

# Abstracts of the ASHS

## Northeast Region Annual Meeting

University of Delaware, Newark

8–10 January 2009

### Papers

#### Cross-hybrid Compatibility of Inkberry with Meserve Holly and Common Winterberry

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Inkberry [*Ilex glabra* (L.) A. Gray]] is a native evergreen shrub with dark green foliage, which brings much more attention for nursery growers in the northern landscapes in the US. Inkberry was hybridized with cold-hardy male meserve hybrid hollies [*Ilex xmeserveae* S.Y. Hu] and common winterberry [*Ilex verticillata* (L.) A. Gray]. Cross-pollination of *Ilex glabra* and its five cultivars with both above male plants was carried out in greenhouse to test their compatibility during their blooming season. Cross-compatibility of *Ilex xmeserveae* and *Ilex verticillata* significantly differed among *Ilex glabra* and its cultivars. Inkberry and its cultivar ‘Chamzin’ and ‘Densa’ had higher compatibility with either *Ilex xmeserveae* or *Ilex verticillata*. Their fruit sets were 55.1%–68.7% and 43.6%–86.0%, respectively. However, ‘Compacta’ and ‘Nigra’ had less compatibility and their fruit sets were 14.0%–32.1% for *Ilex xmeserveae* and 21.0%–38.0% for *Ilex verticillata*. ‘Shamrock’ was almost incompatible with neither of them; only lower than 3.7% fruit set was observed. Most of their fruit sets were aborted and the fully developed seeds were less than 54.2% (*Ilex xmeserveae*) and 32.4% (*Ilex verticillata*). The pollen germination in situ observed with fluorescence microscope also supported the above results. Therefore, reproduction isolation barriers such as inhibition of pollen germination, lack of fertilization, endosperm failure and/or embryo abortion should be avoided through selecting a suitable female *Ilex glabra* cultivar.

Lijuan Han is a visiting professor from Changchun Normal University in China.

#### Zinc Uptake of *Sedum* spp. in Various Ratios of Crumb Rubber-amended Green Roof Substrate

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Extensive green roof systems are designed primarily to mitigate storm water runoff from impervious surfaces in dense urban areas. Expanded shales, slates and clays are inorganic materials typically used as substrate. In addition to the high embodied energy from production, these materials can impose restrictions for retrofitting existing structures due to weight. The use of crumb rubber, a recycled tire material, may reduce substrate loads, reduce the use of energy during substrate production and improve the porosity and longevity of many green roof substrates. However, zinc is released from crumb rubber in potentially toxic levels for ornamental plants. This study investigates the tolerance of *Sedum* species grown in the green roof substrate, rooflite™, amended with one of six volumetric proportions of crumb rubber (0%, 6%, 12%, 18%, 24%, and 30%). Three *Sedum* species: *S. album* L., *S. reflexum* L., and *S. kamschaticum* Fisch., were grown in 10-cm (4 inch) pots in an incomplete randomized block design. After 5 months of growth under greenhouse conditions, the plants were harvested and the dry mass was determined. The foliar zinc content was determined by ICP analysis at the University of Delaware

Soil Testing Laboratory, Newark, DE. Significantly reduced dry mass and insignificant differences in zinc content were a product of higher zinc concentrations in the tissues of plants grown with crumb rubber. The results were highly variable imposing restrictions for inference on *Sedum* spp. response to crumb rubber zinc. These results suggest the use of crumb rubber should be limited to small proportions in substrates having high zinc adsorption capability, planted with zinc tolerant species. However, more rigorous testing is needed to determine zinc tolerance levels of *Sedum* spp.

#### Effect of Iron Source on Plant Quality of Geranium (*Pelargonium xhortorum*)

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This study was conducted to determine the effect of four iron sources on overall plant quality of geranium (*Pelargonium xhortorum*) cultivars grown at low pH levels. The iron sources included three chelates (iron—EDTA, EDDHA, and DTPA) and iron sulfate as a non-chelate control. The geranium cultivars included ‘Blue Wonder’, ‘Stardom Bright Pink’, and ‘Stardom Deep Lavender’. A 17–4–17 custom fertilizer with a complete complement of micronutrients, except iron, was prepared and divided into four 500-g batches. One of the three chelate treatments was added to each of three batches and iron sulfate was added to the fourth to act as the non-chelate control. Plants were arranged in four replicate randomized complete blocks and received a 250-ppm nitrogen continuous liquid feed with one of the four fertilizers for the first 4 weeks. Fertilizer concentrations were increased to 350 ppm nitrogen for the remaining 9 weeks. At the completion of the experiment, each of the geraniums was assigned a rating from 0 to 5 to indicate overall quality. Plants that were treated with the fertilizer containing iron sulfate, the non-chelate control, exhibited much higher quality ratings than those plants treated with fertilizer containing iron EDTA, DTPA, or EDDHA. The plants treated with iron EDDHA and DTPA had higher quality ratings than those treated with iron EDTA. Our findings indicate that iron chelate fertilizers may not be the most optimal for growing geraniums. We suspect that sulfur may play a key role in maintaining geranium plant quality and intend to explore the effect of sulfur in subsequent research.

#### Effect of Iron Source on Plant and Floral Biomass of Geranium (*Pelargonium xhortorum*)

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This study was conducted to examine the effect of three iron chelates (iron EDTA, iron EDDHA, and iron DTPA) and iron sulfate, on the development of micronutrient toxicity in geranium (*Pelargonium xhortorum*) cultivars grown in low pH media. Geranium cultivars included ‘Blue Wonder’, ‘Stardom Bright Pink’, and ‘Stardom Deep Lavender’. A 17–4–17 custom fertilizer with a complete complement of micronutrients except for iron was made and split into four equal aliquots. One of three iron chelate sources was added to each of three aliquots and iron sulfate was added to the fourth to act as the control. Plants were arranged in four replicate randomized complete blocks and received continuous liquid feed (CLF) with a 250-ppm nitrogen complete fertilizer solution containing one of the four iron sources for the first 4 weeks. Fertilizer concentrations were increased to 350 ppm nitrogen for the remaining 9 weeks. The plant and floral biomass

for each plant in the trial were collected at the completion of the experiment to measure plant health and overall growth. Plants treated with iron EDTA, DTPA, and EDDHA had less mean log biomass than plants treated with the non-chelate iron sulfate. The iron EDTA, DTPA, and EDDHA treated plants also had less floral log biomass than plants treated with iron sulfate. The results indicate that the plants treated with fertilizer containing the non-chelate iron sulfate had greater biomass and floral mass than plants treated with fertilizer containing a chelated iron source.

