

Abstracts of the ASHS

Northeast Region Annual Meeting

Cornell University, Ithaca, N.Y.

6–7 January 2006

BY THE NUMBERS: ASIAN LONGHORNED BEETLE AND THE NEW JERSEY EXPERIENCE

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New Jersey has two active quarantines currently under the jurisdiction of the USDA's Cooperative Asian Longhorned Beetle (ALB) Eradication Project. Encompassing just over twenty (20.2) square miles, these quarantines are located in the northeastern and central coastal regions of the state, in close proximity to the ports of New York, Newark, and Elizabeth. Public education and media outreach have been instrumental in confirming the presence of ALB in New Jersey, as both quarantines are the result of citizens' reports. Twenty five personnel have been directly assigned to this eradication effort, with outside contractors taking up the remaining effort. Nearly 33,000 trees have been inspected, resulting in 11,000 (33%) removals of infested or high-risk host species trees. Major losses have occurred in populations of Norway and red maple, London planetree, and American elm, species which have received widespread praise (and unfortunate over-planting) for their tolerance of urban planting sites. Regulatory Contracts (597) and Compliance Agreements (137) were necessary to formalize the quarantine and to create strong working partnerships between the USDA, municipalities, and industry to gain access to all trees and to control the movement of all "green material" in the quarantine areas. Municipalities currently cooperating in the New Jersey Community Forestry Program have begun offsetting this major deforestation and canopy cover loss with the planting of 2,545 nonhost trees, with full reforestation expected over the next several years. In addition, >22,000 trees have been treated with Imidacloprid as a possible deterrent to any activity or spread of ALB in the Garden State.

DEVELOPMENT OF A WHITE-FLOWERED, COLD-HARDY ALSTROEMERIA

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Alstroemeria, the Inca lily or lily-of-the-Incas, is becoming a popular garden plant in the United States. In past years, the primary interest in *Alstroemeria* has been for its cut flowers. However, recent cold-hardy introductions (USDA hardiness zone 5) have expanded the interest of this colorful plant as a garden perennial throughout the U.S. Previously, garden interests were restricted to warmer zones in the southern United States where *Alstroemeria* could over-winter. This research describes a breeding procedure which has been used with the objective to develop a cold-hardy, white flowered *Alstroemeria*. The interspecific hybrids were bred with the use of *in ovulo* embryo rescue. Reciprocal crosses were made between several white-flowered cultivars and the cold hardy Chilean species, *Alstroemeria aurea* during the summers of 2004 and 2005. Ovaries were collected 10–23 days after hand pollination and their ovules were aseptically excised. Ovules were placed in vitro on 25% Murashige and Skoog (MS) medium under dark conditions until germination. Three weeks after germination they were then placed on 100% MS medium, and subcultured every three to four weeks thereafter until they were large enough for rooting. After rooting and acclimation, plants were transferred to the greenhouse. Successful hybrids that were produced in 2004 were evaluated under greenhouse and field trials during 2005. Data on the flower color for each of the hybrids were recorded, as well as certain morphological characteristics that can indicate cold-hardiness. Hybrid plants are being over-wintered outside in Ithaca, N. Y. (USDA zone 5), and Riverhead, N. Y. (USDA zone 7), during the next several years for a more accurate assessment of cold-hardiness. Self pollinations and reciprocal crosses with the white-flowered

parents were performed on the F₁ generation in the summer and fall of 2005 in order to determine segregating characteristics. Few ovules were obtained from F₁ generation crosses. Successful F₂ generation plants are being grown in vitro and will be transferred to the greenhouse where flower color will be noted. Root squashes and pollen staining were completed to determine ploidy levels and assess male sterility of the F₁ generation.

ETHYLENE IN STORAGE: AN EVALUATION OF THREE INFLUENTIAL FACTORS ON TULIP BULBS' SENSITIVITY TO ETHYLENE DURING POSTHARVEST SHIPPING AND STORAGE

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During transport and the subsequent storage of tulip bulbs, inadvertent failure in ventilation and/or high contamination of *Fusarium*-infected bulbs may expose healthy bulbs to high concentrations of ethylene. Ethylene is known to cause many detrimental effects on forcing quality, including gummosis, increased respiration, flower bud abortion, bulb splitting and poor rooting. In this work, exposure duration and timing as well as the post-stress storage temperatures were evaluated for their potential effects on ethylene sensitivity in bulbs of four tulip cultivars. Degree of damage in sensitive cultivars 'Apeldoorn' and 'World's Favourite' increased with days at about 10 ppm ethylene starting at 9 and 16 days respectively. This effect strongly depended on timing of ethylene stress, as late treated bulbs showed more severe responses to ethylene treatment than early treated bulbs. Additionally, bulbs that were cooled immediately after ethylene stress, compared with those stored at 17 °C after stress, have significantly higher flowering quality in all attributes measured. This response was also strongly dependent on timing of ethylene stress and cultivar. Implications of the potential cold reversal of ethylene damage as well as effects of ethylene exposure duration and timing of stress on shipping and storage recommendations will be discussed.

