were achieved via topdressing with Osmocote Plus 15-9-12 at rates of no additional fertilizer, 4 grams

10 grams, and 15 grams added to containers. These treatments were chosen based on recommendations of a low, medium and high range of fertility from Osmocote Plus 15-9-12.

Results and Discussion: The covering trial results showed that a double layer of Dewitt N-Sulate™ insulation fabric increased in vigor by an average of 1.5 points on a 5 point rating scale for *Pennisetum alopecuroides*. Fertilizer at a rate of 3.17 kg (7 lbs) per 2.29 m^3 (1 yd^3) increased vigor by 1 point. Additionally, fertilizer at a rate of 3.17 kg (7 lbs) per 2.29 m^3 (1 yd^3), in combination with wet (25%) irrigation treatments, on average, increased vigor by 1 point on a 5 point rating scale for *P. alopecuroides*. Vigor increased on average by 1 point for *Pennisetum* 'Hameln,' using a double layer of Dewitt N-Sulate™ insulation fabric and fertilizer at a rate of 3.17 kg (7 lbs) per 2.29 m^3 (1 yd^3). The vigor of *Pennisetum* 'Little Bunny' was not affected by any of the treatements

In the age trial, none of the treatments were significant for *Pennisetum alopecuroides* or P. 'Hameln' because all plants overwintered well at both locations. For *Pennisetum* 'Little Bunny,' age of the plant was significant at both locations; young plants survived and rated higher in vigor than old plants. The young plants had a 1 point increase in vigor when compared to the older plants on a 5 point scale. This could be explained by the fact that root-bound plant material has been found to overwinter poorly (Walters Gardens, 2010).

In the fertilizer experiment, as fertilizer rates increased, *Pennisetum* 'Little Bunny' decreased in vigor rating with increasing fertilizer additions, from a 3 to a 1 on a 5 point rating scale. Perry (2004) has stated that controlled release fertilizer may cause a flush in growth in plants that are being overwintered and that needs to be avoided. Plants need to be alive but not actively growing during overwintering. If the plants are actively growing, at the time of the first frost, then hardening plants off could be difficult. Managing the fertilizer release of controlled release fertilizers could be difficult late in the season and could promote new growth (Bilderback and Bir, 2007).

In conclusion, we have found that overwintering survival and vigor can be increased if plants are covered when night temperatures are below -6.6°C (20°F). Removing those covers, when temperatures elevated above -6.6°C eliminated the potential for a growth flush and limited excess moisture buildup which helped to minimize diseases. Providing plants with adequate moisture throughout the winter helps to improve plant vigor in the spring. We also found that plants need to be well rooted, but not root bound or poorly rooted since these are subject to higher overwintering losses. Finally, we found that high fertility rates going into the winter can also increase overwintering losses.

The partnership developed between industry and Virginia Tech allowed these studies to be designed and implemented in several locations across the state. The information gained from these experiments help Virginia nurseries stay competitive and cut their overwintering losses and also provide knowledge to the industry. These partnerships help Virginia Tech stay current in floriculture production methods and help to provide learning opportunities for students involved in the research.

Literature Cited:

Barrett, J. “USDA Numbers Indicate Decline and Growth.” GPN. September 2010: Volume: 20 Number: 9

Bilderback, T. and R. Bir. 2007. Preparing nursery plants for winter. Bulletin AG-454, North Carolina Cooperative Extension Service. 15 Jan 2011. <http://www.ces.ncsu.edu/depts/hort/hil/ag454b.html>.

Cunliffe, B.A. and M.H. Meyer. 2002. Propagation time affects winter survival and finishing date for ornamental grasses. J. Environ. Hort. 20:201-203.

Harris, W.K. “Perennial Overwintering Survey.” Ohio Florist Association annual Short Course. 13 July 2010.

Hicklenton, P.R. 1982. Effectivness of 4 coverings for overwintering container grown ornamentals in different hardiness zones. HortScience 17: 205-207.

Perry, L. 2004. Herbaceous perennials-container overwintering and hardiness. 15 Jan 2011. <http://pss.uvm.edu/ppp/pubs/coh31hardy.htm>.

Rose, M.A. and E. Smith. 2001. Overwintering plants in the landscape. Ohio State University Extension fact sheet. 15 Jan 2011. < http://ohioline.osu.edu/hyg-fact/1000/1016.html>.

Runkle, E. 2007. “Vernalizing Perennials.” GPN 17(9):36-39.

Smith, T.M. 2004. Overwintering containerized perennials. University of New Hampshire. 15 Jan 2011. <http://www.umass.edu/umext/floriculture/fact_sheets/specific_crops/overwint.html>.

Vallentine, J.F. 2001. Carbohydrate Reserves, p. 146-148. In: Grazing Management (2nd ed.). Academic Press, San Diego, Ca.

Walters Gardens. 2010. Fall Planting and Overwintering Recommendations. 15 Jan 2011. <http://www.waltersgardens.com/images/lib/pages/File1-74.pdf>.

Partnership to Advance Knowledge of Plant Growth Regulation

Mara Grossman, John Freeborn, Holly Scoggins, Joyce Latimer
Department of Horticulture, Virginia Tech, Blacksburg, Virginia 24061

mgrossman@vt.edu

Index words: benzyladenine, Configure, plugs, branching

Significance to Industry: Plant growth regulators (PGRs) are widely used by growers as a tool to control plant height, form and flowering in ornamental plant production. However, using PGRs can be challenging, because plants respond in different ways to PGRs depending on species, cultivar, growing conditions, and the PGR utilized. New varieties and cultivars are continually being developed; ongoing research is needed to keep PGR guidelines up to date. New PGRs on the market have not been evaluated for use in many crops, but growers want to take advantage of their use. Growers use a combination of resources for information on applying PGRs, including other growers, product labels, industry representatives, trade journals, and university research.