### Fungus against Fungus: Biocontrol of Damping-off

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The fungal biological agents *Trichoderma harzianum* Rifai strain KRL-AG2 G41(Th), *T. virens* Strain G-41 (Tv), or their combination (ThTv; at half rates each the single application rate) were applied to 'Marketmore 27' cucumber seeds (*Cucumis sativus* L.) to provide protection against damping-off caused by *Pythium aphanidermatum* in inoculated soilless media. Cucumber represented a model system in which seeds were either osmotically primed ( $\text{Ca}(\text{NO}_3)_2$  at  $-2.5$  MPa for 3 days at  $25^\circ\text{C}$ ) or non-primed. Protection against damping-off was increased by an aqueous slurry coating of Th (1 mg/seed) on non-primed seeds (76% emergence) or primed seeds (63% emergence) compared to non-coated, non-primed seeds (16% emergence). Coating the seeds with Th either before or after priming had no effect on percentage emergence. In a second study with lower disease pressure, slurry coating of non-primed or osmotically primed seeds with Th, Tv, or ThTv reduced percentage damping-off and increased final emergence percentage. The combination ThTv coating eliminated damping-off only in non-primed seeds, and tended to reduce percentage damping-off in primed seeds compared to coating with Th or Tv alone. In a third study using only non-primed seeds, slurry coatings with mefenoxam fungicide, Th, Tv or ThTv decreased total damping-off to 3%, 7%, 2%, and 0%, respectively, from the 30% occurring in non-coated seeds. Th, Tv or ThTv applied to the growth medium at the same rate as the seed coating (1 mg/seed) were generally as effective as the seed coatings. Further studies tested the effects of ThTv against damping-off in the microgreen 'Early Wonder' table beet (*Beta vulgaris* L.). Coating the seedballs (0, 0.25, 0.5, or 1.0 mg ThTv per seedball) had little effect on percentage damping-off. However, imbibing the coated seedballs in moist vermiculite (250% water) for 2 days before sowing reduced percentage damping-off by  $\geq 30\%$  points. Percentage damping-off decreased with increasing ThTv concentration only when Agro-Lig (Leonardite shale that is 75% humate) was added to the vermiculite. In a second study with beet seeds, we examined the effects of different methods of application of 0.25 mg ThTv/seedball. Seedballs coated with ThTv and control seedballs had 100% damping-off. Imbibing the coated seeds in moist vermiculite (250% water) for 2 days reduced damping-off to 53%. Incubating the ThTv in moist vermiculite for 2 days before a 2-day imbibition period for added seedballs reduced damping-off to 78%, but when Agro-Lig was added to the vermiculite, damping-off was reduced to 41%. Further work will focus on refining techniques to enhance preplant ThTv efficacy against damping-off in beet microgreen production.

### Structural Architecture of Fruit Tissues of the Bell Pepper (*Capsicum frutescens*), as Determined by Fluorescence Microscopy

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*Capsicum annuum* var. Bell is by size one of the largest representatives of the *Capsicum* genus, a genus wherein capsaicin, a bioactive compound, is produced. Capsaicin is currently recognized for its medicinal value and its use as the active ingredient of the capsicum pepper spice. The bell pepper fruit, however, develops virtually without producing capsaicin, and the question is that with the non-synthesis of capsaicin in bell pepper fruits, what anatomical features and metabolic

characteristics distinguish the bell pepper from other pepper types? This work was designed to investigate anatomical and structural differences among four pepper types: bell, jalapeno, habanero, and cayenne. We measured relative dry matter percentage of each pepper, using samples of approximately 1 g each. There were four replicates per treatment, measuring the fruit at two maturity levels: (1) the green and (2) the red/orange stages of development. Structural differences of the pepper fruits were also examined by stereofluorescence microscopy, and images were secured to compare structural and anatomical characteristics of the fruits. Bell pepper fruits had higher water content percentages than habanero, jalapeno, and cayenne, with the green stage having about 5% more water content on average than the red stage. Of all the four peppers, the cayenne red pepper had the highest dry weight, averaging 21%, with the bell pepper fruit having the least dry weight, averaging about 6%. As to the structural anatomy of the fruit, stereofluorescence imaging showed that the walls of the pericarp of the bell pepper fruit had a unique "rafter" or "cross-beam" structure, thereby accounting for structural support of its large size, when compared to the three other pepper types. Individual cells of the bell pepper fruit were also found to be larger than individual cells of the other pepper types. Measurement of the quantities of cellulose and lignin in the fruit tissues of the pepper types is planned as follow-up work to this study.

### Comparative Contents of Food Nutrients and Food Element among Several *Capsicum* Pepper Fruit Types

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Capsicum pepper species of the Solanaceae are a widely consumed vegetable, and numerous reports exist of their contents of nutrients and minerals in different types of peppers. Capsicum peppers have different metabolic profiles also, especially for their content of capsaicin, a medicinal alkaloid and a spice ingredient. Our objectives were therefore set to measure and compare food nutrients and contents of essential elements among four different types of capsicum pepper types, namely: jalapeno, bell, habanero, and cayenne. We dried duplicate tissue samples of the matured green and red pepper types in a Fisher Isotemp oven, ground and extracted the tissues and analyzed the centrifuged and vacuum-filtered extract in a Metrohm 790 Personal IC System. Nutrient content within the seeds and placenta tissue were a first focus in our analyses of the fruit. Other tissues were measured subsequently. When we measured for cations and anions in the extracts, we found that nutrient contents and concentration of elements of the tissues varied widely for sulfur, phosphorus, sodium, ammonium, calcium, and potassium, among the four pepper types for the two green-mature and red-mature stages. With potassium, for example, both mature-green and mature-red Bell pepper were determined to average approximately 54 and 41 mg per gram of oven-dried tissues, respectively. Matured-green and matured-red habanero averaged at 108 and 120 ppm per gram of oven-dried tissues, respectively. These results show that the nutrient and elemental content of different pepper types vary significantly, and their fertilizer requirements during production and their nutrient contributions in forming diets should both be prescribed during production and considered in developing human diets.

### Spectrometric and HPLC Analysis of Yellow Vine Syndrome in Cranberry in Massachusetts

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The production and quality of cranberries may be affected by environmental stress. Yellow vine syndrome, interveinal chlorosis moving from older to younger leaves, has been observed in cranberry bogs. The reason for the development of the syndrome is unknown. Our goal is to investigate the mechanisms underlying yellow vine

syndrome in cranberry plants and as a result develop a strategy to solve the problem. Spectrometric analysis revealed that the yellow vine leaves showed a  $28\% \pm 4\%$  and  $26\% \pm 4\%$  decrease in chlorophyll *a* and chlorophyll *b* compared to normal leaves, respectively. The ratio of chlorophyll *a* to chlorophyll *b* was the same in both types of leaves, suggesting the PSII organization remains unaffected. The loss of chlorophyll suggests that the numbers of PSII centers are dramatically less in the yellow vine leaves, which is supported by a chlorophyll fluorescence study (see poster by Zhang et al.). The carotenoid and antioxidant contents in the yellow vine samples were also significantly lower than normal leaves. These lines of evidence imply that the yellow vine leaves might be vulnerable to excess light. Shading of cranberry plants with yellow vine appeared to reduce the syndrome and increased the chlorophyll content by  $14\% \pm 2\%$ . We propose that photoinhibition is one important mechanism for the formation of yellow vine syndrome in cranberry plants. HPLC profiles showed that two unknown components at 8.04 and 16.1 min are associated with the formation of the syndrome. LCMS identification of these unknown components and HPLC protein analysis of the yellow vine leaves are in progress. Supported by funding from USDA CSREES and UMass Dartmouth Chancellor's Research Fund.

### Research on Production of Organic Grown Ramapo Tomatoes at the EARTH Center

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The 'Ramapo' tomato, developed at Rutgers in the late 1960s, has re-emerged because of its taste and appeal to direct marketers and consumers in New Jersey. Rutgers worked with a private seed company to cross the two original lines and re-create the hybrid 'Ramapo'. The 'Ramapo' tomato research trial was conducted at the EARTH Center, Rutgers Cooperative Extension of Middlesex County, NJ. The 'Ramapo' tomato was compared to 'Better Boy', a popular homegrown variety, and 'BHN-589', a commercial variety. There were 10 plants of each variety placed in 3-ft rows planted 4 ft apart. Varieties were planted in a complete randomized block design. Tomatoes were planted in raised beds on black plastic with twin-wall irrigation. The plants were watered at regular intervals throughout the summer and fertilized with organic products at recommended rates. All plants in this trial demonstrated excellent resistance to disease and insect pests. Wider spacing allowed for adequate air circulation. Growth rate and harvest data were very similar for each tomato variety in this trial; however, 'Ramapo' and 'Better Boy' had the highest production with about 100 lb of fruit per plant. Taste test data revealed similar results for all three varieties with no significant differences in preference. These data indicate that 'Ramapo' compared favorably with more recent varieties and provides a viable alternative for small farms and home gardens.

