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METHODS OF FERTILIZER APPLICATION EFFECTS ON DISTRIBUTION OF NUTRIENTS IN ORCHARD SOILS

Warren C. Stiles*, Terence L. Robinson, and W. Shaw Reid, Cornell University, Ithaca, NY 14853

Fertilizer treatments were applied by spreading over an herbicide-treated in-row strip, with or without irrigation using single-drip emitters per tree, or through drip irrigation. Distribution of nutrients in soils was evaluated by analysis of soil samples collected at various depths and distances from the irrigation emitters at the end of the 8-year experimental period. $\text{NO}_3\text{-N}$ was increased in the 0- to 40-cm depth by soil surface application but below 40 cm with fertigation. Fertigation increased P in the wetted zone within the 0- to 40-cm depths. Surface application of K increased levels primarily in the 0- to 20-cm zone, while fertigation increased K to depths of 80 cm. Zinc and Cu concentrations were increased by fertigation to 80-cm depth. In general, nutrients applied to the soil surface were less readily moved into the soil profile, while fertigation resulted in greater movement of nutrients to greater depths within the wetted zone of soil.

USE OF SPRING FLOOD FOR PEST CONTROL IN CRANBERRY PRODUCTION: IMPACT ON NITROGEN USE, PLANT GROWTH, AND YIELD

Carolyn DeMoranville, University of Massachusetts, Cranberry Experiment Station, East Wareham, MA 02538

Extensive study of the use of late water (LW, a 4-week spring flood used to control pests) in modern cranberry production systems began in 1993, focused on the effects of the flood on pests and the cranberry plants, and compared LW to companion early water (EW, no spring flood) bogs and to their own histories. In 1993 and 1994, LW bogs had yields comparable to EW controls with N fertilizer reductions of 35% and 60%. In the year following LW, N use returned to pre-LW levels. In 1995, N use was reduced by 65%. However, yield on LW bogs was reduced in 1995, at least in part due to anomalous winter weather and drought. Upright length and density did not differ between LW and EW bogs (1993–95). This may have been due to reduced N dose offsetting any growth-promoting effects of LW. In 1994 and 1995, LW bogs had fewer flowers than EW bogs, but increased fruit set compensated in 1994. LW may adversely affect yield in some years but this could be offset by reduced production costs or increased yields in following years. Cost/return budgets are being studied.

FINE FESCUE SPECIES AND CULTIVARS FOR GOLF COURSE ROUGH AND MOUND USE

Annamarie Pennucci, Northeast Turf and Ornamental Research, Milford, NH 02055

Five species and 27 cultivars of fine-leaved fescues (*Festuca* sp.) were evaluated for low-maintenance utility turf in a variety of golf course conditions. Cultivar selection and management techniques varied across six sites in 4 years. Germination, tillering, rapidity of establishment, turf density, and general turfgrass quality were significantly different between both species and cultivars. Annual and seasonal decline and recovery of turf quality was also dependent on

both species and cultivar. Greater differences exist within cultivars in some species than between species. Aspect, slope, soil disturbance, shade, seeding date, irrigation, fertility regime, mulch, and mowing influenced establishment and seedling development. Absence of endophytic fungi and development of diseases, insects, weeds, and post-germination disturbance markedly contributed to losses in turf quality, percent living cover, and increased erosion potential. Success and duration of fescue slope plantings are both positively and negatively correlated to various site characteristics and management techniques. Fescues are an appropriate choice in specific circumstances.

REGENERATION OF *SOLANUM QUITOENSE* FOR THE PRODUCTION OF SOMACLONAL VARIANTS RESISTANT TO ROOT-KNOT NEMATODES

Luisa Santamaria* and Sherry Kitto, Department of Plant and Soil Sciences, University of Delaware, Newark, DE 19717

Solanum quitoense, also known as naranjilla or lulo, is a native species of Ecuador and Colombia. Its value is based on the uncommon sweet-sour flavor of its fruits, which is appreciated in the national and international markets. The worst problem for this crop is the root-knot nematode *Meloidogyne incognita*. The main objective of our research is to develop root-knot nematode-resistant naranjilla via somaclonal variation. Seeds of *Solanum quitoense* 'Baeza' germinated quicker than those of 'Dulce'. Seeds given a 2-week dark treatment had 100% germination compared to 75% germination for seeds placed under lights (16-h photoperiod, 60 $\text{mmol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$). Single-node explants proliferated an average of nine nodes after 1 month of culture. Microcuttings (two nodes, 3.5 cm) stuck in sand and placed under a humidity dome under mist had an average of five roots averaging 25 cm in length after 3 weeks. Stems regenerated shoots better than petioles or leaves and explant orientation/polarity had no effect on regeneration. Root cultures of *Solanum quitoense* inoculated in vitro with *Meloidogyne incognita* showed susceptibility to root-knot nematodes.