EFFECTS OF GA₄₊₇ AND BA APPLICATION ON POSTPRODUCTION QUALITY IN 'SEADOV' POT TULIP FLOWERS

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The effect of GA₄₊₇ plus benzyladenine (BA) on postproduction quality was investigated in 'Seadov' tulips (*Tulipa gesneriana*). Potted tulips at half-colored bud stage or full-bloom stage were sprayed with a range of GA₄₊₇ plus BA, and placed in a simulated consumer environment (SCE) in order to determine effectiveness of the compound at each stage. Regardless of plant stage, treatment with GA₄₊₇ plus BA effectively improved individual flower longevity and whole plant longevity in the range of concentrations tested. GA₄₊₇ plus BA had a strong effect on enhancing flower longevity when sprayed to mature (fully colored) buds, and a lesser effect on immature (green) buds, and whole plant longevity increased with higher doses of GA₄₊₇ plus BA. When applied to open flowers, however, concentrations over 50 mg·L⁻¹ reduced individual flower and whole plant longevity relative to lower concentrations resulting from unwanted full-opening of older flowers and exaggerated gynoceium growth. Concentrations as low as 10 mg·L⁻¹ significantly increased longevity of tulip flowers of all age classes. The effects of enhancing postproduction quality of 'Seadov' pot tulips were primarily derived from the BA component of the compound.

SEVERE CUTBACK OF STOCK PLANT INFLUENCES ROOTING IN SHOOT OF QUERCUS BICOLOR AND QUERCUS MACROCARPA

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Two experiments were conducted to determine the effect of severe stock plant cutback on rooting in two oak species *Quercus bicolor* and *Quercus*

macrocarpa using two propagation systems, layering and cuttings. In experiment 1, field grown plants were either cutback leaving a 0.04 m (1.6 in.) stump above soil level or left intact (not cutback) \approx 1.7 m (66.9 inches) tall. Shoots arising from cutback treatments and intact plants were layered using a field layering technique and air layering respectively. Results showed significantly higher ($p < 0.01$) rooting percentages in layered propagules arising from severely cutback plants in both species [\approx 77% in *Quercus bicolor* and \approx 70% in *Quercus macrocarpa*] compared with air layered shoots arising from intact plants [1% in *Quercus bicolor* and 0% in *Quercus macrocarpa*]. In experiment 2, shoots arising from three stock plant heights (severely cutback 0.04 m, cutback 1m and intact \approx 1.7m plants) were either etiolated or grown in full light and cuttings rooted in a perlite medium under mist. Of the two species studied, propagule position was found to have no significant effect on rooting in *Quercus macrocarpa* cuttings, but significantly ($p < 0.0001$) influenced rooting in *Quercus bicolor*. Rooting was highest 59.3% in cuttings taken from cutback-etiolated stock plants. Comparing just the three cutback levels, rooting was highest (45.2%) in cuttings arising from 0.04 m stumps followed by those from 1m stumps 7.5% and lastly intact plants 3.8%. The best rooting results were observed in shoots arising from severely cutback stock plants (0.04 m) using the field layering technique.

THE NATURE OF CONFLICT IN PUBLIC GARDENS

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Public gardens are complex, multi-faceted, diverse organizations that execute a broad scope of tasks including fundraising, educational programming, marketing, public relations, and horticultural research. This broad scope of work creates numerous challenges for these institutions. One of which is conflict between front-line and administrative staffs. The goal of this research is to help explain why conflict between front-line and administrative staffs exists in public gardens. The research found no existing research on the topic of conflict in botanic gardens, but some in other industries. The research was a mixed methods design, including two case studies at separate public gardens and an online questionnaire. Both case studies consisted of separate focus groups and individual interviews with staff at different levels of the organization. Questionnaire results also came from various personnel levels (front-line and administrative) of public gardens. Once final data collection occurred, they were coded into similar categories outlined by the Malcolm Baldrige Standards, an internationally recognized assessment tool for excellence. Early analysis of the data indicates that conflict occurs due to a lack of: a clear mission and vision, effective communication, and empowerment within the organization.

DEVELOPING AN INITIAL PLAN FOR A CENTER IN PUBLIC HORTICULTURE AT THE UNIVERSITY OF DELAWARE

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Universities are attempting to enhance the quality of their academic and research endeavors as competition increases for students, faculty, and funding. To further its mission of providing excellence in education, research, and extension, the University of Delaware (UD) has created a number of Centers and Institutes devoted to providing leadership to a particular field of study. Because of its unique location in the "hotbed of public horticulture," UD is interested in establishing an interdisciplinary Center in Public Horticulture. The objective of this study was to create an initial plan for a Center in Public Horticulture at UD outlining its mission, goals, objectives, structure, and function. The plan resulted from an internal environmental assessment of the Plant and Soil Sciences Department at UD, an external environmental assessment of the field of public horticulture, and an analysis of existing Centers and Institutes at UD. This qualitative study utilized surveys, interviews, and focus groups with selected internal and external stakeholders from academia, the green industry, government, and public gardens. Internal stakeholders, in the resulting data, emphasized the Center's role in engaging undergraduate and graduate students and conducting relevant research. External stakeholders indicated that the Center may also focus on providing continuing education

or certification programs to public horticulture professionals. The research regarding existing Centers and Institutes produced a variety of recommendations regarding the Center's structure, governance, funding, research activities, and partnerships and collaborations.

GYPSUM AFFECTS AMERICAN GINSENG'S GROWTH, NUTRITION, AND GINSENOIDES

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In the Northeast, wild American ginseng (*Panax quinquefolium* L.) is typically found growing in the dense shade provided by deciduous hardwood tree species such as a sugar maple, in slightly acidic soils with relatively high calcium content. Woods cultivated ginseng is often grown in forest farming agroforestry systems under similar conditions. Supplemental calcium by soil incorporation of gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) is often recommended for woods cultivated ginseng. The objective of this study was to investigate the effects of this practice on soil chemical properties, plant growth and quality of American ginseng. In a greenhouse pot culture experiment, 2-year-old seedlings were treated with 0, 2, 4, 8, or 16 $\text{Mt} \cdot \text{ha}^{-1}$ gypsum and grown for 12 weeks. Gypsum application decreased soil pH slightly, elevated soil electrical conductivity and increased available soil Ca and sulfate concentrations. Tissue calcium concentration was increased with by gypsum treatment, but shoot and root growth was reduced. HPLC analysis of root ginsenosides revealed that Re, Rb1, Rc, and Rb2, PT ginsenoside (sum of ginsenoside Rb1, Rc, Rb2, and Rd) and total ginsenoside concentration increased by gypsum soil amendment.