Research is necessary to help growers determine the correct use of PGRs in managing different crops. Research into PGRs is a partnership between growers, industry and university research. As one of the components of this partnership, Virginia Tech and Virginia Cooperative Extension, with support from Fine Americas, Inc., have been investigating both timing and application rates of Configure, a new PGR on the market.

Configure is a PGR which contains benzyladenine (BA), a synthetic cytokinin. The application of additional cytokinins disrupts apical dominance and stimulates the growth of lateral buds (Cline, 1991). This results in more basal or lateral branching, depending on the plant's growth habit, and fuller plants. In a study of 18 juvenile perennials tested after transplanting to 3.5" pots, BA increased lateral offshoots in 89% perennials tested (Martin and Singletary, 1999). When applied to several petunia cultivars, BA increased branching and flowering (Carey et al., 2008). BA has been shown to have cultivar specific effects (Carey et al., 2009; Garner et al., 1997). Fine Americas, Inc. has funded independent research on this new product to test its use on different crops.

Currently many growers treat plants with PGRs after plugs have been transplanted. Over the last year, we have conducted studies using Configure on plugs prior to transplant, which can have significant benefits for growers. Reduced time of application and reduced chemical cost will result in a more cost effective method of treating plants. Additionally, if treating plants earlier in their lifecycle results in quicker production times, even more savings could be realized. For producers who sell plants as plugs to be finished by other growers, producing fuller plugs more rapidly could be important to sales and profitability.

Nature of Work: In our study, plants arrived as unrooted cuttings, which were then dipped in rooting hormone and stuck into 72 size flats filled with Fafard 3B. Cuttings were allowed to root under mist with bottom heat for two to three weeks. As soon as plants were showing roots on four sides of the root ball

but before the root ball was tightly held together, plants were treated with Configure at the following spray rates: 0 ppm (control), one application of 300 ppm, two applications of 300 ppm with second application two weeks after the first, or one application of 600 ppm. The first treatment of Configure was applied between 14 and 35 days after sticking, depending on the crop. After treatment, plants were grown in the 72 size flats under greenhouse conditions for 3-4 weeks until they were ready for transplant, and then were potted up into quart pots and grown for 4 more weeks. Data measurements were taken at the time of first treatment, 0 weeks after treatment (WAT), and at 2 WAT, 3 or 4 WAT and 7 or 8 WAT. Measurements included: plant height, average plant width, number of branches and leaders or basal breaks, ratings of phytotoxicity, flowering status, and root and shoot dry weights.

Research conducted to this point has included the following crops: *Agastache* 'Purple Haze', *Gaura lindheimeri* 'Siskiyou Pink', *Lavandula* x *intermedia* 'Provence', *Leucanthemum* x *superbum* 'Snowcap', *Salvia nemorosa* 'May Night', *Aster* 'Professor Kippenuburg', *Campanula* 'Cherry Bells', *Cosmos atrosanguineus*, *Rosmarinus* 'Hill Hardy', *Verbena bonariensis* 'Lollipop', and *Veronica* 'Goodness Grows'. Results varied by crop.

Results and Discussion: Of the eleven crops studied, nine showed a significant increase in branching at time of transplant, 3 or 4 WAT (Table 1). After transplant and growing out for an additional four weeks (8 WAT), only three of the crops studied had increased branching, six crops showed no significant differences in branching compared to control plants and two crops showed decreased branching. Using Configure on plugs did increase branching in 80% of crops studied, although this effect did not last after growing out in most plants.

Two crops showed phytotoxic effects. Slightly distorted leaves were noted in Cosmos; however the effect did not noticeably alter finished plant quality. Tip burn in Aster caused the death of many emerging branches. Plants did not recover in the plug stage or after transplant.

Root dry weights were unaffected in six of the eleven crops studied at the time of transplant. Four crops had reduced root dry weights, whereas one crop, Rosemary, had increased root dry weights. Root dry weights are an indication of the plant's growth and the plant's readiness for transplant. The crops that showed reduced root weights also showed increases in branching. However, only one crop, Agastache, had both reduced root growth at transplant and decreased branching after transplant and growing out. In most plants, Configure applications did not have a negative effect on finished plant quality despite reducing root growth in some crops at time of transplant.

Treating plants with Configure as plugs prior to transplant did result in more branching which produced a plug that appeared fuller at an earlier stage of growth, although the effect was not long lasting in some species. Rooting was negatively affected in some crops but did not seem to influence the overall growth of the plants. Further studies on different species, as well as further studies on the benefit of repeat applications of Configure in responsive crops will help growers decide when to apply treatments.

These results represent important information for growers. It is our responsibility as researchers to find ways to ensure growers have access to our findings. These results were used to contribute to the brochure "Configure Product Information and University Trial Results" published by Fine Americas, Inc.

(2010). Results will also be presented at industry conferences and published in trade journals and extension publications. By using multiple methods to distribute this information, we hope to reach a wide audience to best put our research results to use.

Research into the use of PGRs will improve plant production methods and enable growers to produce more marketable plugs and plants. By working with industry partners and growers, university research expands our knowledge of plant growth and strengthens the floriculture industry.

Literature Cited:

1. Carey, D., Buhler, W., and Whipker, B., 2009. Stimulating Plant Growth, p. 20, 22, 24, Greenhouse Product News.
2. Carey, D., Whipker, B., Mccall, I., and Buhler, W. 2008. Cytokinin based PGR affects growth of vegetative petunia. Proc. 35th Annu. Mtg. Plant Growth Regulat. Soc. of America. 1:85-89.
3. Cline, M.G., 1991. Apical dominance. Bot. Rev. 57:318-358.
4. Garner, J.M., Keever, G.J., Eakes, D.J., and Kessler, J.R., 1997. Benzyladenine-induced offset formation in hosta dependent on cultivar. HortScience 32:91-93.
5. Martin, S. and Singletary, S. 1999. N-6 Benzyladenine increases lateral offshoots in a number of perennial species. Combined Proc. Intl. Plants Propagators' Soc. 49:329-334.