BIOCHEMICAL AND HEREDITARY STUDIES ON ENZYMES AND GENES CONTROLLING ANTHOCYANIN SYNTHESIS IN APPLES

Zhiguo Ju*, Chenglian Liu, Yongbing Yuan, Yongzhang Wang, and Gongshi Liu, Laiyang Agricultural College, Shandong Province, China

Crosses between red cultivars produced high frequency of less-colored progeny, while hybridization between non-red cultivars yielded some red-fruited F_1 trees. When harvest was delayed and light intensity increased, both green and yellow cultivars accumulated some anthocyanin with higher UDPGal:flavonoid-3-o-glycosyltransferase (UFGalT) activity in colored areas. Overall, anthocyanin accumulation and UFGalT activity were highly correlated ($r = 0.8921$, $P = 0.0001$) in fruit from both parental trees and their F_1 progeny, but UFGalT activity always was relatively high in fruit peel, whether anthocyanin accumulated or not. There were no significant differences in phenylalanine ammonia-lyase or chalcone synthase activities among the cultivars, and they did not change much after hybridization.

CHEMICAL AND PHYSICAL PROPERTIES OF COAL BOTTOM ASH-BASED ROOT MEDIA AND THEIR EFFECT ON POINSETTIA NUTRITIVE STATUS, GROWTH, AND FLOWERING
Dharmalingam, S. Pitchay*, and B.C. Bearce, West Virginia University, Morgantown, WV 26506-6108

Rooted cuttings of 'Supjibi' poinsettia were potted in peat vermiculite, mixed with coal bottom ash at 0%, 25%, 50%, 75%, or 100% by volume. Values of pH were higher in media containing coal bottom ash. In general, pH increased for the first 4 weeks, during which time 50–100 ppm (N) fertilizer was being applied, decreased temporarily when 200 ppm fertilizer began, and then increased and stabilized for the last 5 weeks. At first, pH tended to be higher with increase in ash, but when 200 ppm fertilizer was begun, pH became the same in all coal ash levels. Once fertilization was stopped, pH tended again to be higher in ash media. Levels of EC remained low in all media when 50–100 ppm of fertilizer was applied, but increased after 200 ppm fertilizer was begun, increasing to excessive levels 2 weeks later. With more watering, EC declined in the 0% ash, but remained high in 50% to 100% ash media. Leaf Ca content increased with increase in media ash but was below the normal range in all plants. With increase in media ash, water capacity decreased, but bulk density increased. Bract color development in plants in ash media appeared delayed.

ENHANCEMENT OF POSTPRODUCTION QUALITY OF EASTER LILY BY GROWTH REGULATORS

Susan S. Han, Department of Plant and Soil Sciences, French Hall, University of Massachusetts, MA 01003

The development of postproduction foliar chlorosis is one of the critical problems that remains unsolved in Easter lily production. Plants at the white puffy stage were sprayed with 500 mg gibberellic acid (GA₃)/liter, 500 mg benzyladenine (BA)/liter, 500 mg each GA₃ and BA/liter, 500 mg ProGibb (containing 500 mg GA₃/liter)/liter, and 1000 mg Promalin (containing 500 mg GA₄ + GA₇/liter and 500 mg BA/liter)/liter, and a water control. Development of foliar chlorosis was evaluated in a simulated interior environment at a temperature of 22.6 ± 0.2°C and illuminated 12 h·d⁻¹ with 11.2 ± 0.1 mmol·m⁻²·s⁻¹ from cool-white fluorescent lamps. Results demonstrated that GA₃, BA, ProGibb, and Promalin are effective in delaying the development of foliar chlorosis of cold-stored plants. Promalin was the most effective. Concentrations of Promalin as low as 50 mg·liter⁻¹ were effective. Treatments had no effect on the development and the longevity of flower buds. This study thus suggests that application of Promalin to Easter lily plants prior to marketing is a viable solution to preventing postproduction development of foliar chlorosis.