1-METHYLCYCLOPROPENE EFFECTS ON EXTERNAL CARBON DIOXIDE INJURY OF 'EMPIRE' APPLES

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The ethylene inhibitor, 1 methylcyclopropene (1-MCP), is used extensively in New York to maintain quality of the 'Empire' apple cultivar through the marketing chain. However, the cultivar is susceptible to external CO_2 injury, a physiological disorder that develops predominantly on the unblushed area of the apple skin. Injury is expressed as tan colored, smooth, water-soaked areas that become irregularly shaped, rough, depressed and wrinkled. The disorder usually occurs during controlled atmosphere (CA) storage. 1-MCP may increase susceptibility of fruit to external CO_2 injury. Three experiments have been carried out to investigate postharvest manipulations that may attenuate the effects of 1-MCP on external CO_2 injury of 'Empire' apple. 1) The effect of CO_2 concentration (1%, 2.5%, and 5%) and time of exposure to 2.5% and 5% CO_2 during CA storage. 2) Delaying exposure of fruit to 5% CO_2 after harvest to up to 14 d. 3) Using lower concentrations of diphenylamine (DPA), an antioxidant that is known to eliminate susceptibility at normal rates. The results show that higher external CO_2 injury levels are associated with higher CO_2 concentrations, but that 1-MCP does not increase the exposure period of susceptibility to injury during CA storage. Susceptibility to CO_2 injury is decreased markedly by delaying application of CA storage in untreated fruit. In contrast, high susceptibility to injury is maintained in 1-MCP-treated fruit as long as 14 days after harvest. DPA eliminated injury in 1-MCP-treated fruit, even at 250 ppm, 25% of commercial rates used for superficial scald control. Our data show that 1-MCP increases susceptibility of 'Empire' apples to external CO_2 injury and special care is therefore required to avoid fruit losses. Nonchemical means may reduce losses, but the only technology that has been shown to eliminate risk of injury is DPA treatment.

APPLE ROOT GROWTH, TURNOVER, AND DISTRIBUTION UNDER DIFFERENT ORCHARD GROUND COVER MANAGEMENT SYSTEMS

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Minirhizotrons were employed to study new root occurrence, turnover, and depth distribution of apple (*Malus × domestica* Borkh.) rootstocks under four groundcover management systems (GMS): preemergence herbicide (Pre-H), postemergence herbicide (Post-H), mowed sod (Grass) and hardwood bark mulch (Mulch) that have been maintained since 1992 in an orchard near Ithaca, NY. Two root observation tubes were installed on both sides of one tree in three replicates for each GMS treatment. Root

observations were taken at 2–3 week intervals during growing seasons of 2002 and 2003. Tree growth and yield data were collected annually since 1992. The Mulch and Post-H treatments had bigger trees and higher yields than other treatments; whereas the Grass treatment had the smallest trees and lowest yields. Higher number of new roots was observed in a light crop year (2002) than a heavy crop year (2003). Mulch trees had more shallow roots and Grass trees had fewer total roots than other treatments. Root diameter was positively correlated with overwintering root survival. The Pre-H GMS had higher root mortality during a hot and dry growing season (2002). GMS treatments affected root number and root depth distribution patterns. Hot and dry weather conditions and crop load reduced new root emergence, increased root mortality and reduced root median lifespan. GMS treatments together with environmental factors affected root growth, turnover and distribution.

USING HIGH TUNNELS TO EXTEND THE RASPBERRY SEASON INTO LATE FALL

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The use of high tunnels is a technology that can be implemented just about anywhere for a modest cost, and can be used to bring crops on earlier or extend them later in the season. Raspberries are a high value crop that, in season, sell for more than \$3.00/lb. In the middle of winter, raspberries can sell for more than \$10.00/lb. Our goal was to produce raspberries in October and November, after the field season ends from frost and rain, and when the selling price of raspberries doubles. Our project examined primocane-fruiting varieties and methods of managing plants to delay their production beyond the normal late August-September season. The first part of the study was to monitor the growth and productivity of several late varieties that typically fruit too late for the New York climate. One selection (NY01.64) and one cultivar (Josephine) appeared very promising for high tunnel production. The second set of treatments manipulated 'Heritage' so that it fruits later than the normal September season. The five treatments were an unmanipulated control, applying straw over plots in late February at the rate of 6 tons/acre after a period of cold weather, mowing canes to the ground in early June shortly after they emerge, pinching primocanes (removing the top 4–6 inches) when they reach a height of about 2½ ft, and pinching when canes were 3½ ft tall. Each of these 4 treatments delayed flowering and shifted production to later in the season. The late pinching treatment appeared to provide the best yield curve under the high tunnel.