Table 1. Effects of Configure on branching and root dry weight at time of transplant [3 or 4 weeks after treatment (WAT)] and branching after growing out (8 WAT)

Crop	Branching at transplant	Root dry weight at transplant	Branching at 8WAT
Agastache	40% increase	Reduced 40%	Decreased at two highest rates
Aster	Decreased branching	No effect	Plants with two applications of 300 ppm failed to grow out
Campanula	No effect	No effect	No effect
Cosmos	80% increase	Reduced 40%	Increased at all treatments levels, especially at one application of 300 ppm or 600 ppm (60% increase)
Gaura	20% increase	No effect	80% increase
Lavandula	20% increase (highest two rates)	Reduced only with two applications of 300 ppm	Increased 85% (only plants treated with two applications of 300 ppm)
Leucanthemum	Branches doubled	Reduced 25-40%	No effect
Rosemary	40 % increase with highest rates	Increased at all treatment levels	No effect
Salvia	35% increase with one or two applications of 300 ppm	No effect	No effect
Verbena	Increased 70%-140%	No effect	No effect
Veronica	Increased 100%-200%	No effect	No effect

Water conservation in ornamental crops through the use of alternative irrigation water sources

Genhua Niu[1], Raul I. Cabrera[2], Terri Starman[3], and Charlie Hall[3]

[1]AgriLife Research and Extension Center at El Paso, Texas A&M System, 1380 A&M Circle, El Paso, TX 79927

[2]AgriLife Research and Extension Center at Dallas, Texas A&M System, 17360 Coit Road, Dallas, TX 75252

[3]Department of Horticulture, Texas A&M University, College Station, TX 77843

Significance and Objectives

Many communities in Texas and other states are facing water shortages as well as water quality issues (poor or marginal water quality). A tremendous population growth in many southern states is also putting a strain on their water supplies and a worrisome competition between urban and agricultural activities. Drought in the future is unpredictable and some regions have encountered extended and devastating drought periods in the past years. In addition, intensive agricultural operations like nurseries and greenhouses are also under pressure of water conservation and minimization of fertilizer- and chemical-laden water drainages and runoff effluents. Besides the fact that a large number of communities are already facing water shortages and rationing, many of these areas with water quantity problems are often plagued by poor or marginal water quality issues. Water availability and water quality issues are getting worse over time and are significantly impacting the future of green industries (greenhouse, nursery, landscape), and therefore the need for research and education programs that address them. In addition to irrigation management, water conservation can be achieved through irrigating greenhouse-nursery crops and landscape plantings with alternative water sources, and save the dwindling clean/fresh water supplies for other purposes. Plant species that are low-maintenance, more water and salt stress-tolerant will certainly be more competitive in green industry activities. We are striving to identify these plant species and the cultural practices that will allow for their successful production when grown under these challenging stresses.

The types of available alternative or non-potable water sources vary with regions or even locations. Generally, municipal reclaimed water is often the main alternative water. In some

places, ground water or shallow aquifer saline water, and agricultural drainage water are available. The overall salinity and chemical composition of these alternative waters vary with locations and sources. Reclaimed water is defined as domestic or municipal wastewater that has received secondary treatment. The salinity of reclaimed water measured as electrical conductivity (EC_w), which varies depending on the water source and treatment processes, ranging from 1.0 to 1.9 $dS \cdot m^{-1}$. To be successful in using these alternative water sources, information on salt tolerance of economically important ornamental plants and their salinity threshold is needed.

Nature of Partnerships, Alliances, Brands and Initiatives

Our team in the Texas A&M University System are addressing water quantity and quality issues and needs through cooperative research, teaching and extension programs and activities. In the past few years, our research activities have been focused on screening and identifying salt tolerance of many ornamental crops and on determining water use of these plants. The identification of threshold salinity levels for ornamental species will allow for the use of these materials under conditions that include the use and management of recycled, reclaimed and poor-quality irrigation waters in nursery/greenhouse operations and urban landscapes. The water use and crop coefficient data of ornamental plants will help nursery industry, landscape professionals and homeowners to increase irrigation efficiency by scheduling irrigation timing and amount more attuned to real crop/plant needs.

Water is also one of the priority areas stated in the strategic plan for the Ellison Chair in International Floriculture. One of the first activities of the current holder of the chair was to develop a comprehensive website that compiles many of the resources regarding water BMP's, conservation practices, water auditing tools, Texas and U.S. policy resources, and detailed information regarding the clean water act (http://ellisonchair.tamu.edu/emphasis-areas/water-resources).

We are grateful to receive the financial support from federal, state, local agencies and industries. The Rio Grande Basin Initiative (RGBI), a Federal Initiative, administrated through USDA-NIFA and the Texas (A&M) Water Research Institute, along with New Mexico State University, has supported the targeted research and extension activities in the basin since 2001. We have received funding from RGBI for Urban Landscape Water Conservation (Task 5) and

Saline and Wastewater Management and Water Reuse (Task 7) to support our research and extension activities on water conservation of ornamental plants. The Texas Water and Development Board, Texas Nursery and Landscape Association, the International Cut Flower Growers Association, the Joseph H. Hill Foundation, Texas Department of Agriculture's Specialty Crops Program, El Paso Water Utilities, and several greenhouse and nursery growing firms have also provided support and funding for our water conservation programs and activities.

For our future research and extension efforts, we are continuing our effort in water conservation related to the green industry. Examples are, a PhD graduate student (Amy Cai), supported by T. Starman, G. Niu and C. Hall, working on drought and salt tolerance of garden roses, including Earth-Kind® roses. Niu is a co-PI on a USDA-NIFA Specialty Crops Research Initiative, "Impact and social acceptance of selected sustainable practices in ornamental crop production systems", in which she will evaluate the sustainability of plastic container alternatives for use in nursery production systems, determine the impact of biocontainers on water use of nursery crops and the impact of landscape performance. R. Cabrera is leading research projects on the characterization of nutrient and water daily and seasonal use and patterns by greenhouse roses, and the effect of localized rootzone water/nutritional stresses on rose flower productivity and quality. These projects have been financially supported by the International Cut Flower Growers Association (through the J.H. Hill Foundation), plus the gracious in-kind donations and advice from key growers in California and Colombia. Another water-related research project pertains to the estimation of water and nutrient use in mistletoe-infested landscape/street trees, in particular assessing the impact of the semi-parasitic American mistletoe (*Phoradendron* spp.) on the water economy of the trees and their surrounding urban landscapes.