ORGANELLE-SPECIFIC LOCALIZATION OF IPTASE IN TRANSGENIC *NICOTIANA*

Gregory S. Rogers* and John J. Frett, Plant and Soil Science Department, University of Delaware, 149 Townsend Hall, Newark, DE 19711

Nicotiana transformed with the isopentenyl transferase (ipt) gene from *Agrobacterium tumefaciens* was fixed for 1 h in 1% glutaraldehyde and 4% formaldehyde. Ultrathin sections were collected on nickel grids. Grids were treated with polyclonal anti-IPTase antibody raised in rabbits and visualized with 10 nm, protein-A-labeled colloidal gold. Gold label was found throughout the cell, including the cell wall, vacuole, rough ER, and organelles. Cell wall and vacuole labeling appears to be due to non-specific binding and is greatly reduced by a BSA block. Mitochondria and chloroplasts also showed gold label, but not greater than established background levels. Labeling above background levels on the rough ER, free polysomes, and further label in the free cytoplasm indicate a cytoplasmic role for IPTase.

SEED QUALITY EFFECTS ON HYDROPONIC LETTUCE

Ahmet Korkmaz* and Wallace Pill, Department of Plant and Soil Sciences, University of Delaware, Newark, DE 19713

Achievement of head size uniformity at final harvest reduces loss and increases profitability for the hydroponic lettuce grower. Shoot fresh weight of 'Cortina' lettuce (*Lactuca sativa* L.) at 7 or 21 days after planting (DAP) was inversely proportional to the number of days

required for seedling emergence, and was greater for raw than for pelleted seeds. Head fresh weight at final harvest (61 DAP) was directly proportional to seedling length at 21 DAP, but raw and pelleted seeds produced equal head weights. Thus, initial seed (seedling) vigor differences were maintained to final harvest. Osmotic seed priming (–1.5 MPa KH₂PO₄, 20 h, dark) led to increased germination rate at 15, 25, and 35°C; had no effect on germination synchrony; and increased germination percentage only at 35°C. Covering raw or pelleted seeds sown in depressions of the phenolic foam trays with fine (No. 5) vermiculite compared to leaving the seeds uncovered, and soaking the trays in hydroponic solution rather than water, increased seedling shoot fresh weights. Seeds sown on their first day of germination or primed seeds gave greater seedling shoot fresh weights than pelleted seeds. However, the more uniform seedling shoot fresh weights from germinated seeds than from primed seeds was associated with more rapid and synchronous seedling emergence.

GENETIC MARKER-AIDED STUDIES OF INCOMPATIBILITY SYSTEMS IN TOMATO

Robert Bernatzky*, Richard H. Glaven, Grant R. Hackett, and Bruce A. Rivers, Department of Plant and Soil Sciences, University of Massachusetts, Amherst, MA 01003

Self-incompatibility (SI) is the inability of otherwise fertile gametes to produce viable zygotes upon self-fertilization. The *S* locus of *chromosome 1* in *Lycopersicon* is thought to be the main controlling factor in SI. However, the significance of other chromosome segments in the control of SI or the effect of a foreign genetic background on the *S* locus has not been thoroughly explored. In addition, the relationship between SI and wider interspecific crossing barriers remains unclear. Using DNA and protein markers for *chromosome 1*, we have created a series of backcross lines that contain either 1) the *SI* locus and flanking chromosome region from a *SI* species in a *SC* species background or 2) the same chromosome region from a *SC* species in a *SI* species background. The reproductive behavior of these plants will be discussed.

SEEKING POTATO CLONES WITH ELEVATED TUBER METHIONINE USING PROTOPLAST REGENERATION PROTOCOLS

Alan R. Langille*, Department of Applied Ecology and Environmental Sciences, University of Maine, Orono, ME 04469-5722, and Yu Lan and D.L. Gustine, U.S. Department of Agriculture, Agricultural Research Service, Pasture Laboratory, University Park, PA 16802

'Russet Burbank' leaf protoplasts were cultured in cell layer (CL) media containing the amino acid analog, ethionine (ETN), at concentrations ranging from 0 to 9 μM. A decrease in plating efficiency was observed when ETN concentrations in CL exceeded 3 μM. Calli that developed were placed on C media containing ETN concentrations up to 200 μM. Regenerated plants were grown to maturity in a growth chamber and resulting tubers were analyzed for free methionine. Selected protoclones produced tubers whose free methionine content exceeded that of the 'Russet Burbank' control by ≈3-fold. Methodology used will be discussed.