### How Do Home Gardeners' Preferences and Perceptions Affect Their Pest Management Decisions?

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Integrated pest management (IPM) education for home gardeners is available from a variety of sources, but little is known about its effectiveness in persuading gardeners to adopt preferred practices. In 2008, we conducted a survey-based study of home gardeners in Maryland, Delaware, and West Virginia to identify potential motivating factors and/or barriers to the adoption of IPM strategies. The survey questionnaire was posted online and was also made available by Master Gardeners at various venues. The survey queried respondents about quality of information sources, level of concern on environ-

mental issues, major factors in their choice of pest control strategies, likelihood of employing specific IPM strategies, and self-perceived gaps in their knowledge of pest management-associated subjects. We incorporated a novel approach offering specific scenarios to confirm motivating factors in respondents' choice of either a pesticide or a non-pesticide alternative. A total of 313 home gardeners completed the surveys. Respondents were most receptive to Master Gardeners, Cooperative Extension and the Internet as sources for all types of gardening and pest control information. Cost, travel, and time expended to access information influenced respondents' choice of information sources, with a highest rating for a source's ability to provide both pesticide and non-pesticide alternative control measures. When presented with the scenario-based questions, respondents were motivated to choose alternatives to pesticides in all cases except situations where a pesticide was characterized as safer or more effective. This study confirms other studies showing home gardeners express strong concern for protecting the environment and human health in making pest control decisions and believe they are likely to take positive actions to ensure such protection. We are conducting further research to determine whether the motivating factors identified in this study actually result in adoption of improved practices by home gardeners.

### Color Trials: Connecting the Public to Horticulture at University of Delaware Botanic Gardens

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The University of Delaware Botanic Gardens' (UDBG) Landscape Color Trial Garden was established in 2007 to evaluate the summer performance of selected herbaceous plants grown for annual color. Currently, the UDBG display is the only trial garden in Delaware, offering opportunities for one-of-a-kind evaluations specific to regional climate and growing conditions in a low-maintenance garden. In June 2008, seven plants each of 290 taxa were installed in a 10,000 square foot planting bed, with 42 of the selections installed under 62% shade cloth. Selections were evaluated bi-weekly for flowering and foliage quality on a scale of 1 (poor) to 5 (excellent), taking into account attractiveness, pest and disease resistance, habit uniformity, and overall ornamental value. Top performers included *Begonia* 'Big Red Bronze Leaf', *Begonia* 'Big Red Green Leaf', *Chrysocephalum apiculatum* 'Flambe Orange', *Eucalyptus gunnii* 'Silver Drop', *Euphorbia hypericifolia* 'Diamond Frost', *Impatiens walleriana* 'Super Elfin Red' (shade), *Juncus inflexus* 'Blue Arrows', *Lantana camara* 'Luscious Citrus Blend', *Rudbeckia hirta* 'Tiger Eye Gold', *Solenostemon scutellarioides* 'Henna' (shade), and *Solenostemon scutellarioides* 'Indian Summer' (sun). The data collected during the study was sent directly to industry participants and posted on the UDBG webpage for public review. Evidence suggests the color trial's high visibility in a public garden allows it to serve as a resource not only for plant breeders but for connecting students, professors, researchers, industry professionals and the general public to current horticultural research.

### Sino-American Botanical Exchange: Encouraging Greater Botanical Collaboration Through a Mutually Beneficial Staff Exchange Program

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Due to the diversity of China's native flora, and its similarity to North America's flora, there is great interest for study and botanical collaboration. With increasing regulations and bureaucratic barriers, American botanical gardens encounter challenges to successfully work and collaborate with their Chinese peers. Regulations, limited budgets,

and smaller staff sizes have hindered collaboration among small to medium sized gardens in both China and the United States. With the combined objective to encourage more collaborative work among large botanical gardens and open the door for smaller gardens, this study examined the potential support for and advantages associated with a proposed Sino-American horticultural staff and educational exchange program based on the example of the Garden Club of America's Interchange Fellowship/Martin McLaren Scholarship program. Semi-structured on-site interviews were conducted in China during July 2008 with the directors and/or upper management at 11 botanical gardens in seven provinces/provincial level cities. The Chinese directors identified four main priority areas for professional development among their staff: 1) best horticultural practices, 2) public education methods, 3) public outreach techniques, and 4) private fundraising and development strategies. The American perspective was documented through surveys, interviews, focus groups, and case studies. Data supports the hypothesis that the creation of the proposed program would greatly benefit future Sino-American botanical collaboration by providing a mechanism for reliable, annual, and reciprocal exchange. Moreover, it would provide avenues for other types of exchange by nurturing cross-cultural relationship building, connecting horticultural institutions in each country with the future leaders in the other country, and by providing greater access to type specimens and wild species populations. It will also simultaneously create a resource network available to non-associated individuals or institutions wishing to collaborate.

#### **Plant Collections Management at Welkinweir: A Professional Outreach Project in the Longwood Graduate Program**

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The Professional Outreach Project is a major component of the Longwood Graduate Program curriculum in which students partner with a regional public horticulture institution and work within real-world problem solving situations, similar to what they would find as horticulture professionals. Second year fellows initiate the project and all nine fellows in the Program plan and experience the work needed to complete the project; students are guided by an Advisory Committee comprised of invited, working professionals, which is chaired by the Director of the Longwood Graduate Program. For the 2008 project, the Fellows identified "plant collections management" as their preferred topic to explore with an institutional partner, including aspects of database software, labeling techniques, and mapping technologies. For this project, the Fellows selected Welkinweir (an arboretum in Pottstown, PA) as their "client" and divided into four teams (the Policy Team, the Labeling Team, the Database Team, and the Mapping Team), with each concentrating on one of these specific components of plant collections management at Welkinweir. The Fellows created maps utilizing GIS technologies, developed a handbook to instruct staff and volunteers on the labeling protocols, as well as how to manage the plant collections BG-Base database, and they successfully secured grant funding to purchase labeling equipment. This presentation will highlight specific components of Welkinweir's plant collections management protocol that were developed, updated, improved, and better recorded and interpreted by the Longwood Graduate Fellows in the Professional Outreach Project 2008.

#### **The Current Status and Issues of Blueberry Production in China**

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In the past seven years, the area of blueberries planted in China has increased from 24 to 1,323 ha, and is projected to increase to 14,900 ha by 2010. More than 10 provinces have begun commercial blueberry culture. Blueberries are grown from Northeastern to Southwestern China. Blueberry cultivars were chosen for different production areas based on the regional climate. Lowbush blueberry and half-high

blueberry, about 20% and 15% of the total area respectively, are mainly cultured in the Northeast; northern highbush blueberries, about 37% of all production areas, are mainly cultured along the coastal line area of Liaoning, Shandong, northern part of Jiangsu, and part of Yunan Province. Rabbiteye and southern highbush are mainly cultured in Zhejiang, Jiangsu, Guizhou, and part of Yunan provinces, have 28% of the total production area. Production of blueberries in China increased from 2 to 340 tons from 2001 to 2007, and it is estimated that it will increase to 12,300 metric tons. More than two-thirds of the fruit are used for the fresh market with more than 80% being exported to Japan or Hong Kong. Less than one-third of the fruit produced was processed for IQF and exported to other countries.

The major issues caused by the rapid development include: 1) site selection for orchards have not been properly evaluated and many of the orchards being established in regions where the conditions are not suitable for blueberry growing; 2) cuttings used for planting are too small and most orchards have only a few easy propagated cultivars; 3) rapid development has led to poor quality orchards; and 4) the lack of experience with fruit harvest and processing. Five initiatives for blueberry growing include: 1) developing blueberry growing areas in suitable regions ecologically; 2) mastering cultivation techniques; 3) selecting varieties scientifically and preparing strong cuttings for planting; 4) carrying out soil management carefully; and 5) establishing plantations following the experimental trials.