STORAGE TEMPERATURE AND RELATIVE HUMIDITY EFFECTS ON QUALITY AND ANTIOXIDANT COMPOSITION OF STRAWBERRY FRUIT

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The New York strawberry (*Fragaria ×ananassa*) industry is focused on sale of relatively short term storage cultivars that are ripe at harvest. Although storage of harvested fruit at low temperatures is generally recommended, growers have reported reduced fruit quality in the market after low temperature storage. Therefore we have explored the potential for using intermediate temperatures for strawberry storage. Physical qualities and antioxidant composition of the Jewel cultivar stored in 75%, 85%, or 95% RH at 0.5, 10, and 20 °C for 4 days have been studied. Overall quality declined more rapidly at 20 °C, especially at 95% RH, than at 10 °C and 0.5 °C. There was little change in weight loss at 0.5, 10, and 20 °C for 2 days but it increased at the lowest RH at 10 °C and increased rapidly from day 3 at 20 °C in lower RHs. Firmness was maintained, or even increased, at 0.5 or 10 °C than 20 °C, but soluble solids concentrations were lower at higher than lower storage temperatures. Red color development and anthocyanin concentrations were controlled more at 0.5 or 10 °C than at 20 °C. Total phenolic compounds were higher at 20 °C than at other temperatures at all RHs. The total antioxidant capacity of berries was higher at 10 °C than at 0.5 or 20 °C. However, total ascorbic acid concentrations, flavonoid contents, and were not affected by RH and temperature. In conclusion, while the best temperature for long term storage is 0.5 °C, quality can be maintained at 10 °C for acceptable periods of time. High RH environments increase the loss of quality at higher storage temperatures. Higher storage temperatures may cause faster ripening and accumulation of antioxidant compounds, but marketable quality of the fruit may be reduced.

IMPACT AND MANAGEMENT OF STRAWBERRY BUD WEEVIL (*ANTHONOMUS SIGNATUS*) ON RASPBERRY IN THE NORTHEAST

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The strawberry bud weevil (*Anthonomus signatus*), "clipper," is an invasive pest to northeastern U.S. strawberry and raspberry crops. Strawberry is the primary host of clipper, but it has been observed damaging raspberry crops as well. The first objective for this research is to determine the importance of clipper as a pest on raspberries in the northeastern U.S. Raspberry plantings were scouted weekly on 13 grower-cooperator farms in Maine during the late spring and early Summer 2005 for the adult insects and bud injury (clipped or not). 10 canes from each site were then collected and the number of total buds and clipped buds were taken. This data will be correlated with the bud injury data to determine interrelationships between clipper populations and bud injury levels on different varieties of raspberries. The first year of this research has determined that clipper is a pest of raspberry in the northeastern U.S. Up to 55% clipper damage was found on raspberry plants in 2004 and up to 22% clipper damage was found in 2005. The other objective for this research is to develop integrated pest management (IPM) strategies for clipper on raspberry crops in the northeastern U.S. While scouting the farms this past summer, some different scouting techniques were tested for their efficiency and effectiveness at predicting the population levels of clipper on the crop. The scouting method of white sticky traps were hung in the field and provided the most accurate method of scouting for clipper in the field. In addition to this research, the importance of clipper as a pest of raspberries was tested using greenhouse-grown plants. They were analyzed for the ability of raspberry fruit yield to compensate for the loss of flower buds due to clipper damage. The research showed that plants with any clipped buds yielded significantly lower and the mean number of berries is significantly lower than the control plants with no clipped buds. The results also showed that the mean berry size was highest if there were no primaries clipped and significantly lower if primaries or secondaries were clipped concluding that there is little or no compensation in Killarney red raspberries when buds are clipped. This is a thesis project in progress with one more season of data to collect. Concluding the research, this work should improve grower awareness of clipper as a pest of raspberries and provide an IPM program to manage clipper on raspberries in the Northeast.

THE EFFECT OF TEMPERATURE AND PHOTOPERIOD ON THE LEAF SENESCENCE AND PARTITIONING OF ASTILBE AND PAEONIA

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The effect of temperature and photoperiod on leaf senescence and partitioning were studied in Fall 2004 using *Astilbe simplicifolia* 'praecox alba' and *Paeonia* hybrid 'Barrington Belle' and Fall 2005 using *Paeonia* Paula Fay and *Astilbe chinensis* × *purpurea*. Bare root divisions and crowns were potted and grown outdoors during the spring and summer. Plants were treated to either Ithaca fall outdoor and controlled warm (70–60 °F) environment under normal daylength (about 12 hours) or longday (LD15 hours in 2004 and 16 hours in 2005). The chlorophyll readings and senescing leaves were significantly affected by treatments in the two plants in 2004. There was no significant difference in the change in the total dry biomass in *Paeonia* hybrid 'Barrington Belle' grown under different treatments but the number of large buds was highest in those grown at 70–60 °F at LD. Higher total plant biomass was observed over-all in *Astilbe simplicifolia* 'praecox alba' in warmer greenhouse environment and under LD. The effect of photoperiod and its interaction with temperature were significant in weights of *Astilbe simplicifolia* 'praecox alba' roots. Greenhouse grown plants had higher bud numbers compared to outdoor-grown plants. In 2005, *Astilbe chinensis* × *purpurea* in the greenhouse under LD had more shoots and large buds than the other treatments. Senescing leaf and chlorophyll reading was affected by temperature and photoperiod and its interaction. *Paeonia* Paula Fay under LD outdoors had more large buds than those under natural photoperiod, but is similar in effect to those in the greenhouse. Results may be used to improve propagule quality, adjust crop production cycle and cultivation in different climate.