LOWEST SURVIVAL TEMPERATURE (LST) ESTIMATES FOR *KALMIA LATIFOLIA* (L.) AS AFFECTED BY NUCLEATION/SEEDING TREATMENTS

John Wachter* and Paul E. Cappelletto, University of Maine, Landscape Horticulture Program, Orono, ME 04469

Terminal stem cuttings of *Kalmia latifolia* were collected from wild plants (Milford, N.H.) on 12 Nov. and transported on ice to Orono, Maine, for analysis. Samples were processed as follows: 1) stems wrapped in dry cheesecloth; 2) stems wrapped in moist cheesecloth; and 3) stems seeded with crushed ice and wrapped in moist cheesecloth. Prepared samples were subjected to freezing tests to a low temperature of –36°C. Following two weeks of incubation at 21°C, samples were evaluated for leaf, petiole, stem, and vegetative bud damage. Evaluation of frozen samples revealed: 1) stem tissue remained undamaged to –36°C; 2) leaf damage was inconsistent across all handling methods, with no clear LST estimate, and ice seeding

generally resulted in increased tissue damage; 3) LSTs for vegetative buds and petiole bases were -18°C and -15°C , respectively, and both yielded definitive and consistent results across all treatments. The results indicate bud and petiole tissue to be the best to use for future studies on LST estimates in *Kalmia latifolia*.

REGIONAL CLIMATE DIFFERENCES HAVE VARYING EFFECTS ON SCALD SUSCEPTIBILITY OF 'DELICIOUS' APPLES
Sarah A. Weis* and William J. Bramlage, University of Massachusetts, Amherst, MA 01003

Cool preharvest temperatures and increasing fruit maturity at harvest reduce poststorage superficial scald incidence. In the absence of cool preharvest temperatures, the role of fruit maturity in determining scald susceptibility becomes greater. Larger amounts of preharvest rainfall also contribute to reduction in scald incidence. Data from 'Delicious' grown in a number of locations worldwide will be used to demonstrate this.

EVALUATION OF *PODISUS MACULIVENTRIS* (HETEROPTERA: PENTATOMIDAE) FOR CONTROL OF THE COLORADO POTATO BEETLE ON POTATOES GROWN UNDER ROWCOVER
Rose Hiskes* and Richard Ashley, Department of Plant Science, Box U-67, University of Connecticut, Storrs, CT 06269-4067

Podisus maculiventris, a Colorado potato beetle (CPB) predator native to Connecticut, is commercially available. This research evaluated *Podisus*' effectiveness against CPB at different predator-to-prey ratios. Field experiments were conducted over two summers. The first summer yields in the treatment with 100 CPB eggs and 6 predators and the control (0 CPB eggs and 0 predators) were significantly higher than treatment with 100 CPB eggs and 0 predators. The second summer yield for treatment with 100 CPB eggs and 12 predators and the control were significantly higher than the remaining treatments with 0, 3, and 6 predators. *Podisus maculiventris* holds promise for control of CPB on potatoes grown under rowcover. Further research, determining the effects of all native CPB predators as pesticides more favorable to them are used, is needed.

GENETICS OF FLOWERING HABIT IN STRAWBERRY: A MAP-BASED APPROACH

Thomas M. Davis*, M. Sean Hill, Rebecca S. Gallien, and James E. Pollard, Plant Biology Department, University of New Hampshire

Strawberry flowering habit can be classified as either day-neutral (DN) or short-day (SD), depending on whether plants are insensitive or sensitive to photoperiod, respectively. Short-day (SD) cultivars produce mature fruit for just a few weeks in early summer. New floral initiation does not commence until triggered by the combination of short daylength and low temperature in the fall. Day-neutral (DN) cultivars do not require particular daylength conditions to initiate flowering, and so continue to produce flowers and mature fruit into late summer and early fall. We are using a map-based approach to characterize the genetic determinants of flowering habit in strawberry at both the diploid and octoploid levels. A recessive gene conferring DN flowering habit has been identified, and its position determined with respect to molecular markers on the *Fragaria vesca* genetic linkage map. We are using the technique of bulked segregant analysis (BSA) in an effort to find random amplified polymorphic DNA (RAPD) markers linked to a putative dominant gene conferring the DN habit in the octoploid, cultivated strawberry, *F. ×ananassa*.

