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Afternoon Session

INFLUENCE OF CALCIUM NUTRITION AND TEMPERATURE ON PLANT PERFORMANCE
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Beginning in 1980, candidates form the Geneva apple rootstock breeding program have been planted in test orchards to determine rootstock effects on tree size, productivity, suckering, burknot development and anchorage. We made no pre-planting laboratory estimates of rootstock influence on these characteristics. Seedlings were screened for susceptibility to Phytophthora cactorum, fire blight, and woolly apple aphids.

Three large progenies, derived from Malling 9, M.27, and Ottawa 3 crossed with Robusta 5, were tested under ‘Northern Spy’ in NY, ‘Topred Delicious’ in WV, Summerland McIntosh in MI, and ‘Golden Delicious’ in AR. Sixty to 85% of the candidates induced tree size similar to that found with MM.111 or domestic seedlings. Less than 5% of the stocks were as dwarfed as M.26. There were no differences in frequency of occurrence of dwarfing stocks among the 3 progenies.

SENSITIVITY OF TISSUE-CULTURED RASPBERRIES TO PREEMERGENT HERBICIDES
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Eight experiments over 3 years in both the greenhouse and the field were used to measure the effects of herbicide active ingredients, rate, formulation, timing of application, cultivar, propagule type, age of propagule, charcoal root dip, and their interactions on growth of raspberries. Data indicated that tissue-culture propagated raspberries were more sensitive to most labeled herbicides at planting than conventional propagules. In addition, wide variation in cultivar response was observed, with purple raspberries exhibiting the most sensitivity. Napropamide and postemergent grass herbicides were safe to use at planting, but oryzalin and simazine caused phytotoxicity. Sales application was delayed for several weeks after planting. Metolachlor exhibited the opposite trend, suggesting leaf uptake of this herbicide. Trends in growth the first season were also reflected in pruinose emergence in the second year. Charcoal root dips did not sufficiently ameliorate the effect of herbicides, and formulation did not affect plant response. Hand-weeded plots always performed poorly, suggesting that disrupting the shallow root system with cultivation is deleterious to plant growth.

EFFECT OF TILLAGE AND HERBICIDES IN ASPARAGUS ESTABLISHED WITH SEEDLING TRANSPLANTS
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Asparagus (Asparagus officinalis L. cv. Centennial), established with seedling transplants in 1983 was maintained in a no-till system or with a conserving tillage system of rototilling (Bcm). Metribuzin or metribuzin + napropamide at 1.12 and 1.68 kg ai/ha were used for weed control in both tillage regimes. Tillage reduced yields by 19, 43 and 56% in 1985, 1986, and 1987, respectively. Tillage did not affect the pattern of yield distribution throughout the first full harvest season of 1987; the number of large spears decreased while the number of mediumsized spears increased over the season, regardless of treatment. The largest total yields occurred in mid-season. The use of napropamide did not significantly affect yields and there was no tillage X napropamide interaction. Control of annual broadleaf and grasses was equivalent with the use of either metribuzin or metribuzin + napropamide, regardless of tillage. However, there were significantly higher populations of volunteer asparagus seedlings in tillled than in no-till plots. [4-amino-6-(1,1-dimethylpropyl)-3-(methylylthio)-1, 2,4-triazin-5(4H)-one, N,N-diethyl-2-(1-naphthalenyl)oxy]napropamide].

EFFECTS OF PHENYLACETIC ACID CONCENTRATION ON SURVIVAL AND PLATING EFFICIENCY OF POTATO MESOPHYLL PROTOPLASTS AND REACTION OF REGENERATED PLANTS TO SUBSEQUENT INOCULATION WITH RHIZOTOXIN SOLANI
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Somatic variation associated with protoplast regeneration is being utilized in an attempt to improve disease resistance qualities of the potato. Mesophyll protoplasts cv. ‘Russet Burbank’ were cultured in media containing varying concentrations of phenylacetic acid (PAA), a phytotoxin associated with Rhizoctonia solani. Cell survival and plating efficiency were determined during the 14 day incubation period. Surviving colonies were regenerated and resultant protoplasts were evaluated following inoculation with the fungus. Results will be discussed.
IN SITU MEASUREMENT OF FRUIT COLOR DEVELOPMENT IN SIX RED DELICIOUS STRAINS
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The objective of this study was to determine the rate of fruit color development in 6 strains of Red Delicious apple (Malus domestica Borkh) on M 7A rootstock. The strains included Ace, Oregon Spur II, Rynard Spur, Rared Royal, Red Prince, and Starkrimson. Chromaticity values (L*, a*, b*) were measured with a Minolta CR-300B colorimeter on 5 tagged apples on each of 10 trees of each strain. Measurements were made at approximately the same location on each fruit 8 times from July 27 through harvest (Sept 21). Calyx diameter of each fruit was also measured. Color variations were observed even on July 27; Starkrimson and Red Prince had the greatest increase in green color. Positive a* (red color) values were obtained in all strains except Starkrimson and Red Prince by Aug 11. Rapid increases in red coloration occurred in all strains between Aug 16 and Sept 1. At harvest, as expected, variations existed between strains in value (L*), a*/b* ratio; however, all strains approached their ultimate color by the end of the first week of September.