The Alliance for Cooperative Course Sharing in the Plant Sciences

Michael R. Evans[1], Richard Harkess[2], Jeff Kuehny[3], and Janet Cole[4]

[1]Department of Horticulture, University of Arkansas, Fayetteville, AR

2Department of Plant and Soil Sciences, Mississippi State University, Starkville, MS

[3]School of Plant, Environmental and Soil Science, Louisiana State University, Baton Rouge, LA

[4]Department of Horticulture, Oklahoma State University, Stillwater, OK

With reductions in resources available for teaching and the loss of faculty teaching positions over time, curricula in the plant agricultural sciences have come under significant pressure. In many cases, course offerings have been downsized and very often when faculty positions are not filled, or filled under a similar job description, courses are eliminated. This phenomenon has resulted in less diverse and thorough curricula in the undergraduate plant agricultural sciences. Colleges of agriculture often have difficulty in offering important core classes (i.e. plant physiology, plant anatomy, etc.) that serve as the building block for more advanced classes (i.e. classes in soil management, international agriculture markets, secondary uses of plants, etc.). This is particularly true for smaller colleges of agriculture that have fewer faculty and teaching resources from which to draw. As science and job markets change, the need for new courses and changes to curricula to address these emerging issues occurs. However, with limited faculty and resources, smaller colleges of agriculture are often unable to develop and to offer courses to meet new educational needs or priorities (i.e. classes in soil management, international agriculture markets, secondary uses of plants, etc.). Additionally, some courses, although very important to the plant agricultural science curriculum, may have low student numbers per class (sometimes by design or necessity) and are thus an inefficient use of teaching resources.

To address these problems the participating institutions created the *Alliance for Cooperative Course Exchange in the Plant Sciences* (ACCEPtS). The ACCEPtS program serves as the mechanism for the participating institutions to share teaching resources and to use those teaching resources to develop, maintain, and share courses in the agricultural plant sciences. By participating in this course exchange program, the institutions are able to reduce course

duplication, offer students courses taught by experts in the subject matter, jointly develop core classes as well as classes related to emerging issues that they would otherwise be unable to offer students, and increase the efficiency with which they utilize teaching resources. Sharing of courses through ACCEPtS also allows each institution to maintain significant flexibility and to utilize the courses as best serves the needs of their respective students and states.

An operating agreement was developed by the participating institutions. The operating agreement delineates how the institutions interact, institutional responsibilities and the responsibilities of the ACCEPtS Coordinating Committee which oversees the program. The *Institute for Academic Alliances* (IAA) at Kansas State University works with ACCEPtS as a contracted partner. Using the Expansis system, the IAA provides unified course enrollment information, invoices for tuition billing among the institutions, grade dissemination and annual reports. Whereas, the ACCEPtS Coordinating Committee oversees operations, the IAA handles the mechanics involved in course sharing and information exchange.

Courses that are shared among the institutions are referred to as ACCEPtS courses. Students registering for an ACCEPtS course being taught by faculty at an institution other than the student's home institution are referred to as ACCEPtS students. All ACCEPtS courses are listed by each participating institution according to that institution's catalog number. Each institution decides the appropriate course level and numbering system for each course based upon the syllabus and course description provided by the instructor. Each institution approves the courses and includes them in their respective catalogs. Each institution uses the courses in their respective curricula as each department chooses. Different departments within the plant sciences have flexibility to use the courses as best serves the needs of their students.

Students register for an ACCEPtS course at their home institution and under their home institution's catalog number for that course. This avoids any issues related to the transfer of courses or courses taken late in a student's career being taken off-campus since these courses are viewed as on-campus or resident courses. Students pay tuition at the rate at which they would pay for a traditional on-campus course at their respective institution. Although students at different institutions pay different tuition rates for the same course, the tuition is the same as if

the courses where taught on-campus with traditional delivery methods. All student policies related to registration, withdrawals, tuition refunds, etc. are those of the student's home institution.

Enrollments for ACCEPtS courses from each institution are reported to IAA using the Expansis system which then transfers the enrollment to the teaching institution under the teaching institution's course number. Thus, the teaching institution and instructor receives a unified enrollment under a single course number. Final grades are reported by the course instructor to IAA which disseminates the grades to each student's home institution (to a designated instructor of record) under the course number that the student was registered. Therefore, from a student perspective, only the content delivery is different from other traditional on-campus courses for which the student registers.

Tuition collected from students participating in ACCEPtS courses is distributed in one of several ways. In cases where the teaching and receiving institution are the same (i.e. student taking the class as a traditional on-campus course) all tuition funds (100%) remain with the teaching institution. This avoids various legal issues faced by certain states. In all other cases, 65% of tuition collected for ACCEPtS courses is transferred to the teaching institution. The student's home institution (the receiving institution) receives 15% of the tuition funds. The ACCEPtS program receives 20% of the tuition collected for ACCEPtS courses. These funds are used to pay for services provided by IAA and to support future course improvements or the development of new shared courses to meet emerging needs.

The participating institutions have in common several delivery systems. All of the participating institutions have distance education facilities and personnel. Because all classes are unique and may be best served by different delivery systems, the delivery method for each course is decided upon by the course instructor with the approval of the ACCEPtS Coordinating Committee. During the first three semesters that the ACCEPtS program has offered shared courses, instructors have used a wide variety of tools to develop and disseminate their course content. Among the tools have been custom developed web sites, Camtasia-based presentations, narrated Powerpoint presentations, recorded lectures, blogs, Tegrity chat sessions and discussion boards.