SUSTAINING CROP GROWTH WITH COMPOST AND PLASTIC MULCH

Otho S. Wells* and James R. Mitchell, Department of Plant Biology, University of New Hampshire, Durham, NH 03824-3597

In 1992 and 1993, a run-down, infertile field was treated with 0, 12, 24, and 48 T/A (day weight) of compost. Timothy was grown on the plots each year and removed. In 1994 and 1995, 'Earliqueen' muskmelon was grown in the same plots, along with four types of synthetic mulch (black plastic, IRT-100 plastic, IRT-200 plastic, and paper). Over the two years, there was a consistent crop response. As compost rates increased, crop yield increased. The highest yields were with the

higher rates of compost coupled with the IRT mulches. After 2 years of cropping, the soil nutrient status remained at acceptable levels at the 24 and 48 T/A rates of compost. Generally, organic matter, pH, and CEC increased with increasing compost rates. Foliar diseases were suppressed with the compost at all rates.

INTRA-NURSERY SPREAD OF PLANT PATHOGENS: A CASE FOR EXCLUSION AND SANITATION AS DISEASE CONTROL METHODOLOGIES

Annamarie Pennucci, Northeast Turf and Ornamental Research, Milford, NH 03055

Four novel and five commonly occurring diseases of ornamental nursery stock were evaluated for patterns of dissemination and rapidity of movement within a commercial nursery. Newly acquired but infected nursery stock provided a readily available inoculum source. Dissemination, pathogen movement, and disease development were positively correlated to minimal plant proximities, overhead irrigation, and communal root or soil environments. Water containment and recycling systems allowed movement of waterborne pathogens between plants on the same bench, in the same row, or on contiguous sheets of plastic or landscape fabric. Diseased plants located above uninfected stock or upstream or inside overhead irrigation systems provided a source for rapid aerial spread of conidia. Detached diseased plant parts provided rapid physical movement of pathogens and disease developed despite applications of fungicides. Exclusion of diseased plant materials accompanied by rigorous sanitation offer important means of limiting pathogen movement within the nursery.

UNIVERSITY OF CONNECTICUT DISEASE-RESISTANT PEPPER VARIETY TRIAL

Jude Boucher, Gianna Nixon*, and Richard Ashley, Department of Plant Science, Box U-67, University of Connecticut, Storrs, CT 06269-4067

In 1995, we compared the horticultural characteristics of one *Phytophthora* blight, one cucumber mosaic virus, and 12 bacterial leaf spot-resistant varieties to two popular commercial peppers in a replicated trial at the University of Connecticut. Fruit were graded for size and shape and yields were separated into early and late-season harvests. Other parameters measured were plant height, canopy width, and fruit wall thickness, length to diameter ratio, number, weight, and the percent marketable. Unreplicated demonstration plantings with three or four resistant varieties each were conducted at 12 commercial farms in 1994-95 and at the university's research farm in 1994. Several resistant varieties were judged to be equal or superior to the two popular cultivars based on a combination of characteristics, including observations on disease susceptibility at local farms. Resistant varieties recommended for New England conditions include Boynton Bell (Harris Moran), King Arthur and PSX 271092 (Petoseed), Admiral and Reinger (Roger NK).

GENETIC RELATIONSHIPS AMONG RESISTANCE TO ZUCCHINI YELLOW MOSAIC VIRUS, WATERMELON MOSAIC VIRUS, PAPAYA RINGSPOT VIRUS, AND POWDERY MILDEW IN MELON (*CUCUMIS MELO*)

Konstantinos Anagnostou and Molly Kyle, Department of Plant Breeding and Biometry, Cornell University, Ithaca, NY 14853, and Rafael Perl-Treves, Life Sciences Department, Bar-Ilan University, Ramat Gan 52900, Israel

We have studied the relationship of resistance to watermelon mosaic virus (WMV), zucchini yellow mosaic virus (ZYMV), papaya ringspot virus (PRSV), and powdery mildew (PM) in melon (*Cucumis melo*). We have confirmed monogenic dominant inheritance of these four resistances and report that PI414723-4S₃, which was initially selected as a source of ZYMR, is also a source of dominant monogenic resistance to PRSV. Further, we observed departure from independent assortment for resistance to WMV and ZYMV in a study of 73 (UC Top Mark × PI414723-4S₃) F₃ families ($\chi^2 = 39.87$ significant at both 0.01 and 0.05 levels), indicating linkage between *Wmv* and *Zym*. The map distance between these resistance genes calculated from the number of recombinant families (RF% = 9.58) was 10.5 cM. Compari-

sons among WMV, PM, ZYMV-PM, PRSV-PM, ZYMV-PRSV, and WMV-PRSV of 48 (TM × PI414723-4S₃) F₃ families, which were screened with all four pathogens, showed no consistent cosegregation.