EFFECTS OF K, Mg, B, and Zn APPLICATIONS IN MICHIGAN AND EMPIRE APPLES
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Study was conducted in a commercial orchard located in the Hudson Valley. Soil was the same as that at Knickerbocker, Tytico Diane-sandy mixed mesic. Trees consisted of Macmurray/MM106 and Empire/MM106 planted at 287 trees ha⁻¹ in 1980. The object of the study was: (1) Establish a K response curve; (2) Compare effects of soil-applied versus foliar-applied B; (3) Evaluate responses to foliar-applied EDTA-Zn. A non-orthogonal series of 9 treatments was studied over a 5-year period beginning in fall 1983. Individual plots consisted of 40 trees, 20 of each cultivar, in a randomized complete block design with 3 replications. Sulfate of potash-magnesia was applied annually in the fall to supply K (200 lb ha⁻¹) at rates of 0, 14, 43, and 86 kg ha⁻¹. EDTA-Zn (14% Zn) was applied at rates of 0.5 lb sq ft. Leaves and fruit were analyzed annually for K, Mg, B, and Zn, respectively.

Response to K additions were non-linear. Annual application of 86 kg K²O ha⁻¹ approached optimal response for this soil. Multiple regression analyses indicate approximately 60% of variance in leaf K attributable to K supply in top 20 cm of soil. Response to K additions was dependent upon soil application of B. Rates of Mg supplied were inadequate to meet crop requirements. Leaf Zn levels did not indicate carryover effect of EDTA-Zn sprays into succeeding seasons. Yield and fruit size correlated closely with leaf K and Ca levels.

EFFECTS OF GYPSUM ON EXCHANGEABLE CA, Mg, and K IN THE SOIL, AND ON LEAF AND FRUIT MINERAL COMPOSITION OF APPLES
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Gypsum was applied annually from 1980 beneath Delicious trees at 0.3 lb sq ft, and from 1986 beneath Cortland trees at 0.5 lb sq ft. Leaves and fruit were analyzed annually for Ca, Mg, K, and P. In 1986, soil samples (Scituate fine sandy loam) were taken each year for measurement of pH and exchangeable Ca, Mg, and K. Gypsum increased leaf and fruit Ca and decreased leaf and fruit Mg in the second (Delicious) and third (Cortland) year of treatment. In Delicious fruit the increments of Ca increase and Mg decrease were constant over time, but in leaves both responses increased with time. K and P levels in leaves and fruit were not affected.

OXYGEN REQUIREMENT OF ETHYLENE FORMING ENZYMES IN APPLE FRUIT AND APPLE FRUIT TISSUE
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Ethylene evolution, assessed by internal ethylene concentration (IEC), was studied in preclimacteric and climacteric "Gala" apples. IEC decreased immediately when fruits were transferred from air to 1.5% O₂. Returning fruits to air resulted in rapid increase in IEC, indicating 1-ami-cyclopropane-1-carboxylic acid (ACC) accumulated in low O₂. Ethylene production rates of tissue from single fruits were correlated with respective intact fruit ethylene production. Response of tissue to ACC treatment was influenced by fruit maturity. ACC treatment increased ethylene production of preclimacteric tissue yet caused no increase in production of climacteric tissue. The conversion of ACC to ethylene by fruit tissue was influenced by O₂ levels. At 25 C, 50% inhibition of ethylene production by tissue was observed at approximately 6% O₂.