All instructors have used some type of course management system (i.e. Blackboard, Moodle, etc.) to communicate with students, maintain enrollments and post grades. Testing has typically been accomplished using course management systems in combination with Lockdown Browers and proctors.

The participating institutions vary in their academic calendars (the beginning and ending dates of semesters, holiday periods, etc.). These issues are addressed on a course-by-course basis since the delivery method has a significant impact on how the issues may be addressed. Some courses are designed so as to allow students to proceed at their own pace. Other courses are more structured with more live or time dependent activities. Each instructor takes these issues into account when designing the course and the Coordinating Committee reviews and approves the solution for each course. Essentially, each instructor works with the ACCEPtS Coordinating Committee to determine the most effective method of delivering course content to meet the needs of the students at each institution. In practice, instructors have chosen to begin their classes on the date the latest starting institution begins classes and to end their classes on the date that the earliest ending institution ends classes.

The first nine courses developed by ACCEPtS included: 1) Greenhouse Management, 2) Greenhouse Management Lab, 3) Organic and Sustainable Horticulture, 4) Sustainable Nursery Production, 5) Temperature Stress Physiology, 6) Horticulture Crop Physiology, 7) International Horticulture, 8) Plant Growth and Development, and 9) Sustainable Landscape Design. The participating institutions began sharing courses through the ACCEPtS program in the Fall Semester of 2009. By the end of Fall Semester 2010, eight of the nine courses had been taught at least once. A total of 320 students enrolled in the ACCEPtS courses for a total of 888 credit hours. Future plans include expanding both the number of courses shared as well as the number of institutions participating in the ACCEPtS program.

THE TEXAS SUPERSTAR® PROGRAM
SUCCESS THROUGH PARTNERSHIP

Brent Pemberton[1], Michael Arnold[2], Tim Davis[2], Daniel Lineberger[2], Cynthia McKenney[3], David Rodriguez[4], Larry Stein[4], Charles Hall[2], Marco Palma[4], and Richard De Los Santos[5]
[1]Texas AgriLife Research, [2]Texas A&M University, [3]Texas Tech University, [4]Texas AgriLife Extension, [5]Texas Department of Agriculture; b-pemberton@tamu.edu

Texas Superstar® is a marketing assistance program that involves the promotion of outstanding plants that have proven performance in most regions of Texas. From the beginning, this program has represented a partnership between the Texas A&M University Agriculture Program and the ornamental industry in Texas. Only the most reliable and best-looking plants make the grade. The criteria for selecting a Texas Superstar® plant include:
1) Must be attractive and useful to the gardening masses.
2) Must be unique and offer desirable and ornamental characteristics not usually available in commonly sold plants.
3) Must consistently perform well for most Texas consumers regardless of their plant expertise and growing locations.
4) Must be as pest resistant as possible (deer proof an added bonus).
5) Must be able to be propagated and mass-produced in sufficient numbers to meet the increased consumer demand.
6) Preferably is so attractive in the sales container that it sells itself to the consumer who has never heard of the many attributes of the plant.
Conservatively, Texas Superstar® marketing promotions have been estimated to have resulted in $15 million of increased sales at the major wholesaler level not including value-added components or smaller wholesaler production.

Texas is an ecological microcosm of the USA. The state spans 4 USDA hardiness zones, has 15 unique land resource areas and 8 major soil orders, and has annual precipitation rates ranging from 8 inches per year in the far west to 56 inches per year in the far east. The four major trial sites for the program are in College Station, Lubbock, Overton, and San Antonio. These sites represent major differences in ecological zones near major population centers in the state. All decisions concerning plants selected for trialing or designated for promotion are made by the Texas Superstar® Executive Board. Members are:

- Brent Pemberton, Chair, Texas AgriLife Research-Overton, TX
- Michael Arnold, Texas A&M University-College Station, TX
- Tim Davis, Texas A&M University-College Station, TX
- Daniel Lineberger, Texas A&M University-College Station, TX
- Cynthia McKenney, Texas Tech University-Lubbock, TX
- David Rodriguez, Texas AgriLife Extension Service-San Antonio, TX
- Larry Stein, Texas AgriLife Extension Service-Uvalde, TX

The Texas Superstar® program grew out of regional marketing promotions coordinated by Dr. Jerry Parsons in the San Antonio, TX region in the 1980s. In 1989, the first statewide marketing promotion was accomplished featuring the Texas Bluebonnet. By the mid 1990s, the acronym CEMAP which stands for Coordinated Education and Marketing Assistance Program was used for the program. In 1997, the term Texas Superstar® was coined by the Executive Board. All

promotions were retroactively designated Texas Superstar® plants. Texas Superstar® was trademarked at the time. Later, the trademark was registered and the rights were assigned to the Texas Agricultural Experiment Station (now Texas AgriLife Research). In 1998, Texas Superstar® tags were first used. Five cents per tag sold was designated for the program. Horticultural Printers helped develop the brand by donating artwork and the patent search. Wal-Mart purchased the first tags.

In the mid 1990s, Dan Lineberger created the Aggie Horticulture website. The CEMAP Program folder was present on this site from the beginning. Aggie Horticulture was among the first 10,000 servers to become a part of the World Wide Web. There are now over 273 million servers on the Web. In June 1999, the www.TexasSuperstar.com domain was registered. In 2010, the Texas Superstar® website received 140,008 user sessions with 3,571,745 hits.

By the mid 2000s, changes began to challenge the viability of the program. Tag sales were declining and some key personnel left the program due to other pursuits, retirement, or health considerations. However, recent changes and additions to the Executive Board has helped the program remain alive and to begin a renewal of industry partnerships and a campaign to increase consumer awareness in the program. In 2009, the Texas Department of Agriculture greatly increased activity in partnership with the Go Texan Program. A Texas Superstar® brochure originally created in 1999 with the Texas Nursery and Landscape Association was updated and printed, ads were placed online and in the regional magazine Texas Monthly, stakes and hang tags were made available on request to growers and retailers, point of purchase materials were made available to retailers, and television ads in English and Spanish were planned for central Texas markets in 2011.