A SURVEY OF HEAT TOLERANCE IN LIMA BEAN (*PHASEOLUS LUNATUS*)

Kathryn R. Kleiner* and John J. Frett, Plant and Soil Science Department, 149 Townsend Hall, University of Delaware, Newark, DE 19711

A greenhouse study was designed to determine the relative heat tolerance of 10 lima bean cultivars and to evaluate the effects of high temperature on lima bean yield. Cultivars were arranged in a randomized complete block with three blocks per treatment. The temperature treatments were 25C day/15C night and 35C day/25C night. Cultivars varied in their response to the higher temperature, allowing for classification into three heat response groups: intolerant, average, and tolerant. Heat-intolerant plants did not experience a significant reduction in number of pods, but number of beans and total bean weight were reduced at the higher temperature. Number of seeds per pod and average weight per bean also tended to decrease in intolerant plants at 35C. In future experiments, these data will be correlated with random amplified DNA (RAPD) markers. These markers will be evaluated for their potential for heat tolerance screening.

GROWTH AND YIELD OF GREENHOUSE TOMATO WITH CONSTANT OR INTERMITTENT HEATING OF THE ROOT AND SHOOT

M.P.N. Gent* and Y.Z. Ma, Department of Forestry and Horticulture, Connecticut Agricultural Experiment Station, New Haven, CT 06504

What is the effect of constant compared to intermittent heating of the shoot and root on growth, nutrient status, and yield of greenhouse tomato (*Lycopersicon esculentum* Mill)? Seedlings were transplanted early, on 4 Mar. 1994 and 1 Mar. 1995, or late, on 25 Mar. 1994 and 31 Mar. 1995, into troughs of peat-lite mix. The troughs were heated to 21C by buried tubing, either constantly, or for 12 h during the day or the night, or they were not heated. The greenhouses had either 14/14C or 22/6C day/night minimum air temperatures. After 2 weeks, early transplants had the greatest leaf weight with constant root heat and least with no heat. Root weight was greater for 14/14C than 22/6C air heat. With 14/14C air heat, only the no-root heat reduced leaf weight, whereas with 22/6C air heat, root heat ranking was constant > day > night ≈ no heat. With late transplants, only the no heat reduced leaf weight. Most nutrient concentrations were less in late than in early transplants. Number of fruit, and number and weight of marketable fruit produced by 1 July from early transplants was affected by root heat; the ranking was constant heat > day > night > no heat. The 22/6C air heat increased marketable yield because of fewer small, irregular and blossom end rot fruit. Root heat had no effect on yield of late transplants.

GROWTH AND N AND C METABOLITES OF TOMATO IN RESPONSE TO ROOTS WARM DURING THE DAY AND COLD AT NIGHT, OR VICE VERSA

Yong-Zhan Ma* and Martin P.N. Gent, Department of Forestry and Horticulture, Connecticut Agricultural Experiment Station, New Haven, CT 06504-1106

How are C and N metabolites affected by a root-zone temperature (RZT) in phase or out of phase with the photoperiod? Tomato (*Lycopersicon esculentum* Mill.) was grown with an air temperature of 20C, and RZT that was in phase with a 12-h photoperiod, 28C in the light and 12C in the dark, or out of phase, 12C in the light and 28C in the dark. Seedlings were grown in flowing solution containing 200 μM NO₃ and excess amount of other mineral elements. The flow rate increased with plant size. After 8 days, plants were harvested at the end of the day and at the end of the night. The relative growth rate (day⁻¹) was slightly greater for in-phase (0.19) than out-of-phase RZT (0.17) and less than that at a constant air and RZT of 24C (0.22). RZT affected N accumulation and partitioning of C and N metabolites. Cool roots contained more NO₃ and free sugars than warm roots. Leaves had less NO₃ in the light than in the dark, and NO₃ in leaves of plants with an

out-of-phase RZT was depleted in the light. Concentration of free amino acids and protein was greater and the amount of starch was less in leaves of plants with in-phase RZT.