#### **Effects of Diammonium Phosphate and Vigor-Cal-Phos on Growth and Yield of Lowbush Blueberry**

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A commercial lowbush blueberry (*V. angustifolium* Ait.) field with a history of low leaf N and P concentration was used in this study. Treatment plots (1.8 x 15 m) received 448 kg/ha diammonium phosphate (DAP) (18-46-0) or the equivalent of 18 kg P<sub>2</sub>O<sub>5</sub> as either two or three applications of Vigor-Cal-Phos (VCP) (4% Ca, 0.2% Cu) with or without DAP. DAP was applied preemergent on 23 May with a hand-held spreader. Foliar sprays of VCP were applied on 14 and 27 June 2007 (9 kg/ha rate) or on 14 and 27 June and 13 July 2007 (6 kg/ha rate). An untreated plot served as a control. A randomized complete-block design with 6 treatments and 6 blocks was used. Composite leaf tissue samples taken 5 July indicated control plot deficiencies of leaf N (1.54%) but not P (0.128%), compared to the 1.6% N and 0.125% P standards. Leaf N concentrations were raised to sufficiency levels only by DAP treatments. Leaf P concentrations were raised by either the two or three applications of VCP alone or the DAP, compared to the controls; and concentrations were even higher when treatment plots received VCP and DAP. Leaf Ca concentrations were not affected by any of the treatments but leaf Cu was higher in plots treated with VCP. Stems cut within four 0.03-m<sup>2</sup> quadrats per plot indicated that stem density was increased by combining either of the VCP treatments with DAP, compared to the control and the DAP or either VCP treatment alone. The percentage of branched stems and length of branched stems was increased by DAP but even more so when combined with VCP. Flower bud density was positively correlated with stem density ( $r = 0.66$ ) and branching ( $r = 0.55$ ). Berry yield, estimated by harvesting a 0.6 m wide strip using a self-propelled mechanical lowbush blueberry harvester, averaged 65% higher for plots receiving DAP, compared to controls. The increased potential yield seen when DAP and VCP were applied together was not realized in actual berry yield.

*Specified Source(s) of Funding:* Department, College, State and/or HATCH Private (Agro-K Corporation).

#### **Developing a Crop Water Stress Index in Cranberry**

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Water management is arguably one of the most critical issues affecting cranberry production. The crop water stress index (CWSI) is

the most often used index which is based on canopy temperature to detect water stress. However, no such indices have been developed for the American cranberry plant (*Vaccinium macrocarpon* Ait.). An experiment was set on five commercial cranberry beds to measure plant canopy temperature using infrared thermometers, air temperature, relative humidity and other weather related measurements, soil moisture content, soil moisture tension and plant response to water stress. The objective of data collection was to develop a CWSI for cranberry plants. Linear regression techniques were used to develop a relationship between plant canopy and air temperature differences with vapor pressure deficit. Cranberry beds constructed on sand subgrades were associated with higher stress levels compared with peat based beds. The matric tension of the soil increased with a decrease in soil moisture content. There was a diurnal variation in CWSI with the highest levels of stress experienced between 1200 to 1500 HR in both sand and peat beds. Peat based beds had a high CWSI of 0.4 while sand based beds reached CWSI of 0.9, indicating severely stressed cranberry vines and this occurred slightly after 1200 HR. As the vapor pressure deficit (VPD) increased so did the CWSI, with disproportionately high stress in sand based beds. The CWSI is a useful tool that can be used to make decisions on when to irrigate plants, but its usefulness is limited to clear and sunny days.

### **New Developments in Commercial Beach Plum Cultural Practices**

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Barriers to commercial fruit production of *Prunus maritima* include: 1) minimal information on cultural requirements and soil fertility standards, and 2) trellising and pruning methods. On a commercial orchard of 1000 plants the Cape May County Beach Plum Association and Rutgers Cooperative Extension have developed commercial practices to expand on existing knowledge. Seedlings were planted 8 ft apart within the row and 12 ft between the rows. Our results indicate that 1-year-old seedlings should be pruned to one main stem 12-18 inches high. Due to the high winds in Cape May County, a trellis system is required to maintain upright plants. Vertical trellising was implemented on 2-year-old plants. Posts were installed with three wires; the highest at 7 ft, with trees pruned to 7-ft maximum height. The most compatible pruning style with this trellising system proved to be the central leader. For beach plums soil pH is preferably 6.5 to 7.0. K-Mag (400 lbs of 0-0-22-11)/acre was applied in the fall. Boron applications were made as indicated by soil tests. Additionally, at one-half green-stage a dilute foliar spray of Solubor® was applied at 1 lb/100 gal, plus 1 qt of 9% EDTA-Zinc chelate. In March, nitrogen was applied at a rate of 40 lb N/acre. Pesticide sprays were applied according to the Mid-Atlantic Fruit and Berry Guide for plum orchards. At this commercial orchard and at Rutgers NJ Experiment Station in Cream Ridge, NJ there were a large number of cecropia moth larvae observed on the beach plum plants. It was determined that the mouthparts of these larvae prevent them from inflicting damage exceeding any economic threshold. This orchard continues to be monitored for new cultural information. Seed or stock sources providing superior fruit types remain unavailable.

### **Vegetative Growth of ‘Chandler’ Strawberry Plants Treated with Prohexadione-calcium Root Dips and Foliar Sprays**

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Foliar sprays of prohexadione-calcium have been shown to inhibit runner production in strawberry plants, and could therefore reduce the amount of labor required to remove runners for plasticulture systems in the northeast, where earlier planting time is required for plant establishment, but which results in high runner production. Preplant root dips of prohexadione-calcium may offer another, less expensive and more efficient method of inhibiting runner growth. Chandler plants

were treated with prohexadione-calcium as a root dip at concentrations of 100 or 200 ppm, prior to planting 10 July 2008 into a plasticulture system in Maine. One-half of the plots also received a supplemental foliar spray of 100 ppm prohexadione-calcium on 13 Aug., when runner plants were first observed emerging in untreated plots. During the planting (non-fruiting) season, prohexadione-calcium root dips significantly reduced runner production. The lower rate reduced runner by 51% and the higher rate by 62%. A single foliar spray of 100 ppm with no root dip reduced runner growth by 24%. The addition of a foliar spray to plots receiving root dips further reduced runner growth, although the effect was not significant. Other vegetative parameters measured were generally also reduced by prohexadione-calcium treatments, including leaf number, petiole length, runner internode length, root length and plant dry weights, although the effects were often nonsignificant. Crown numbers were not significantly affected by any of the treatments. Fruit will be collected in 2009 to determine the effects of the treatments on plant yield and fruit quality.

### **Preplant Compost and Mycorrhizal Inoculation Improved Long-term Growth and Yield of ‘Honeycrisp’ Apple Trees**

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The long-term effects of preplant soil-incorporated compost, mycorrhizal inoculation (MI) at planting, and the combination of the two were measured on ‘Honeycrisp’ apple trees on M.26 EMLA and G.16 rootstocks. Compost at a rate of 331 kg wet weight per tree was tilled into the soil prior to planting. Tree roots were dipped into endomycorrhizal inoculant made up of several species. The study had a split-plot design with compost and MI as the main plots and rootstock as the subplot. Trunk cross-sectional area (TCA), a measure of general tree growth, was increased by compost with G.16, but not M.26 in the 7<sup>th</sup> year after planting. MI increased TCA of M.26, but not G.16. The combination of compost and MI had no effect on TCA of either rootstock. In year 7, there was no difference in tree size between the two rootstocks. Yield of G.16 was greater than M.26 until year 7 when rootstock interactions with compost occurred. Yield differences between treatments were small until year 6 when compost and compost with MI had greater yield than the control or MI alone. G.16 was highly biennial, so yield in year 7 was greater in the control and MI treatments than in either compost treatment. In M.26, yield was greatest with MI, intermediate with compost and lowest in the control and compost with MI treatment.