In addition, a partnership has been found in the work done by Marco Palma and Charles Hall of Texas A&M University. Recently, Collart, Palma, and Hall (2010) found that only 15% of the total consumers were completely aware of the Texas Superstar® brand. Consumers who are aware of the program, considered the high temperature resistance, no pesticide usage and the minimum soil preparation required as the best Texas Superstar® features. Of those aware of the brand, 88% said they were satisfied or highly satisfied and only 6% were dissatisfied with the product performance and they assured they found out about this brand through friends or store displays. Of those aware of the brand, 84% exhibit a strong repurchase intention and suggested they would definitely or probably purchase again. The willingness-to-pay by the average respondent for a Texas Superstar® plant was estimated to be 10% higher than the willingness-to-pay for an unbranded plant.

Needless to say, there is much work to be done to raise consumer awareness of the program, but the brand is highly accepted by those who are aware of it. The Texas Superstar® program started with partnerships and the future of the program is dependent on the continuing growth and strength of these partnerships.

Literature cited

Collart, A.J., M.A. Palma, and C.R. Hall. 2010. Branding awareness and willingness-to-pay associated with the Texas Superstar® and Earth-Kind™ brands in Texas. HortScience45(8):1226-1231.

TEXAS SUPERSTAR® PROMOTIONS FOR 2011

The Texas Superstar® Executive Board is excited to announce the promotions planned for 2011. A Texas Superstar® promotion includes a news release that is usually picked up by many newspaper garden sections, magazines and other publications or news media outlets statewide. In addition, County Horticultural Agents across the state promote these plants via local news media. Texas Superstar® plants are usually identified with a plant tag in retail outlets. The sale of these tags provides revenue to support the trials and development of future promotions. See www.TexasSuperstar.com for more information on all aspects of the program. The Texas Superstar® Program has also partnered with the Texas Department of Agriculture's Go Texan Program (http://www.agr.state.tx.us/gt/jumppage/0,1486,1670_0_0_0,00.html). For a limited time, Texas Superstar® tags are available at no charge from TDA for use in tagging plants for retail sale. Contact TDA for information regarding these tags. The promotions for Turk's Cap and Angelonia are planned for April 2011. The promotion for the "Baby's Breath" Euphorbias is planned for May 2011. And, the promotion for the "Cool Season" Euphorbias is planned for October 2011.

Turk's Cap (*Malvaviscus arboreus* var. *drummondii*) - How would you like a plant for your garden that takes full sun to shade, is drought tolerant once established, has showy flowers all season long, attracts hummingbirds and butterflies, and oh yeah is a native plant so it poses not issues with being invasive? Too much to ask from one plant? Not really. Turk's cap, known in the scientific community as *Malvaviscus arboreus* var. *drummondii*, is a native of southcentral and southeast Texas woodlands where it is usually found in the shady understory. Plants are very site responsive with best growth in partial shade and moist rich soils, however this homegrown Texas Superstar® is tough enough to withstand full sun and occasional drought. Turk's cap can be grown as an annual in north Texas, while plants become perennial in USDA zones 8 to 11, and progressively more shrub-like in south Texas. Dark green broadly ovate leaves have cordate bases and three prominent lobes. Leaves may be lighter green and take on more of a quilted appearance in sunnier sites. The dark green leaves are a perfect foil for the bright cherry red, soft pink, or white flowers which resemble miniature Turk's turbans. Plants tend to sucker and form slow growing colonies with upright stems, typically three to six feet tall depending upon the quality of the site. This species typically has rich cherry red flowers, but white forms are available as is the pink flowering cultivar, 'Pam Puryear'. Turk's cap is also a fantastic plant for feeding migrating populations of hummingbirds and the small flattened round cushion-shaped red fruit are eaten by other wildlife. Pests are of minimal concern in the landscape, with white flies, scale, and mealy bugs occasionally encountered mostly in nursery or greenhouse environments. 'Fiesta' is a variegated form with splotchy yellow, green, and whitish leaves, but it requires pruning of reversions to retain its variegation. This native Texas son deserves a shady spot in every Texas garden.

Angelonia Serena® series (*Angelonia angustifolia*) – With the common name Summer Snapdragon, this South American native makes itself right at home in the gardens of Texas. From the hot, humid summers of east and central Texas to the hot dry days of the High Plains, this popular summer annual puts on a nonstop show of flowers during the summer season. The Serena® series from PanAmerican Seed is the first to be grown from seed instead of cuttings. It

has proven to stay more reliably in flower during the growing season than varieties propagated vegetatively. Seed is available in White, Purple, Lavender, Lavender Pink, and a Mix. They branch well without pinching and grow to about 12 to 18 inches in the garden in full sun. They are drought tolerant, but need regular moisture. Shearing is not necessary, but can be used to rejuvenate flowering. They can be used in the front of the border, as a ground cover, or even in mixed containers.

"Baby's Breath" Euphorbias (*Euphorbia hypericifolia* syn. *Chamaesyce hypericifolia*) – Very few euphorbias that are not of the weedy type do well in a hot Texas summer. But a new type of euphorbia has come onto the scene that we call "Baby's Breath" type because of the billowing effect that the small white flowers have in the landscape. These profusely flowering summer annuals provide clouds of white flowers all season long that can be used for edging, as a ground cover, for weaving between plants in a border, or in mixed containers. The cultivar 'White Manaus' from GroLink® has been the most vigorous in our trials and stands up brilliantly to our Texas heat. Breathless™ White from Ball FloraPlant is another strong grower. 'Silver Fog' from Dummen Red Fox and 'Hip Hop' from GroLink® are both smaller types that are best used in mixed containers where they blend and support any plant they are mixed with. They are great fillers for mixed containers as they provide a bright fine texture to the combination. All of these euphorbias are selections of a North American species and stand up to full sun conditions, but will also tolerate some shade. They are vegetatively propagated. Water use is moderate and shearing is not needed.