EFFECTS OF ETHEPHON AND AVG ON FRUIT CUTICLE OF 'DELICIOUS' APPLES

Zhiguo Ju* and William J. Bramlage, Department of Plant and Soil Sciences, University of Massachusetts, Amherst, MA 01003

Cuticle provides a barrier for secretory of volatile lipophilic metabolites like α-farnesene in fruit. The accumulation and oxidation of α-farnesene or the propagation of its oxidation products can be affected by the thickness, the constituents, and the structure of this cuticle. To measure the development changes of cuticle components, 'Delicious' trees were treated separately with 250 ppm aminoethoxyvinylglycine (AVG) on 12 Sept. and 200 ppm ethephon on 19 Sept. Fruit were harvested on 28 Sept. and stored at about 20C for 6 weeks. Total wax in both treatment and control fruit at harvest was around 2.8 mg/f.fr.wt. It increased rapidly after 2 weeks and reached 8.4 mg/g fr.wt. in control fruit after 6 weeks, which paralleled increasing internal ethylene and accumulation of α-farnesene. Ethylene synthesis, α-farnesene, and total wax accumulation were enhanced by ethephon treatment and completely suppressed by AVG treatment during the whole period of storage. The cutin contents in fruit from treated fruit and the control were similar at harvest, and they remained constant during storage.

RFLP TAGGING OF CUCUMBER MOSAIC VIRUS RESISTANCE GENES IN PEPPER VIA DISTRIBUTIONAL EXTREME ANALYSIS

Yiping Zhang*, Vince Lackney, and Molly Kyle, Department of Plant Breeding and Biometry, Cornell University, Ithaca, NY 14853

We report the detection of molecular markers linked to polygenic recessive resistance to cucumber mosaic virus (CMV) in pepper using distributional extreme analysis. A total of 132 mapped tomato genomic, cDNA, and pepper genomic clones from different linkage groups in two existing pepper maps, especially from the ones showing tentative CMVR QTLs, were selected as hybridization probes for Southern blots, in which DNA from the 12 most resistant and 15 most susceptible individuals from a large segregating F₂ were probed. Several clones appeared to cosegregate with CMV resistance phenotype. Further analysis is being done to place these markers on existing molecular linkage maps. The precise locations of resistance genes can be defined by examining additional markers within the region. The availability of closely linked DNA markers may facilitate marker-aided selection in pepper CMV resistance breeding programs.

A DEMONSTRATION OF HORTICULTURAL CROP PRODUCTION ON A RECLAIMED SURFACE MINE SITE IN SOUTHERN WEST VIRGINIA

Donna Coffindaffer-Ballard*, B.C. Bearce, J. Skousen, and G. Lambert, West Virginia University, Morgantown, WV 26506-6108

A 0.2-ha reclaimed minesoil site near Welch, W. Va., was amended with sewage sludge, hardwood bark, and a sorghum-sudan hybrid green manure crop to demonstrate production of horticultural crops. A selection of crops, including white birch, forsythia, zinnia, tomato, yarrow, red raspberry, and strawberry, was planted and grown. Plant growth and development, including flower and fruit production, tended to be enhanced by sludge-amended soils and reduced in green manure and hardwood bark-amended soils. Sludge increased pH, Ca, P, and Mg levels above that in the other treatments. Hardwood bark increased Mn but decreased P. The green manure amendment increased soil Fe content. In 1994 'Allstar' strawberry yield and berry weights were similar for all plots, but yield was about 10% of expected and was very close to the economic break-even point. Third-year yield of 1992 planted 'Heritage' raspberries was about one-half the expected yield of 5000 lbs/acre, but still considered profitable. Zinnia flower production yielded a calculated 32% return on investment. Assuming that 50% forsythia plants were saleable in 2 years, return on investment was projected to be 30%. For white birch, assuming half were saleable in 4 years, a 16% return on investment was projected.

EFFECT OF WATER STRESS ON HEAT STRESS TOLERANCE IN GERANIUM

Rajeev Arora*, Dharmalingam S. Pitchay, and Bradford C. Bearce, Division of Plant and Soil Sciences, West Virginia University, Morgantown, WV 26506-6108

This study evaluated the effect of reversible water stress on heat stress tolerance (HST) in greenhouse-grown geraniums. Water stress was imposed by withholding irrigation until pots reached $\approx 30\%$ (by weight) of well-watered (control) plant pots, and maintaining this weight for 7 days. Control plants were watered to just below field capacity, every other day. Leaf xylem water potential (LXWP, MPa), leaf-relative water content (LRWC, %), media water content (MWC, % fresh weight), and heat stress tolerance (HST, LT50) were determined for control and stressed plants. HST (LT50), defined as temperature causing half-maximal percent injury, was based on electrolyte leakage from leaf disks subjected to 25 to 60C. Control-watering was restored in stressed plants and above measurements made after 7 days of recovery. Data indicate: 1) LXWP, LRWC, and MWC in control and stressed plants were -0.378 and -0.804 MPa, 92.31% and 78.69% and 82.86% and 15.5%, respectively; 2) HST increased significantly in stressed as compared to control plants (LT50 of 55C vs. 51C); 3) control plants were near maximally injured by 53C treatment and sustained more than 3-fold greater injury than stressed plants at 53C. In recovered plants, LXWP and RWC reversed back to control levels, paralleled by loss of higher HST.