### **Reducing Nitrogen Usage in Watermelon by Using Precision Nitrogen Applications**

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With the emphasis on reducing excess nutrient applications in Maryland vegetable fields, which will reduce nutrient movement into the Chesapeake Bay, this research examined supplying nitrogen to watermelon plants only when needed as determined by the plant’s nitrate content. Four levels of nitrogen concentrations were applied to watermelon, ‘Crimson sweet’, in rows 4 ft wide by 100 ft long: Two treatments had 80 or 100 lb of actual nitrogen (N) applied before planting (nitrogen source was a 50-0-0 calcium nitrate) with two treatments receiving only 80 or 100 lb of N while the other treatments (80+ or 100+) receiving 80 or 100 lb of N plus an additional 1-2 applications of nitrogen fed through the drip-tube when needed. The other three treatments received 120, 150, or 200 lb of N before planting. There were four replications. Yields (number and weight) were taken on 5 and 8 Aug. Brix values were also taken at harvest. Results: Nitrate levels only neared the lower part of the recommended range once when watermelon fruit was between the size of a golf ball and a softball in the 80 and 100 lb of nitrogen treatments. Twenty pounds of N (in the form of urea) was then applied to the 80+ and 100+ treatments only. Weight of watermelon yield was significantly greater for the 80+ and 100+ treatments compared with the 80 or 100 lb of N treatments (orthogonal contrasts). The 80+ and the 100+ treatments were numerically the greatest yielding treatments compared with the

120, 150 or 200 lb of N treatments. There were no differences in the mean number of watermelon fruit between treatments with an average of 17.7 fruit per treatment. To see how quickly the plant made use of an application of nitrogen, I measured the nitrate concentration in the leaf petiole sap of watermelon in all rows after urea had been applied. Nitrate concentrations increased greatly after 24 hours and significantly at 48 hours in the treatments in which it was applied compared to the treatments it was not. Nitrate concentrations were significantly greater in the 80+ and 100+ treatments than the 120, 150 or 200 lb of nitrogen treatments 4 and 5 days respectively after urea was applied. Ten days after the urea application there was a rapid drop-off of N concentration in plants in all treatments. These results indicate that yields either can be maintained or increased by using less total nitrogen and timing applications to when plants would best utilize the nutrient.

#### **Determination of Fecal Coliform and *Escherichia coli* Presence in Irrigation Water**

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Irrigation water contamination has become more of a concern as reported foodborne illnesses have increased. Irrigation water in New Jersey is being tested for fecal coliform to determine if another water source should be selected or a treatment system should be considered. The problem with using fecal coliform is that it is a group of different bacteria that include both pathogenic and non-pathogenic forms. Other options are to test for generic *Escherichia coli*, pathogenic *E. coli*, or other individual pathogens such as *Salmonella*, *Shigella*, etc. As each test is added, the cost to growers increases and becomes cost prohibitive for small producers. Five locations were sampled on a weekly basis from 15 July to 18 Aug. 2008 (six sampling dates) to determine fecal coliform and generic *E. coli* levels in surface water irrigation sources. Samples were collected using standard procedures recommended by the commercial laboratory analyzing the samples. Sampling locations consisted of a river, two spring fed ponds, a dam on a stream and a pond located in a runoff area. Fecal coliform mean levels (colonies/100 mL) for six sampling dates were lowest at the two spring-fed locations (44 and 85 colonies) and highest at the runoff site (986 colonies). The river site averaged 375 colonies while the dam had 283 colonies. All three sites had levels above what would be considered acceptable in New Jersey for irrigation water (200 colonies/100 mL). No *E. coli* was detected at one spring-fed pond site while the other averaged 65 colonies. At the other three sites, levels ranged from 145 to 224 colonies/100 mL. Mean high colony counts for fecal coliform and *E. coli* were the results of runoff during rain events. Growers should sample for both fecal coliform and *E. coli* over time to determine a baseline for their water sources.

#### **Creation of a Local and Sustainably Managed Foodshed on Maryland's Lower Eastern Shore**

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The goal of this project is to increase the number of farmers on Maryland's Eastern Shore using organic, sustainable farming practices. In doing so, a secondary goal is to provide marketing outlets for this increased network of farmers to sell their products locally. Through a liaison with LESSON (Lower Eastern Shore Sustainable Organic Network) and her individual efforts, the Educator has created a "Network of Farmers" interested in both farming organically and/or finding new potential markets. In the course of six different programs, 63 growers have attended one or more of the trainings offered over the past 2 years. Topics have included Organic Vegetable Production 101, the basics of drip irrigation, organic twilight tours, one-on-one with an organic inspector, understanding the timing of succession plantings, basic crop budgeting, and which implements and equipment are necessary for different acreage operations. The success of this group is in the informal social connections developed between farmers, allowing for the more experienced ones to work along side and teach the less experienced ones. The Educator has assisted three growers securing EQIP funds for Transitioning to Organic Production and has

generated \$13,055 in grant monies to continue expanding sustainable vegetable production on Maryland's Lower Eastern Shore.

#### **Characterization of the Secretory Process of Capsaicin in *Capsicum chinense* var. *Habanero***

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One aspect of the complexity of plants is their synthesis of alkaloids, which are complex biomolecules, many with rather indistinct roles in plant metabolism. Some of these compounds have been linked to systems developed for plant protection; however, too many of these compounds have very important uses as foods, medicines, and other significantly valuable compounds. Capsaicin, an alkaloid produced in the *Capsicum* genus, is one of such molecules, and with variation in capsaicin levels and mechanisms of synthesis and storage in different *Capsicum* pepper fruits, it is important to pursue opportunities for characterization of the anatomical differentiation that affords the synthesis and accumulation processes among types and species in the genus. In this work, our objective was to compare the ultrastructure of the fruits of the bell pepper, a species virtually devoid of capsaicin, with that of the habanero pepper, one that is very rich in capsaicin. Microscopic analyses were key protocols in the investigation. Tissues from fresh pepper fruits and fruit tissues stored in glyceraldehyde were prepared for stereofluorescence microscopy, confocal microscopy, and scanning electron microscopy. Placenta tissues were the focus of our study although other tissues were also investigated. Vesicles were virtually absent on placenta tissues of the capsaicin-free bell fruit; however, vesicles were abundant on placenta tissues of the habanero fruit. No distinct structural glandular tissues were found on the pepper placenta; however, the functional role of epidermal cells of the placenta changed in time during ontogenic development of the fruit. Quantitative measures were developed for oleoresin accumulation, capsaicin being the major oleoresin in the pepper fruit. A unique feature of the images is that they show time-dependent exudation of oleoresins from the epidermal cells through cell walls into apoplastic compartments that develop between the cuticle and the epidermis. This work captures images that characterize the secretory process for capsaicin in *Capsicum chinense* var. *habanero*.

#### **Transgressive Segregation and Cytomixis: Important Genetic and Cytological Phenomena in the Phenotypic Expression of Essential Oil Constituents and Patterns in *Mentha* (Mint)**

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During the past 30+ years, I have documented two genetic and cytological phenomena in the genus *Mentha* (mint): (1) transgressive segregation is the observation of extreme phenotypes in hybrids and (2) cytomixis is the cytological intrusion of DNA into the cytoplasm of an adjoining cell. In *Mentha*, cytomixis produces gametes in multiples of the monoploid number, thereby producing dosage effects in the phenotypic expression of genes for essential oils in the hybrids, which, in turn, is observed as transgressive segregation. Cytomixis, formerly considered either a pathology or artifact in the first half of the 20<sup>th</sup> century, has now been documented in many other plants, from mosses to angiosperms, and it can also be induced artificially with chemical agents. The implication is that unusual phenotypes can be generated by simply effecting large numbers of hybrids and selecting desirable traits in the progeny of those species that have cytomixis (natural or induced).

#### **Mechanical Harvesting Characteristics of Several Small Greens**

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The harvesting characteristics of several leafy greens including spinach, kale, turnip greens, mustard greens and collards were evaluated in high density, precision planted, once-over harvest production systems. Yield and plant architecture were measured for each crop grown on two different bed sizes. Using a harvester with a band

saw-type cutting mechanism, harvest recovery was measured for each production system. In general, harvesting costs for small greens can be reduced with the bandsaw-type cutter. Field losses were lowest for spinach and highest for collards; most losses were loose leaves cut by the bandsaw but not retained on the harvester. Turnips were the exception where uncut leaves represented a majority of the field losses. Results suggest total harvest losses are proportional to plant leaf size in small greens. No significant differences in harvesting characteristics were measured between smooth and semi-savoy spinach varieties. Next phase of harvesting research needs to focus on better retaining cut leaves and possible changes in cultural practices to accommodate better recovery. With these improvements, a universal greens harvester will be suitable for the mid-Atlantic region.