"Cool Season" Euphorbias (*Euphorbia martinii*, *E. characias* subsp. *wulfenii*, *E. amygdaloides*, and various hybrids) - There is a cool new Texas Superstar® in town ready to add some color to your fall and winter gardens. Enter the Cool Season Euphorbias. This collection of unique plants provides attractive rosettes of solid or variegated foliage in colors including lime green, cream, pink and maroon. The flowers on this crop are tall spikes of colorful bracts which provide months of color in the spring. These Euphorbia hybrids are hardy from USDA zone 6 to zone 8. They are durable enough to provide winter foliage interest followed by spring flowers either in the ground or in containers without protection from the winter cold. In northern parts of the state, particularly in the High Plains area, they can also tolerate summer heat and drought. Plant these show stoppers in a full sun location with well drained soil. They are a great addition to rock gardens, container plantings or perennial beds. They provide outstanding foliage that mixes well with pansies and other winter annuals, especially in containers. No need to worry about diseases or pests with these tough plants. For a tight mounding plant, select 'Tiny Tim'. If you wish to have more of a red or dark maroon color, try 'Blackbird'. 'Rudolph' has dark green foliage with red accents. 'Tasmanian Tiger' or 'Glacier Blue' is notable for excellent cream and green variegated foliage. Whichever cultivar that you select, you will find this Texas Superstar® will extend your color season.

Floriculture and Fundraising: A Public-Student Partnership For Learning Job Readiness in Floriculture

Sabine R. Green, Geno A. Picchioni
New Mexico State University, Las Cruces NM 88003
swhitley@nmsu.edu

Index Words: fund raising, floral design, student evaluation tools, silent auction

Significance to the Industry: The floriculture industry seeks university-trained employees with wide ranging skills, including hands-on experience, internships, and market knowledge. Retail floristry programs cover a wide range of topics, enabling a student to be ready to work or start their own business. Developing this type of college course that emphasizes the retail marketing of agricultural products is becoming increasingly important (Nefstead, 2001). Finding a testing tool to challenge the students to bring all aspects of the course together for a real-world experience is a challenge for the instructor.

Engaging a student in a psychomotor task to reinforce what was learned in part of experiential learning is known as cognitive domain (Newcomb etal., 2004). Instruction that incorporates the presentation of the information coupled with a real-world experiential learning (laboratory style) practicum is likely best for teaching applied skills to novices (Duncan, 1996). Mexal (2004) states that alumni may become interested with well-defined, modest programs that are most familiar to them, and that alumni and emeriti from the specific program or department may respond positively to targeted requests. He notes that this interest can then be used to establish scholarships and endowments.

We have developed a cumulative final exam in practicum format which tests student knowledge on design elements, seasonality, planning, marketing, and customer service skills. Since practicum testing can be costly, we incorporated a public auction to allow bidders to purchase final arrangements. We hypothesized that a bidding audience would appreciate student floral design proficiencies by bidding higher on arrangements that received higher grades. The objective of this paper is to discuss our findings collected over a two-year period.

Methods and Procedures: Students enrolled in the Beginning Floral Evaluation and Design at New Mexico State University (NMSU) are required to participate in a cumulative final exam. The final is a culmination of all concepts learned during the course of the semester. The format for the final exam is untraditional. Students are expected to create a unique floral design of dried, fresh, or artificial materials of their choice, and present it during a public artist's reception. Additionally, the reception doubles as a fundraiser, as it allows the public to interact by utilizing the "silent auction" concept to generate funds. Students are encouraged to interact with the attendees to solicit bids in a tasteful, classic customer service manner. Students are not graded on number of bids they receive, or on the amount of money that they bring in from the winning bid. This testing format allows the students to demonstrate their floral industry product knowledge, basic floral design skills, postharvest knowledge, skills in customer service and interpersonal relations, marketing and advertisement knowledge, and time management.

In addition to the actual floral art, students are required to submit a concept page, advertisement, recipe for the design, and a final portfolio of the planning of their work. The concept page and recipe

(number, type and color of flowers for the arrangement) are submitted one month before the final, to be approved by the instructor. This process encourages timeliness and ensures that the student is preparing for the event. Additionally, it allows the instructor to prepare the fresh flower order for the event. This process mimics the retail floral industry (particularly the special events genre) in that estimates and orders must be placed in time for shipping and product attainment to occur. The student must learn product seasonality in order to place a valid recipe order. The creation of an advertisement draws upon the marketing curriculum, and the final portfolio would serve as a special event concept presented to a potential client.

The day of the final, students are expected to arrive either in time to create their floral piece before the reception, or arrive with the floral piece in hand, completed. Half of a standard 6-foot rectangular table is assigned to each student to create a vignette. The vignette is a focal area that enhances the marketability of a product, such as in retail window displays. The students can choose to turn in requests for vignette items that are in the floriculture inventory (such as drop cloths and pillars) when they turn in their recipe, or they can supply their own items. Students are encouraged to dress appropriately, bringing a feel of professionalism and elegance to the event. Students are graded on all the items. A breakdown of the percentage for each item is presented in Table 1.

During the last two years of administering this final exam, data included the grade that was received for the final exam, starting bid, winning (final) bid, and number of bids received. Linear regression analyses were performed to evaluate the relationships between final exam grade and bidding price, grade and number of bids, and final bid price and number of bids.

During finals week of the second year of data collection (Fall semester 2010), the students were also given an open-ended questionnaire to anonymously share their thoughts and reflections about the experience. The questionnaire prompted students to explain what they thought they were being tested on, if they ever had a public practicum as a testing strategy before, confidence building, and suggestions. Comments and suggestions were collected to facilitate a more positive experience for undergraduates in the future.