EVALUATION OF RIPENING AND FRUIT QUALITY OF 'GALA' AND 'MCLINTOSH' APPLES AT HARVEST AND FOLLOWING AIR STORAGE
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The ripening and fruit quality of 'Gala' (Kidd's D-8)-M.26 and 'Rogers Red McIntosh'/M.26 were evaluated during a 7-week period bracketing normal harvest. Significant numbers of 'McIntosh' entered the ethylene climacteric (1 mg-liter⁻¹ internal ethylene) by Sept. 21. On Sept. 28, 50% were climacteric, and internal ethylene concentrations exceeded 40 mg-liters⁻¹. Internal level of ethylene rose rapidly by the optimal harvest date. The ripening and color on both was similar. It was concluded that 'Gala' and 'McIntosh' ripen at about the same time. At the normal harvest date, 'Gala' were firmer and had higher soluble solids than 'McIntosh' water during storage. 'McIntosh', but if stored in plastic bags water loss was reduced from both cultivars. Fruit were harvested at 3 dates, and quality was assessed after 0, 1, 2, and 3 months in storage. Cultivar preference and fruit quality will be discussed in relation to taste panel evaluation and measured fruit quality parameters following storage.

MANAGEMENT OF PEACH TREE VIGOR THROUGH SOIL MANIPULATION AND ITS CONSEQUENCES ON FRUIT SIZE AND YIELD

A field study was conducted on three year old peach (Prunus persica (L.) Batch) cultivars Redhaven, Loring and Jersey Queen to determine the effect of two sod treatments and a bare herbicide strip control on shoot growth, nitrogen content, final fruit yield, fruit diameter, soil water content and canopy temperature. Sod treatments consisted of a continuous Kentucky-31 tail rescue sod and a K-31 sod that was eliminated with paraquat dichloride during stage 1I of fruit growth (50%-1). Shoot growth, leaf nitrogen content and final fruit yield followed in order, bare-sod > continuous sod. Final shoot diameter was greatest with the sod-I treatment in all but Redhaven followed by bare and continuous sod treatments. Fruit maturity was advanced in both sod treatments by as much as 14 days over the bare control. Soil water content was greater in both sod treatments to a depth of 120 cm compared to the bare control. Treatments effects on canopy temperature were observed.

DEVELOPMENT OF A BOOM SPRAYER FOR "T" TRELLIS APPLES
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A sprayer module was developed for "T" trellis apples and mounted on an existing WVU mechanical harvester mainframe in place of the harvesting module. The sprayer module consisted of a Durand-Mayland model 105 LTS sprayer and two horizontal booms with four D2-13 hollow cone nozzles per boom which delivered spray from above and below the tree canopy. The lift capability of the harvester mainframe could elevate operator and sprayer top simultaneous to spray an apple tree in a multiple tiered "T" trellis systems. The hydrostatic drive, front wheel pivot steering, all terrain tires and solenoid valve controls provided excellent maneuverability, traction and ease of sprayer operation. The trellis sprayer is more economical to operate because it requires less horse power since a fan is not needed for spray delivery. The advantage of the trelliser mainframe to perform both spraying and harvesting operations, equipment costs would also be reduced.
EVALUATION OF A BOOM SPRAYER FOR PEST CONTROL IN 'T' TRELLIS APPLES
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A boom sprayer module, developed for 'T' trellis apples and mounted on the WVU mechanical harvester mainframe, was compared to a Swanson DA23 3-point hitch airblast sprayer to evaluate insect and disease control and spray deposit. The percent of fruit damaged by insects and diseases was similar with the two spray systems in the outer canopy, however, the boom sprayer provided superior control in the center region of both 'Red Delicious' and 'Golden Delicious'. The boom sprayer delivered less spray deposit in the outer region, more in the center region than the airblast sprayer. Whereas spray deposition from the boom sprayer was similar in both regions, that delivered by the airblast sprayer in the center was only one-third of the deposit in the outer region. The boom sprayer was found to be less effective than the airblast sprayer in the control of apple scab; when water stress growth in the trellis reached 1 m in height during the summer. The removal of watersprout growth with a sickle-bar mower would permit continued aphid control.