OPTIMAL HANDLING OF BAREROOT PERENNIALS AFTER HARVEST

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The objective of this research was to investigate factors affecting the survival and regrowth vigor after storage of bareroot perennials. The first experiment was to determine the optimal storage temperature for bareroot regrowth and survival. The treatments were done by collaborators in Holland, where the plants were harvested in November 2004, washed, dried, packed and stored at -0.5, 0, or 2 °C for 6 months. *Phlox paniculata* 'Rowie', *Echinacea purpurea* 'Magnus', *Eelleborus orientalis* 'Tricastin' and *Papaver orientalis* 'Fornceett Summer' were evaluated using three replicates per treatment with 18 bareroots per replicate. In *Phlox*, height, the number of shoots and survival increased as storage temperature decreased from 2 to -0.5 °C. In *Papaver*, survival decreased as the storage temperature decreased. In the other species the variables were not affected by these temperatures. The second experiment was to evaluate the effect of drying and rehydration on regrowth of bareroot perennials. Bareroots were dried for 0, 2, 4, 8, or 24 hours at 9 °C and 85% RH before storage for 6 months. In each treatment, nine bareroots were planted per replication without preplant soaking and eight bare-roots were pre-plant soaked in water for ten minutes before planting. In *Phlox*, the pre-plant soaking increased regrowth and survival, but had no effect on *Echinacea*, *Helleborus*, and *Papaver*. For all species, with the limits imposed in these experiments, desiccation had no consistent effect on survival.

CONSUMER PREFERENCES OF TOMATOES GROWN IN HIGH TUNNELS

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Some Maine tomato growers use unheated greenhouses or high tunnels to extend the short growing season. But, what varieties should growers choose? The objective of this trial was to test varieties of greenhouse and open field tomatoes to identify the best performers in high tunnels in terms of yield, quality, disease, and taste. Results showed that both open field and greenhouse varieties produced similar and acceptable yields of high quality marketable fruit. Open field varieties showed more disease than greenhouse varieties. There were some significant differences between individual varieties. Betterboy scored highest in sensory analysis, but lowest in yield/quality. Brillante scored poorly on marketable yields, but well in terms of premium yields, quality, disease and taste. It may be well suited for direct marketing to repeat customers (e.g., farmers' markets). For commercial production Jet Star, Brillante, Cobra, and First Lady II appear to be good choices based on overall scores.

GENE EXPRESSION AND ACTIVITIES OF CELL WALL-ASSOCIATED ENZYMES IN COLD-STORED TOMATO FRUIT

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Tomato fruit (*Solanum lycopersicum* L.) can develop meakiness and enhanced softening when exposed to chilling temperatures during storage, but the involvement of cell wall-associated enzymes in chilling injury development is not well understood. To study this aspect of injury development, we have exposed breaker-stage 'Trust' tomato fruit to a chilling temperature of 3 °C for 0, 7, 14, and 21 days followed by storage at 20 °C for 12 days. Ethylene production was not affected by storage except after 21 days where production was greater at 20 °C. Exposure of fruit to chilling temperatures delayed the ripening-related color change (chroma and hue) and initially increased compression values, but percent extractable juice was not affected consistently. Increased polygalacturonase (PG) activity during ripening was reduced by about 50% after 7 days at 3 °C, and further inhibited with increasing storage periods. In contrast, the activities of pectin methylesterase (PME) and α -galactosidase were not significantly affected by the cold treatments. β -Galactosidase activity was greater in all chilled fruit compared with fruit ripened at harvest, whereas endo- β -1,4-glucanase activity was lower after 21 days at 3 °C. In chilled fruits, transcript accumulations for PG, PME (PME1.9), and expansin (Expt.1) were lower during storage at 20 °C compared with those of nonchilled fruits. Transcript accumulation

for β -galactosidase (TBG4) was affected only at 14 days of cold storage, when transcript accumulation decreased. Cold treatment increased transcript accumulation of endo- β -1,4-glucanase (Cel1) after 12 days at 20 °C and decreased transcript accumulation after 7 days and 21 days at 21 °C. Cell wall analyses to investigate relationships among enzyme activities and cell wall disassembly are ongoing.

EVALUATION OF SKIN SEPARATION (SILVERING) IN FRUIT OF BELL PEPPER CULTIVARS

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Twenty-eight bell pepper cultivars and breeding lines were evaluated for resistance to the crown and stem rot phase of *Phytophthora blight* (*Phytophthora capsici*) and for silvering of fruit at two sites in southern New Jersey in 2005. A randomized complete block design with four replications was setup at Rutgers Agricultural Research and Extension Center (RAREC), Bridgeton, New Jersey and at an on-farm site in Vineland, NJ. Number and weight of fruit with silvering varied significantly depending on pepper line, harvest date, and location. Percentage of phytophthora-infected plants ranged from 0% to 26% at RAREC and 0% to 78% at the on-farm site depending on pepper line. In some cases, new breeding lines exhibited levels of *Phytophthora*-resistance comparable to the resistant cultivar Paladin. Depending on pepper line, percentage of harvested fruit with silvering decreased with later harvest dates. The percentage of fruit with silvering ranged from 0% to 92% during first harvest, 1% to 56% during second harvest and from 5% to 35% during third harvest at RAREC, and from 0% to 22% during second and 0% to 15% during third harvest at the on-farm site depending on pepper line. Less fruit silvering developed in lines with no resistance or tolerance to *P. capsici*. Reports have suggested that phytophthora-resistance is linked to increased silvering in fruit. Silvering in Paladin was 66%, 56%, and 35% compared to only 0%, 1%, and 5% in Camelot (susceptible cultivar) during each harvest at RAREC and was 22% and 15% in Paladin compared to 0% in Camelot at the on-farm site. Interestingly, silvering was lower when pepper lines were grown on high-ridged bare soil beds with overhead irrigation (on-farm site) compared to same pepper lines grown on black plastic mulch with drip irrigation (RAREC).