#### **Fostering Environmental Stewardship and Community Action: Eco-Ventures at the EARTH Center**

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The Eco-Ventures at the EARTH Center summer program provided an opportunity for youth in grades 5 through 7 to participate in outdoor, experiential learning with a focus on ecology and applied environmental stewardship. This 1-week summer program included hands-on learning through exploration, experimentation, debate and discussion. Youth participated in educational activities and discussions concerning environmental awareness and stewardship. The 2008 Eco-Ventures program also included agricultural and gardening topics to help participants understand how they can be environmental stewards in their own back yards. Youth worked with Extension staff to write and film public service announcements which were distributed to various media outlets. Participants developed personal environmental plans of action. Preliminary and post tests results indicated an increase in knowledge on topics addressed and a statistically significant increase in overall test scores. End of program observational evaluations indicated that youth developed teamwork, communication and decision making skills. A 3-month follow-up survey showed that youth had reached their goals, were successful in making personal changes in their environmental impact, and had influenced the decisions of their families, friends and schools.

#### **Rooting of *Camellia oleifera* Abel Cuttings under Low Plastic Tunnels**

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*Camellia oleifera* Abel (tea oil camellia) is an important woody plant for edible oil production in southern China. Grafting is the only method for its clone propagation and the demand for elite cultivars is far beyond the quantity from limited grafting regeneration. One-year-old shoot cuttings were collected from an elite cultivar in a plantation and prepared with various hormones and concentrations. All cuttings were inserted into the well-prepared field beds, which were completely soaked and covered with plastic film for moisture retention. During the experiment from March to July, no additional water was applied for the rooting of cuttings. Hormone is needed for the rooting of tea oil camellia cuttings and all treated cuttings had higher rooting percentage than that of the control. The highest rooting rate, 55%, was observed under the treatment of Guoguang hormones at 1,000 mg-L<sup>-1</sup>. Rotting quality was evaluated using the total root length and the better root quality, 105.1 cm, was produced under the treatment of ABT #1 at 3,000 mg-L<sup>-1</sup>. Both hormone types (liquid and powder) and concen-

trations (1,000, 3,000, and 8,000 mg-L<sup>-1</sup>) did not have significant effect on rooting rate and root quality. Double dips with both liquid and powder hormones had no advance for rooting of cuttings. All treatments under this experiment produced rooting percentage from 22.5% to 55%, significantly lower than later commercial production at average 90% with Guoguang hormones at 3,000 mg-L<sup>-1</sup>. This lower plastic tunnel usually keeps moisture for months in the field and could be applied to cutting propagation for other evergreen woody plants.

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#### **Incidence and Severity of Foliar Diseases in Five Varieties of *Zinnia***

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*Zinnia* remains very popular as a cut flower, and local growers are seeking to expand into these markets as part of their direct marketing and agri-tourism efforts. This study measured regional differences in varietal performance in the coastal plain and piedmont regions of New Jersey. Five varieties of *Zinnia elegans* 'Benary's Giant', 'Oklahoma', 'Peppermint Stick', 'Whirligig', and 'Zowie! Yellow Flame' were included in this study. Performance ratings for production of cut flowers suitable for sale and disease incidence of powdery mildew and bacterial leaf spot were compiled. A randomized complete-block design, with 15 plants per experimental unit, was repeated at the Rutgers NJAES Agricultural Research and Extension Center in Bridgeton (coastal plain) and the Rutgers NJAES Snyder Research and Extension Farm in Pittstown (piedmont), testing the null hypothesis that there would be no difference in disease tolerance between varieties. *Zinnias* were transplanted into the field on 17 May 2006 in Bridgeton and 26 May 2006 in Pittstown. No fungicides were applied during the growing season. The Horsfall-Barrat rating system was utilized for each harvest (19 July to 1 Sept.), and rating scores in the field were determined by the same individuals each week. The two farm location ratings were consistent within their locations, but differed from each other. Bacterial leaf spot was more prevalent at the start of the season, while powdery mildew severity increased dramatically late in the season. Preliminary results revealed that 'Zowie! Yellow Flame' exhibited a higher degree of bacterial leaf spot, but a much lesser degree of powdery mildew when compared to the other varieties. In addition, 'Benary's Giant', the industry standard, displayed no distinctive degree of disease tolerance versus the other varieties. Additional statistical analysis will be conducted to determine other varietal differences.

#### **An Analysis of Urban Tree Planting Programs and Nursery Production Relationships**

Daniel Burcham<sup>\*</sup> and Robert Lyons, Longwood Graduate Program, 126 Townsend Hall, University of Delaware, Newark, DE 19716

Urban tree planting programs, particularly those managed by nonprofit organizations, work to improve communities by involving

residents in tree planting and subsequent management. One recent focus of programmatic efforts includes increasing the diversity of trees planted within cities to mitigate the risks associated with over planting. However, a limitation frequently mentioned by practitioners is an insufficient species inventory diversity offered by tree production nurseries. This study examined the nature of relationships between urban tree planting programs and nurseries in an attempt to wholly understand this phenomena. Research included 11 key informant interviews with tree planting program managers in the Northeast and Mid-Atlantic United States and one survey of tree planting program managers and nurseries within the same area. Initial findings indicate that tree planting program managers and nursery representatives predominantly utilize personal relationships to meet their respective goals. A majority of programs analyzed in this study maintain approved species lists averaging 46 species. During 2008, these programs planted a total number of trees ranging between 23 and 21,025 within their respective cities.

*Presented as part of the symposium on Public Horticulture*

### **An Analysis of Disaster Planning in Public Horticulture Institutions**

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Living collections are vital inventories for public horticulture institutions, particularly botanical and public gardens, that come in direct contact with meteorological elements and exposure on a daily basis. Most of the time, this direct exposure is required for the performance and survival of plant collections. Alternatively, this direct contact with the elements may also cause severe damage and/or destruction during unusually extreme weather conditions to which the plants are not adapted. During wind storms, ice storms, freezing conditions, tornadoes, hurricanes, and fire events, plants and plant collections that are either poorly or not adapted to such extremes can be permanently damaged or killed, resulting in devastating financial and germplasm losses that are often irreplaceable by the institution. This study examined the natural disaster planning process in public gardens in order to identify the characteristics of a natural disaster plan that is truly useful to an organization. Research included two public garden surveys at the national level, three case studies, and nine on-site interviews with botanical institutions that have experienced disasters. The data indicate that preventative measures and mitigation for disaster were not as important to the public garden community as pre-disaster planning for an expedited post-disaster recovery.

*Presented as part of the symposium on Public Horticulture*

### **Effect of Iron Source on Geranium (*Pelargonium xhortorum*) Foliage Color**

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Geraniums (*Pelargonium xhortorum*) grown in low pH media generally exhibit poor foliage color and may display symptoms of micronutrient toxicity. This study was conducted to investigate the effect of four iron sources on the foliage color of geranium cultivars grown at low pH levels. Three geranium cultivars selected for the study were 'Blue Wonder', 'Stardom Bright Pink', and 'Stardom Deep Lavender'. The geraniums were treated with fertilizer solutions containing one of four iron sources: either a chelate (iron- EDTA, EDDHA, and DTPA) or iron sulfate as a non chelate control. Plants were arranged in four replicate randomized complete blocks. The plants received a continuous liquid feed with 250 ppm nitrogen complete fertilizer solution containing one of the four iron sources for the first 4 weeks. Fertilizer concentration was increased to 350 ppm N for the remaining 9 weeks. Five times throughout the experiment a color rating was assigned to each plant using the Munsell plant tissue color chart assessing both color intensity (value) and color hues (chroma). Lower intensity and chroma ratings are indicative of darker,

greener plants. The plants treated with iron sulfate had lower intensity and chroma values indicating they were darker and greener than plants treated with iron EDTA, EDDHA, or DTPA.