PERFORMANCE OF FOUR POINSETTIA CULTIVARS IN ROOT MEDIA CONTAINING COAL BOTTOM ASH OR AGED SAWDUST

Mark D. Sherratt*, Donna V. Coffindaffer-Ballard, and Bradford C. Bearce, West Virginia University, Morgantown, WV 26506-6108

Four poinsettia cultivars were planted in root media containing 0%, 25%, or 50% (by volume) of coal bottom ash or aged hardwood sawdust. Bract color development in 'Supjibi' was delayed in media containing sawdust or ash by up to 8–12 days. Bract color initiation of 'Jingle Bells' and 'Success' occurred earliest in media containing 25% sawdust, but color development was delayed in 50% coal ash. Color development in 'Dark Red Hegg' was not affected by ash or sawdust. Analysis of combined leaves from all four cultivars showed Fe levels below normal where media contained sawdust. Leaf Mo concentrations increased with increased media sawdust to above the normal range, but Mn levels were below the normal range in sawdust media. Leaf Ca levels were below normal in all media, possibly due to excessively high K levels in media and leaves. When fertilizer concentration and frequency were adjusted to media EC levels, control media (0% ash or sawdust) required 100 ppm N once a week. Media

containing sawdust required 300 ppm to maintain EC levels between 1.25–2.25 $\text{dS}\cdot\text{m}^{-1}$ and coal ash media were irrigated with water following the sixth week after planting due to EC levels >2.25 .

GROWTH OF PETUNIA, IMPATIENS, AND IVY AND ZONAL GERANIUMS IN ROOT MEDIA CONTAINING COAL BOTTOM ASH

Dharmalingam S. Pitchay* and B.C. Bearce, West Virginia University, Morgantown, WV 26506-6108

Petunia and impatiens seedlings were planted in cell packs containing 0%, 25%, or 50% (by volume) coal bottom ash (CBA) mixed with peat : vermiculite. High soluble salts caused fresh and dry weights to be greatly reduced in 25% and 50% CBA. This was thought to be due to insufficient drainage in the shallow cell packs. Subsequent crops were grown in 4-inch pots. Double Pink impatiens in 4-inch pots showed no significant difference between control and ash media in the number of buds and flowers, plant heights and diameters, and fresh and dry weights. For 'Mixed Shady Lady' impatiens, the number of flowers, and fresh and dry weights were greater in the control and 50% CBA. Plant heights were reduced in 25% and 50% CBA media. There were no differences in plant diameters among the media. Ivy geraniums showed no significant difference in the number of days from planting to first bloom and 50% florets opening; number of florets, buds, and inflorescences; and stem lengths. Shoot numbers were reduced in 25% and 50% CBA. There was also no significant difference in number of days from planting to first bloom and 50% florets opening, or number of buds and inflorescences for zonal geraniums. Number of florets increased for zonal geraniums in 25% CBA.

INHIBITION OF AMINOETHOXYVINYLGLYCINE ON FRUIT COLORATION OF 'DELICIOUS' APPLES

Zhiguo Ju*, Yongbing Yuan, and Chenglian Liu, Laiyang Agricultural College, Shandong Province, China

Aminoethoxyvinylglycine (AVG), an ethylene synthesis inhibitor, is a potential chemical to prevent preharvest fruit drop and improve storage quality of apples. Since ethylene promotes anthocyanin synthesis, effects of AVG on fruit coloration is a concern of fruit growers. 'Delicious' apple trees were treated with 250 ppm AVG on 6 and 26 Aug. and 15 Sept., respectively. Fruit were harvested for analysis on 5 Oct. The anthocyanin accumulation and chlorophyll degradation in treated fruit were significantly lower when AVG was applied in August, which resulted in a low percentage of red fruit compared with the control. However, AVG did not inhibit anthocyanin synthesis and chlorophyll degradation when applied on 15 Sept. UDPGalactose : flavonoid-3-o-glycosyl-transferase activity also was reduced by AVG treatment in August, but not in September.