A STUDY OF THE LANDSCAPE INDUSTRY IN NORTHERN NEW JERSEY IN THE NEW MILLENNIUM

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In a 1998-99 survey of the landscape service industry in northern New Jersey, professionals predicted an average growth rate of 41% for the years 1998-2003. How close did their prediction come to the growth rate experienced by the industry? In 1999, top issues facing the industry were labor, political recognition, access to capital and regulations. How did events during the early years of the new millennium effect the industry? Landscape professionals (159) participating in a 2005 study of the industry reported an average business growth rate of 38% from 1998-2003. The terrorist attacks of 11 Sept. 2001 had consequences for 45% of the businesses; 49 experienced an average decrease in sales of 17%. Drought conditions in 2002 with state mandated water use restrictions effected 100 of the participants' businesses; 51% of whom lost an average of 21% in sales. The drought was followed by a rainy spring season in 2003. The rains hindered 57 of the businesses, 22 reporting a 3% average decrease in sales. There were events that had positive impacts on 48% of the businesses. Low interest rates, building construction and renovation and expansion of services were cited as opportunities for growth. The participants ranked environmental regulations, pesticide regulations, the availability of labor, labor regulations and vehicles/equipment as the top issues/challenges facing the industry in 2005. The landscape professionals predict an average business growth rate of 26% for 2005-2010.

ENDOWMENT STRATEGIES FOR THE UNIVERSITY OF DELAWARE BOTANIC GARDENS

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The University of Delaware Botanic Gardens (UDBG) is at a critical juncture in its development. Momentum of shared interest at the University of Delaware and the College of Agriculture and Natural Resources favors the Gardens' advancement as an institution. Having identified endowment planning as a critical and immediate need for UDBG, the goal of this research was to gather pertinent institutional knowledge from select university-based public gardens throughout the United States that had already created an endowment. Key staff were interviewed during the summer of 2005 at Cornell Plantations, JC Raulston Arboretum, Minnesota Landscape Arboretum, and the State Botanic Garden of Georgia. Valuable insights into the procurement and management of endowments within a university-based garden environment were gained through these interviews. Utilizing these results, as well as input from an advisory Task Force, specific recommendations for the University of Delaware Botanic Gardens were made from within the following topic areas: Organizational Structure, Planning, Current Strategies, The Endowment, and The Donor.

DELAYED 1-MCP APPLICATION EFFECT ON POSTHARVEST FIRMNESS AND SCALD CONTROL OF MCINTOSH AND CORTLAND APPLES

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The objective was to test the efficacy of 1-MCP when applied at 1, 4, 7, or 10 days after harvest. At harvest, internal ethylene (IEC) was undetectable in most fruit. There was a large increase in concentration at 7 days after harvest and an additional increase at 10 days in 'McIntosh'. In Cortland, IEC was very low or undetectable until 10 days after harvest. After 4 months in CA storage, firmness of untreated 'McIntosh' fell below 53 N. 1-MCP applied 1 day after harvest maintained firmness more than later applications. Application at 4–10 days was also effective with little difference between the three dates. 1-MCP was most effective on 'Cortland' when applied 1–7 days after harvest. At 10 days, there was a loss of efficacy in maintaining firmness. Similar results occurred after 7 months of CA storage. Superficial scald of 'McIntosh' was very mild with <1% of the fruit being affected after 220 days storage and 7 days at 20 °C. Untreated 'Cortland' fruit had the greatest incidence of scald with most of the fruit being affected by 200 days. 1-MCP was not effective in preventing scald in 'Cortland'.

THE EFFECT OF FLOOD WATER TEMPERATURE ON CRANBERRY UPRIGHTS AND ROOTS DURING SPRING AND FALL FLOODS

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Cranberry bogs are flooded for several purposes during the growing season, including pest control and harvest. A spring 'late water' and a fall 'harvest' flood were simulated on potted cranberry uprights ('Stevens'). The 'late water' flood is a 1-month flood held on some Massachusetts bogs from mid-April to mid-May. The flood was simulated at 11 and 21 °C. Over the course of the 1-month flood, total non-structural carbohydrate concentration (TNSC) of the upright tissue decreased by 13% and 46% in the 11 and 21 °C treatments, respectively. Root TNSC was not affected by flooding in the 11 °C treatment, but was reduced by 39% in the 21 °C treatment. In the 1-week 'harvest' flood simulated at 12 and 20 °C, TNSC of the upright tissue decreased by 47% and 59% in the 12 and 20 °C treatments, respectively. Root TNSC was reduced by 22% in the 12 °C flood, and by 41% in the 20 °C flood. Two weeks following removal from the 1-month 'late water' flood, uprights in the 11 °C treatment contained 9% more TNSC than uprights in the 21 °C treatment, while root TNSC from the two treatments was similar. No treatment differences were evident in the uprights or roots of the vines subjected to the 'late water' flood by harvest. Two weeks following removal from the 1-week 'harvest' flood, uprights in the 12 °C treatment contained 20% more TNSC than uprights in the 20 °C treatment, while roots of vines in the 12 °C flood contained 17% more

TNSC compared to vines in the 20 °C flood. Vines which were negatively impacted by the warmer 'harvest' flood treatment likely had reduced energy available for winter survival, spring growth and fruit production.