MECHANICAL BLOOM THINNING OF PEACH

A 1.8 m by 1.8 m rope curtain comprised of 3.2 cm strands of hemp rope, doubled and continuously spaced, was tested on peaches ('Prunus persica (L.) Batsch) in full bloom during 1988. Trials were conducted on 3 cultivars ('Redhaven', 'Cresthaven', 'Early Loring') and on 3 pruning/training systems (attached-pruned open center, semi-circular, central leader). Rope curtain treatments were compared to bloom hand thinned controls and 50 DAFB hand thinned controls. Bloom/thinned were determined directly on pre-tagged branches immediately following thinning and again at 50 DAFB. Follow-up thinning time/ tree and average fruit diameter/first branch at harvest were compared. The data indicated that:
1) Thinning with rope curtain treatments were generally equal to bloom hand thinned treatments, 2) thinning with the rope curtain was improved when detail pruning was conducted to eliminate overspraying shoots, 3) follow-up hand thinning was significantly reduced on trees treated with the rope curtain, and 4) fruit size was increased with bloom thinning treatments. A disadvantage of the best unit was that multiple trips (6-8) over the orchard were required; therefore, methods of reducing travel should be investigated.

SPECTROPHOTOMETRIC AND IMAGE CAPTURE AND ANALYSIS SYSTEM (ICAS) QUANTIFICATION OF OXIDATIVE ENZYMES IN PEACH FRUIT.
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The oxidative enzymes peroxidase (POD) and polyphenol oxidase (PPO) in developing peach fruit ('Prunus persica (L.) Batsch cv. Loring') were quantified using spectrophotometric and digital image techniques. Fruits were collected every two days from 25 to 55 days after full bloom (DAFB), separated into endocarp and mesocarp tissue, and frozen for spectrophotometric quantification. POD activity in the endocarp peaked at 43-45 DAFB, and a five-fold increase in POD was observed in the mesocarp from 43 to 55 DAFB. POD activity peaked in the mesocarp at 43-45 and 53-55 DAFB. No clear pattern of POD activity was observed in the endocarp. Net, browning, PPO, and POD activity were quantified in the mesocarp and endocarp using ICAS by examining thin cross-sections of fruit every two days from 18 to 51 DAFB. Net browning was greatest in endocarp before 35 DAFB and in the mesocarp after 35 DAFB. Browning increased in both tissues through 47 DAFB. Net POD activity in mesocarp was greater than endocarp after 31 DAFB. A similar pattern was observed with net POD activity. ICAS determination of net activity was similar to spectrophotometric determination in total activity; a comparison of the two methods is discussed.

EFFECT OF ROOT PRUNING AND DEBLOSSOMING ON PHOTOSYNTHESIS AND WATER RELATIONS OF 'GOLDEN DELICIOUS'/ 'M.9 APPLE TREES.
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'Golden Delicious' and 'M.9 apples apple trees were: 1) mechanically root pruned on 2 sides at 50 cm from the trunk to a depth of 40 cm; 2) deblossomed by hand; 3) root pruned and deblossomed; or 4) untreated. Root pruning and deblossoming decreased photosynthesis, more negative leaf water potential, and reduced transpiration by midday, compared to controls. Deblossomed trees had reduced photosynthesis and transpiration, and less negative leaf water potential, compared to controls. Leaves of root pruned plus deblossomed trees had levels of photosynthesis and transpiration intermediate to these of other treatments alone. Shoot growth of deblossomed trees was lower in chlorophyll content and high in starch content compared to controls. Root pruning by itself had no effect on leaf chlorophyll and starch levels, while root pruned plus deblossomed trees had lower chlorophyll and starch levels intermediate to either treatment alone. Transmission electronic microscopy revealed disruption of chloroplasts of leaves of deblossomed trees, caused by numerous large starch granules. When root pruning was combined with deblossoming, less disruption of leaf chloroplasts occurred.

EFFECT OF ROOT PRUNING AND DEBLOSSOMING ON GROWTH AND FLOWERING OF 'GOLDEN DELICIOUS'/ M.9 APPLE TREES.
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'Mature 'Golden Delicious'/ 'M.9 apple trees were: 1) root pruned on 2 sides at 50 cm from the trunk to a depth of 40 cm; 2) deblossomed by hand; 3) root pruned and deblossomed; or 4) untreated. Root pruning reduced trunk cross-sectional area, shoot length, shoot to spur ratio, and shoot leaf size in cropping trees. The reductions were less on the vegetative growth of deblossomed trees. Root regeneration was abundant on root pruned plus deblossomed trees, but much less so on cropping trees. Root pruning had no effect on leaf mineral nutrient content, while deblossoming reduced foliar levels of N, Ca, Mg, Mn, B, Zn, Al, and Na and increased leaf K. Root pruning had no effect on return bloom, fruit set, or yield. Leaf size, fruit size was reduced. Deblossoming increased return bloom and increased the proportion of lateral bloom relative to spur bloom. Deblossoming stimulated a second flush of bloom in 2 consecutive seasons.