### **Novel Leaf Traits in New Varieties of *Lilium longiflorum* Derived from Tissue Culture**

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Experiments were conducted on new tissue culture-derived varieties of *Lilium longiflorum*. These "Rutgers lilies" (RLs) are of unknown parental lineage and are not closely related to the common commercial varieties. They exhibit novel traits such as short stature, a unique star-faced flower shape and different leaf shapes. Despite the morphological sensitivity of *L. longiflorum* to environmental conditions, specific phenotypic characteristics can be effectively distinguished. One quantifiable function of leaf shape is length-to-width ratio. Diallel, classical pollinations of the RLs and three commercially available varieties were performed. 'Nellie White' and 'White Europe' produced progenies having the longest, narrowest-leaves, while RLs 4-8, 5-3, and 2-1 led to progenies with the broadest, shortest leaves. Reciprocal differences were found for the heritability of leaf-shape. Statistical analyses were performed using GLM and Bonferroni (Dunn's) *t*-test at the  $\alpha=0.05$  level. The evidence indicates that these RLs may prove to be a useful source of new germplasm for breeding and commodity development.

### **Hubbard and Bird House Gourd Perimeter Trap Crop Evaluation for Insect Control in Pumpkin**

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Field research was conducted to determine if 'New England Blue Hubbard' (*Cucurbita maxima*) and 'Bird House Gourd' (also know as 'Bottle Gourd') (*Langenaria siceraria*) would attract striped cucumber beetles (*Acalymma vittatum* (Fabricius)), spotted cucumber beetles (*Diabrotica undecimpunctata howardi* Barber) and squash bug (*Anasa tristis*) away from a main crop of pumpkin when planted as a perimeter trap crop. Cucumber beetle is the main insect pest of cucurbit crops in New Jersey and can greatly reduce plant survival due to the transmission of the bacteria *Erwinia tracheiphila* that causes the disease bacterial wilt of cucurbits. A demonstration was conducted at the Rutgers Agricultural Research and Extension Center in Bridgeton, New Jersey in June to July 2008. Two fields of the pumpkin variety 'New England Pie' were seeded on 11 June at a spacing of 3 ft between plants in a row and 6 ft between rows with 10 rows 150 ft in length. On the same date, two rows of 'New England Blue Hubbard' (in field 1) and two rows of 'Bird House Gourd' (in field 2) were seeded at the same in row and row spacing around fields of pumpkin. In a third adjacent field (field 3) 14 rows of 'New England Pie' pumpkin, 150 ft long at the same spacing, were also seeded on 11 June. The demonstration was set up with 100 ft buffers between each of the three fields. Field scouting of pumpkin leaves and stems began on 11 July and ended on 18 July. The first scouting event showed no differences in cucumber beetle in the pumpkin crop or the perimeter trap crops. Differences in the number of cucumber beetle did not occur until the last scouting date when beetle numbers were highest in the 'New England Blue Hubbard'. During all scouting dates, squash bug was highest in the 'New England Blue Hubbard' compared to pumpkin and 'Bird House Gourd'. 'New England Blue Hubbard' may be a suitable perimeter trap crop for both cucumber beetle and squash bug control for pumpkin.



## Hands-on Horticulture and Science Education for Home-schooled Youth

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In Fall 2007, Rutgers, NJAES Master Gardeners of Gloucester County started a Junior Master Gardener program for home schooled youth. The youth range in age from 5 to 13 years. Some families are members of home school groups, while for the others this is their first time in a group session, providing not only education but also a chance for socialization. The group meets twice a month with each session lasting for 2 hours. The curriculum being used was developed by Texas A&M University. The curriculum consists of projects that encourage recycling and hands-on activities. Initial reaction has been positive. Future evaluation will be done to determine success. This program has prompted interest in an after school program in conjunction with the county library system.

## Effect of Prechilling on Stand Establishment of Purpletop (*Tridens flavus*) and Big Bluestem (*Andropogon gerardii*)

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Purpletop [*Tridens flavus* (L.) Hitchc.] and big bluestem (*Andropogon gerardii* Vitman) are warm-season perennial grasses incorporated into seeding mixes used for ecological restoration of degraded sites. The single-seeded grass fruit, the caryopsis, may exhibit low seed vigor and subsequent reduced stand establishment. Thus, improvement of stand establishment would benefit ecological restoration. Purpletop or big bluestem caryopses were prechilled (14 days at 5 °C in 0.2% KNO<sub>3</sub> for purpletop and 7 days at 5 °C in distilled water for big bluestem) and blotted dry prior to incorporation into a warm-season grass seed mix. When corrected for seed purity and application area, seeding mix rates were 0.23 to 1.91 g big bluestem/m<sup>2</sup> and 0.13 to 0.95 g purpletop/m<sup>2</sup>. Seed mixes were sowed into moistened proprietary peat-lite substrate spread evenly over an area of 0.064 m<sup>2</sup> within a greenhouse. The number of seedlings of both control and prechilled big bluestem caryopses increased linearly with increasing seeding rates. The number of seedlings for prechilled purpletop caryopses increased linearly with increasing seeding rate but there was no linear response for control caryopses. Compared to control caryopses, crop yield was similar or greater for prechilled purpletop at equivalent seeding rates while crop yield for control or prechilled big bluestem was similar at equivalent seeding rates. In conclusion, there was no benefit of incorporating prechilled big bluestem caryopses into a warm-season grass mix but early stand establishment of purpletop was enhanced by incorporation of prechilled caryopses.

## Performance of Short-day Strawberry Cultivars Grown in a Perennial Matted Row System in Maine

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A variety trial was established in Spring 2006 at Highmoor Farm in Monmouth, ME. Twenty-four named varieties and numbered selections were planted and established as matted rows on narrow raised beds with three replications. Plots were 20 ft long and 24 inches wide with a single trickle irrigation line running beneath the beds. Flowers were removed in the planting year. Yield and fruit quality data were collected in 2007 and 2008. Top performing varieties in terms of yield per plot included 'Sable', 'Mesabi', 'Cavendish', 'Mira', and 'Brunswick'. 'Itasca' performed very well in the first year of harvest, but yielded very poorly in the second. Alternatively, 'Wendy' yielded very well in the second season, but had moderate yields during the first season. 'Cabot' produced the largest fruit of any variety in the trial, followed by 'Clancy' and 'Ovation'. Flooding of the planting in 2006 appeared to weaken some of the varieties, and may have led to a red stele infection. Those most notably affected were 'L'Amour' and 'St. Laurent'.

## Preliminary Results of a Low-maintenance Turfgrass Trial at the EARTH Center

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There is an increasing demand for low-maintenance turfgrass varieties to reduce fertilizer and pesticide use, protect the environment, and save time and money. The Rutgers Turfgrass Center continues to evaluate new and existing turfgrass varieties for low maintenance lawns. In Fall 2007, a trial was set up to examine some of the suggested low maintenance turfgrass varieties at the EARTH Center facility of Rutgers Cooperative Extension of Middlesex County, NJ. A total of 11 treatments were replicated four times in a randomized complete-block design. A standard premium sun and shade seed mix was selected as a control for the trial. Germination and growth rates were recorded. From 2007 through the 2008 growing season, all the plots were evaluated for weed density, color, and percent coverage. Minimal amounts of fertilizer and water have been applied since seedling establishment in 2007. Preliminary results show fescues performing very well but additional data will be collected to determine the relative success of each variety in a low-input, low-maintenance environment. The evaluation parameters are compared independently of each other and the compilation of this information will be invaluable to consumers, commercial landscapers, and superintendents interested in designing a low-maintenance landscape. Initial results indicate that select turf-type tall fescues were quick to establish and demonstrated outstanding establishment and performance under low maintenance conditions.