COMPARATIVE ANATOMY OF YELLOWS-INFECTED 'CHARDONNAY' GRAPEVINES IN NEW YORK STATE, VIRGINIA, AND SOUTH AUSTRALIA

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Grapevine yellows is a destructive, worldwide disease of grapevines that is caused by a phytoplasma, a bacterium-like organism that infects and disrupts the vascular system of shoots. The North American form of grapevine yellows (NAGY) has been observed in New York State since the mid-1970s and in Virginia since the mid-1990s. Symptoms duplicate those of vines suffering from an Australian disease complex known as Australian grapevine yellows (AGY). We sought to determine if infected 'Chardonnay' vines have common anatomical characteristics across the three regions. At each geographic site in late summer, 2003–04, leaf and internode samples were taken from younger green regions of shoots and from mature basal regions in the fruiting zone. These were processed for histology. The anatomy of each organ type was compared between locations on the shoot, between geographic locations, and between affected and normal shoots. The phloem was the only tissue universally affected in vines with NAGY or AGY symptoms. In stem internodes, both primary phloem and secondary phloem showed many senescent cells, abnormally proliferated giant cells, and hyperplasia. In affected secondary phloem there was disruption of the radial files of cells that normally differentiate from the cambium into mature phloem cell types. Normal bands of secondary phloem fibers ("hard phloem") in internodes were weak or absent in affected vines. Leaves also had disrupted phloem organization but near-normal xylem organization in vines with symptoms. Leaves of infected vines frequently showed a disruption of sugar transport out of the leaf blades, manifested by a heavy buildup of starch in chloroplasts of mesophyll cells and bundle-sheath cells.

PHOSPHORUS EXPORT FROM CRANBERRY BOGS IS AFFECTED BY FERTILIZER P APPLICATION AND WATER MANAGEMENT

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Although cranberry production typically requires a low fertilization rate compared to many crops, bog waters are generally discharged through surface water flow directly to streams, ponds or lakes and indirectly to coastal waters. Since discharge is primarily to fresh water bodies, and since such waters are generally phosphorus-limited, P is the fertilizer element of most environmental concern in Massachusetts cranberry production. This study was designed to determine how much P enters and leaves cranberry bog systems on an annual basis, what activities contribute to nutrient releases, and what management changes can reduce P discharges. On a total budget basis, including fertilizer applications as inputs and crop and other biomass (leaves) removal as outputs, the bogs were generally net importers of total N and total P. However, total P in outgoing waters was greater than that in source water. Net TP fluvial output averaged 2.08 kg·ha⁻¹·yr⁻¹ in 2002 (range 0.01 to 4.15); 1.66 kg·ha⁻¹·yr⁻¹ in 2003 (range -0.63 to 3.62) and 1.22 kg·ha⁻¹·yr⁻¹ in 2004 (range -1.24 to 4.30). The primary path of nutrient discharge from the bogs was through surface water. Flooding events were the primary source of total P output from the cranberry bogs. Gross total P export from the cranberry bogs was within the range of that for other reported agricultural land uses but greater than that for forested lands. When fertilizer P input was reduced (20% to 35%) at cranberry bog sites for two consecutive seasons, crop yield was not adversely affected and P discharge was reduced compared to that in the initial (prereduction) year.

ORGANIC FERTILIZERS FOR LOWBUSH BLUEBERRY

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A commercial lowbush blueberry field with a history of N and P deficiency was used to study the response to several organic fertilizers. Diammonium phosphate (DAP) is the standard fertilizer for correcting N and P deficiency

in non-organic production. At a rate of 67 kg N/ha Renaissance (8–2–6), Pro-Holly (4–6–4), Pro Grow (5–3–4), Nutri-Wave (4–1–2), or DAP (18–46–0) was applied preemergent to 1.8 × 15 m treatment plots. An unfertilized plot served as the control. Leaf N and P were deficient in the controls. DAP and Pro-Holly raised leaf N to satisfactory levels (1.6%). Only DAP raised leaf P concentrations (0.144%), compared to controls (0.122%). Leaf K was not deficient but was raised by Pro-Holly. Pro-Holly and DAP were equally effective in increasing stem height, branching, branch length, flower bud formation, and yield. Pro-Holly could effectively substitute for DAP in organic wild blueberry production.

MICRONUTRIENT AND HEAVY METAL CONCENTRATIONS IN FIELD-GROWN LETTUCE

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Information about micronutrient concentrations of plants in general can be found in botany and plant physiology textbooks, but micronutrient concentrations in field-grown lettuce is hard to find and so are concentrations of heavy metals. Lettuce consumers may be concerned with heavy metal concentrations and information about heavy metal concentrations may help consumers make a choice. This study examined the concentrations of eight micronutrients and five heavy metals in field-grown lettuce with different fertilization programs. Under the field conditions, different NPK fertilizers and fertilization rates did not differ in the leaf concentrations of micronutrients and heavy metals. The overall means of Fe, Na, Mo, and Ni concentrations in the lettuce were 663, 710, 0.9, and 1.9 $\mu\text{g}\cdot\text{g}^{-1}$ of dry leaves, respectively. These values were significantly higher (over 500% greater) than the values found in textbooks for plants in general. Mean Mn, Cu, B, and Zn concentrations were 55.5, 7.3, 23.7, and 28.4 $\mu\text{g}\cdot\text{g}^{-1}$ of dry leaves, respectively, which are in general agreement with textbook values. Mean concentrations of heavy metals Cd, Co, Cr, and Pb were 1.5, 1.0, 2.9, and 4.5 $\mu\text{g}\cdot\text{g}^{-1}$ of dry leaves, respectively, whereas mean Al concentration was 498.5 micrograms per gram of dry leaves. These results indicate that concentrations of some elements in lettuce leaves can be high under certain field conditions. It would be beneficial for lettuce growers and consumers to have this information.