Advertisement of the event included several avenues. University-wide emails were sent, as well as over 200 individual emails to past attendees, alumni, emeritus, and donors of the NMSU floriculture program. The departmental and college websites also posted information. Local floral shops and wholesalers were invited and asked to advertise the event, and students were encouraged to invite family and friends. The New Mexico State Florist Association and the West Texas-New Mexico regional Florist Association were also notified and asked to send out announcements via email to their membership lists. Additionally, the campus newspaper, radio, and TV station provided public service announcements. In the most recent year, social networking sites such as Twitter, MySpace, and Facebook were also utilized. Data on public attendance of the event was not recorded.

Results and Discussion: The final exam grade reflected the proficiency with which a student incorporated all of the floral design elements and concepts learned throughout the semester. To some degree, the hypothesis (higher bid prices with higher grades) proved to be true in that the final bidding price tended to increase with the grade. The marginal correlation (Fig. 1A) explained 13% of the variation in final bid price among the arrangements and was limited by sample size (N = 24) and by a narrow range of exam scores (88% of the students received a grade of 90 or above). While these findings may be revealing to future students in the validation of grading criteria, other factors more important than grade may affect the bidding price.

A somewhat stronger positive correlation was observed between final bidding price and the number of bids received for a given arrangement (Fig. 1B). This indicates that higher-priced arrangements may be more popular to our bidding audience than are the lower-priced arrangements. There were no apparent correlations between grade and starting bid, or between grade and number of bids (data not shown).

In the after-exam questionnaire, only one student mentioned having a similar practicum type final that included the public, and in a college setting. There was no mention of experiencing a previous fundraising project as in the present course, hence the uniqueness of this concept. Students likened the event to a science fair or an artist's opening at a gallery or museum (example vignette in Fig. 2). Other comments included:

- It raised my confidence as a floral designer
- I felt that I was ready for the real world
- I feel more aware of the (floral) industry, and can identify plants readily, walking through a neighborhood
- I feel I could get hired and flourish in a (floral) shop if the opportunity arose
- I was encouraged to continue designing

In addition to offsetting teaching costs, this unique student-public partnership can serve small-sized academic programs in several ways. Building public awareness increases support and donor clientele. Hosting an annual event helps to create expectation in past attendees. Experiential learning programs such as floriculture should exploit a product that can be offered to the public, which is a by-product of the learning. Allowing public access to "help support a good cause" by purchasing the product is appealing to the general population. If advertised through local and state professional organizations, it creates job opportunities and strengthens collaboration efforts with local industry. Programs other than retail floristry or floriculture, such as animal science, agriculture mechanics, arts, theater, fashion design/merchandizing, could benefit from similar testing formats.

This final exam format has proven to be highly popular at NMSU – to students, faculty and staff, administration, and the public. Further research is pending to generate larger sample sizes that could reveal significant learning outcomes, and to identify apparent factors other than grade affecting bidding prices of the audience.

Literature Cited:

1. Duncan, S.L.S. 1996. Cognitive apprenticeship in classroom instruction: Implications for industrial and technical teacher education. Journal of Industrial Teacher Education 33: (3) 66-86.
2. Mexal, J.G., D. J. Cotter, and A. Palormo. 2004. Seed Money: Helping Our Students Grow: A Model for Giving. NACTA Journal. Mar 48:1 2-6.
3. Nefstead, W. E. 2001. Developing a Retail Management Course: A Case Study of ApEc3821. AAEA Annual Meeting Proceedings. August 2001.
4. Newcomb, L. H., McCracken, J. D., Warmbrod, J. R., and Wittington, M. S. 2004. Methods of Teaching Agriculture (3 ed.). Pearson-Prentice Hall, Upper Saddle River, NJ.

Table 1. Elements of the final exam grade.

Examination component	Percent of total grade
Advertisement and marketing page	10
Recipe and concept page; timeliness	10
Floral design	50
Vignette	10
Final portfolio	20

Figure 1. Relationship between final exam grade and final bid amount (A), and between final bid amount and number of bidders (B) (2009 and 2010 data combined, N = 24 students). Regression equations: (A): Final Bid Price = –69.6 + 1.5(Final Exam Grade), R^2 = 0.13; (B): No. Bids = –0.27 + 0.07(Final Bid Price), R^2 = 0.41.

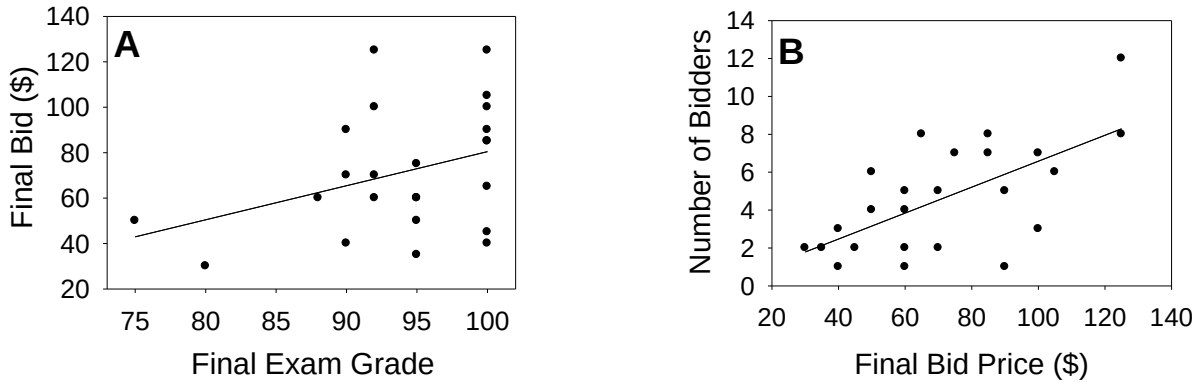

Figure 2. Example of a student vignette at the final examination.