## Shade Effects on Chlorophyll Content and Nutrient Content of Cranberry Vines Exhibiting Yellow Vine Symptoms

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Yellow vine (YV) symptoms on cranberry (*Vaccinium macrocarpon* Ait.) plants appear as yellowing along leaf margins with areas along leaf veins remaining green. It has been reported anecdotally that shaded areas on cranberry bogs tend to recover from YV symptoms quicker than unshaded areas. The objective of this project was to evaluate the effect of shading on the chlorophyll content and nutrient content of cranberry vines exhibiting YV symptoms. Shade structures were installed on a bog over both yellow and green vines. Vine clippings were collected from under all structures and from unshaded green and yellow patches. Chlorophyll content and nutrient content analysis were done on all samples. It appears that shading may positively affect chlorophyll concentrations of vines exhibiting YV symptoms, but may not have any effect on nutrient concentrations.

## In Vitro Regeneration of *Rudbeckia hirta* L. 'Plainview Farm' from Leaf Tissue

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*Rudbeckia hirta* L. 'Plainview Farm', a new multiple-layered ray flowered cultivar, shows potential for potted plant production. After several years of seed germination, this specific morphological trait was still unstable from generation to generation. To maintain its unique features, new leaves were disinfested using 10% ultra bleach as explants. Leaf sections (0.25 cm<sup>2</sup>) were cultured on MS medium supplemented with either BA (0.5, 1.0, and 2.0 mg·L<sup>-1</sup>), KT (2.5, 5, and 10 mg·L<sup>-1</sup>), or

ZT (0.5, 1.0, and 2.0 mg·L<sup>-1</sup>) to induce the callus and microshoots at 27.2 ±1.85 °C and 16-hour photoperiod. After cultivation for 33 days, all treatments significantly induced callus, and the callus sizes were 1.5- to 2.4-fold bigger than those with no cytokinin. KT (2.5 mg·L<sup>-1</sup>) was the better cytokinin concentration for callus induction and microshoot formation. A total of four microshoots per explant could be produced from that KT concentration. All induced microshoots were cultured on MS medium at its one-quarter strength containing either IBA or NAA (0.5, 1.5, and 3.0 mg·L<sup>-1</sup>). No significant rooting difference was observed in comparison with the control (no auxin). The plantlets were transplanted, acclimated in a mist system, and grown in a greenhouse. A total of 96.4% of the potted plants derived from tissue culture were multiple layers of ray flowers, with only 9.6% from seed germination. Therefore, in vitro regeneration of 'Plainview Farm' was a feasible way to produce the double-flowered plants.

*Lijuan Han is a visiting professor from Changchun Normal University in China.*

### **The Quest for a Double-flowered Yellow *Clivia miniata* at Longwood Gardens**

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In the mid 1970s, Longwood Gardens began a breeding program to develop improved forms of yellow-flowered *Clivia miniata*. At this time, yellow-flowered forms of *Clivia* were quite rare, and very desirable. Initial breeding crossed *Clivia miniata* var. *flava*, which has small yellow flowers with an orange-flowered variety, which has exceptionally large flowers. The resulting F1 hybrids were all orange-flowered, suggesting the yellow-flower phenotype was recessive to the orange phenotype. Therefore, seedlings of the F1 generation were intercrossed and some were also backcrossed to the yellow parent. Many yellow-flowered forms arose from both the F2 and backcross populations. These generations also had much larger flowers than *Clivia miniata* var. *flava*, but they were floppy and plant habits were not significantly better than the original yellow-flowered parent. At this time, another yellow-flowered variety (Sir John Thouron) with a very upright formal habit with flowers held well above the foliage was crossed with the best yellow seedlings from the F2 and backcross populations. One orange and two yellow-flowered seedlings with unusual petal mutations emerged from this cross. These seedlings had "keeled" petals (inner whorl of tepals), which eventually had a semi-double or ruffled appearance. Crosses with both colors of keeled-petal-plants resulted in orange flowered seedlings, due to the recessive nature of the yellow flower trait. These seedlings also varied with regard to keeled petals, in that some were absent of keeled petals while others had much more pronounced keeling compared to the parents. There were also individuals where the "keel" had actually separated from the petal to form an extra set of petals. Seedlings were chosen from this population to create the next generation based on degree of keeling. Since *Clivia miniata* takes a minimum of 3 years to flower, there is currently 3 years worth of the seedlings with enormous potential for achieving a yellow double-flower.

### **Effects of Seed Treatments, Commercial Seed Inoculant, and Organic Fertilizers on Germination and Seedling Growth of Common Milkweed (*Asclepias syriaca*) and Purple Coneflower (*Echinacea purpurea*)**

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Common milkweed (*Asclepias syriaca* L.) and purple coneflower [*Echinacea purpurea* (L.) Moench] are native plants used within seed

mixes for ecological restoration. Factors influencing seed germination and seedling growth were analyzed to determine the influence of soil amendments (worm castings, fertilizers), commercial seed inoculant (Mycoplant), and seed treatments (prechilling of common milkweed seed for 3 weeks in distilled water at 5 °C or PEG-priming of purple coneflower at -0.5 MPa for 4 days at 15 °C), or combinations thereof. Treated or non-treated seed were sowed into moistened proprietary peat-lite mix or 75:25 peat-lite mix:worm castings (% by volume) substrate and germinated in a greenhouse. After seed germination, plants were fertilized weekly with 150 ppm-N of 20N-4.4P-16.6K (Scott's Peat-Lite Special), 8N-0.44P-0.83K (McGeary Organics) or 5N-0.44P-0.83K (Maxicrop Liquid Fish). Control treatments were not fertilized. Seed treatments had the greatest effect on final germination percentage (FGP) and shoot dry weight, increasing common milkweed FGP and shoot dry weight by a factor of 25.0 and 2.1, respectively, and increasing purple coneflower shoot dry weight by a factor of 2.2. Compared to the control, commercial seed inoculant plus seed treatment increased FGP of purple coneflower whereas seed treatment or commercial seed inoculant alone did not increase FGP. Treated common milkweed seed that were planted into a peat-lite:worm castings mix had decreased FGP compared to those planted into peat-lite mix alone but peat-lite:worm castings mix had little or no effect on purple coneflower. In conclusion, we found no benefit adding organic fertilizer plus commercial seed inoculant during the first 4 weeks of seedling establishment and that seed treatments alone, for common milkweed and purple coneflower, or seed treatments plus commercial seed inoculant, for purple coneflower, increased FGP and/or seedling growth.

### **In Vivo Chlorophyll Fluorescence Analysis of Yellow Vine Syndrome in Cranberry in Massachusetts**

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A complete nutrition analysis suggests that a nutrition imbalance might be associated with yellow vine development in cranberry. Additionally, the yellow vine syndrome, an interveinal chlorosis advancing from old to young leaves, often worsens in bogs with drainage problems, indicating that water stress may be another factor in the formation of yellow vine in cranberries. Our spectrometric and HPLC data suggest that photoinhibition might be one of the key factors in the development of yellow vine syndrome. Chlorophyll fluorescence analysis enables the monitoring of photosynthetic performance in plants in vivo. In this study we determined the accessible chlorophyll fluorescence parameters in order to explore the mechanisms for producing yellow vine syndrome in vivo. We found that the yellow vine leaves showed a loss of 34%±5% in the maximum quantum efficiency of PS II in vivo. The analysis also showed that the quinone pool size and total photosynthesis in the yellow vine leaves were 28%±3% and of 0.4%±0.2% of normal leaves in vivo, respectively. These parameters of PSII function are dramatically smaller than those in the normal leaves, revealing the numbers of functional PSII centers in the yellow vine leaves may be far less than in the normal leaves. As PSII is the main target of photoinhibition, the chlorophyll fluorescence data strongly support a crucial role of photoinhibition in producing yellow vine syndrome in vivo. Supported by funding from USDA CSREES and UMass Dartmouth Chancellor's Research Fund.