COMPARISON OF NON-CHEMICAL WEED MANAGEMENT SYSTEMS IN EDIBLE SOYBEANS

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Vegetable soybeans [*Glycine max* (L.) Merr.] (edamame) are growing in popularity as a niche crop grown by traditional grain producers. Edamame were grown in an organically transitional system from 2004–2005 at the University of Maryland Lower Eastern Shore Research and Education Center in Salisbury, Md. Four weed suppressing treatments were used in order to determine if this crop would grow well in an organic production system. Five varieties; BeSweet 2020S, BeSweet 292, 414F, Dixie (2004 only), and Mooncake (2005 only) were grown in a RCB design with 4 reps. The weed suppression systems included; a ground cover of commercially purchased compost in a 4-inch layer, a ground cover of straw in a 4-inch layer, New Zealand Clover applied as a living mulch at a rate of 35#/A and an untreated control. Soybeans grown in both commercial compost and clover had significantly higher yields (6,606 and 5,578 lb/acre, respectively) than those grown in the untreated control (4,283 lb/acre), but were not different from those grown in straw (5,578 lb/acre). Weed suppression system also had an effect on the pod number per plant. On average, compost, clover and straw had 49% more pods per plant than the control. Over both years, BeSweet 2020S, BeSweet 292, 414F, and Dixie all had significantly higher yields than Mooncake (5,003, 5,613, 5,522, 7,138 and 1,875 lb/acre, respectively). Variety also had an effect on pod number per plant, with BeSweet 2020S having a 37% higher pod number than BeSweet 292. It is feasible that vegetable soybeans can be grown organically or in a low input system. This value added crop could fill an important niche for both market growers and small traditional grain producers growers.

CULTURAL PRACTICES TO IMPROVE HEIRLOOM TOMATO YIELD

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The cultivar 'Mortgage Lifter' was planted in a 2-year trial to evaluate staking systems. All plots were established with black plastic and drip in a randomized complete block design with three or four replications. In year 1, treatments consisted of straw mulch and plants grown on 4 and 8 ft tomato stakes without straw mulch. In year 2, treatments were added to include topping plants at 4 and 6 ft, when plants grew to the top of the stake and down to touch the plastic or not topping. All were grown on 4-ft stakes. Additionally, plants were grown on 8-ft stakes, but topped at 5, 6, 7, and 8 ft. The first year there were no statistical marketable yield differences between plants grown on 4 or 8-ft stakes, but the yields were significantly higher than the straw mulch treatment after the seventh harvest. The straw mulch treatment did have significantly more cull fruit, lower percentage marketable fruit and a smaller marketable fruit size for all harvests compared to the staking treatments. In year two, there were no statistical differences for marketable yield among the treatments until the late harvests (9–12). For the late harvest, all treatments grown on 8-ft stakes had higher marketable yields than all other treatments. When all harvests were combined, the 6- and 7-ft treatments had higher marketable yields with the exception of the 5- and 8-ft treatments and the 6-ft treatment on 4-ft stakes. Cull fruit yields were only significant among treatments for the mid season harvest (5–8) with the straw mulch treatment having more cull fruit than all other treatments. There were no statistical differences for percentage marketable fruit for any harvest.

INTERACTION OF HARVEST TIME AND STORAGE ON ATTRIBUTES OF EATING QUALITY IN ACORN SQUASH

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Premature harvest of acorn squash is a widespread problem because fruits reach maximum size and optimum color within 20 days after pollination (DAP), well before peak dry matter and sugar content occur. The present study was conducted to determine the relationship between harvest date and physiological factors affecting eating quality in *Cucurbita pepo* L. squash. In the summer of 2005, *C. pepo* squash cultivars were evaluated at three harvest dates, 25, 35, and 45 days after pollination (DAP), with or without a 10-day storage period at 21 °C. Four F₁ hybrid cultivars carrying powdery mildew tolerance (PMT) were evaluated: a semi-bush, commercial acorn cultivar ('Tip Top'), a high quality experimental acorn, bush hybrid (NH1634), and two sweet dumpling-type, semi-bush hybrids (NH1635 and 1636). Data were collected on mesocarp DW, °Brix (soluble solids), and partitioning of biomass between mesocarp tissue and developing embryos during storage. Peak DWs of 20% to 21% occurred at 25 DAP in NH1634, 1635 and 1636, and at 35 DAP in Tip Top (19.5%). At 25 DAP, Brix was low (means of 5.9 to 7.2) across all cultivars. With harvest at 25 DAP plus 10 days storage, °Brix was low in Tip Top (7.1), but was higher than 10 in NH1634 and NH1636. Brix reached near maximum (13 to 15) at 45 DAP in NH1634, 1635 and 1636, and at 55 DAP in Tip Top (12). Embryos were small (DW = 8 to 19 mg) at 25 DAP and grew fairly linearly to a maximum at 55 DAP. Mean embryo DW at 55 DAP was 87.5 mg for Tip Top, 76.9 mg for NH1636, 57.1 mg for NH1634, and 28.5 mg for NH1635. The proportion of total fruit biomass expressed as energy equivalents (kJoules) allocated to embryos in mature fruit (45 DAP + 10 days storage) was 11.8% in NH1635, 18.7% in NH1634, 27.4% in Tip Top, and 30.2% in NH1636. Reallocation of assimilates from mesocarp tissue to developing embryos was a major contributing factor, along with respiration, to a reduction in mesocarp dry matter during storage.