SOURCE/SINK REGULATION OF CARBON FIXATION AND ALLOCATION IN VEGETATIVE APPLE SHOOTS.
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The source/sink ratio was altered on 6-month-old apple seedlings growing in 15 cm pots by the shading of vegetative sinks and source leaves. The net photosynthetic (Pn) rate in a mature source leaf increased by 20 to 60% in developing apical leaves (increased vegetative sink demand) or mature basal leaves (decreased source supply) were shaded compared to control treatments. The net increase in leaf area in the shade in both treatments restored Pn to the level of control plants. Shading either source or sink leaves increased transport of 14CO2 fixation products from the labelled source leaf to the sink leaves. A decrease in leaf Pn was observed when both source and sink leaves were shaded. 14CO2 fixation products accumulated in the labelled source leaf and transferred to adjacent leaves that were shaded. Application of 250 mg·liter-1 BA or NAA to the unshaded leaf increased Pn rate when both source and sink leaves were shaded.

PERMEABILITY OF PEACH CUTICLES TO BORON (B) AS INFLUENCED BY BORON CONCENTRATIONS, pH AND SURFACTANTS.
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As peaches have a very narrow range of adequate internal boron concentration, boron toxicity in peaches is easily induced by soil boron application. Currently foliar boron application for peaches is recommended by many States. However, peaches have been reported to be inert to urea foliar application. Cuticular plasma membrane transport, appears to be the rate limiting step in absorption. The efficiency of foliar boron application has been questioned. To find out the effectiveness of foliar boron application as well as to establish the best application condition, studies investigating the cuticular penetration using both isolated and intact cuticles were thus undertaken.

Both methods proved that peach cuticles do penetrate boron. The permeability coefficient (P) of adaxial cuticles (astomatus) was slower than that of abaxial cuticles (astomatus). There were significant differences among the boron concentrations and surfactants treated. But pH levels influenced boron penetration of abaxial cuticle.
Inheritance of Cold Germinability in Muskmelon (Cucumis melo L.)
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A cold germinable inbred derived from PI 126156 was crossed to a non-cold germinable inbred derived from 'Delicious 51' and a moderately cold germinable inbred developed from 'Minnesota Midget'. Reciprocal F1, F2, and BC generation seeds were germinated in Petri dishes incubated 14 days at 15°C. Germination data were difficult to fit to exact genetic ratios due to maternal effects influencing seed quality. However, data presented in this study indicate the existence in PI 126156 of a cytoplasmic component (CO), that increases the capacity for cold germinability, a homo-recessive gene which confers a high probability of germinability, at 15°C in the presence of CO, and one or possibly two additional modifying genes which increases both the probability of seed germination and the rate at which germination occurs. Additionally, PI 126156 and 'Minnesota Midget' appear to share the cytoplasmic factor and some common nuclear alleles for cold germinability.

Genetic Analyses of Early Blight Resistance in Tomatoes
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One of the most important tomato diseases in the southeast and midwest regions is early blight, caused by the fungus Alternaria solani. Currently, no early blight resistant cultivars are available, but several resistant breeding lines have been developed. The breeding lines C1943, 7182, NC EBR-1, NC EBR-2, and 878187 were included in genetic studies to determine the inheritance of resistance to early blight in tomatoes. Diverse analyses, midparent-hybrid comparisons and generation mean analyses were performed. Hybrid means for area under the disease progress curve (AUDPC) generally were not significantly different from their mid-parent values, indicating additive genetic control for the trait. Results of diverse analyses and generation mean analyses suggested that additional genetic effects were more important than dominant genetic effects for early blight resistance.

Importance of Shifting the Wires in a V-Trellis for Raspberries
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Omission of end-post cross-arm design specifications, in primary publications of the spread-trellises or qrder training systems, may have inhibited adoption of this concept in North America. We independently designed and field tested a end-post cross-arm assembly to facilitate implementation of spread-trellising. Spreading at bloom (i.e., primary blossoms at or past anthesis on nearly all fruiting shoots) was associated with 93% exterior display of fruiting shoots. Only 30% of shoots were oriented to the exterior of the modified V-trellis when canes were trained during dormancy to a stationary V configuration. Intermediate times of shifting the wires resulted in intermediate % exterior display of fruiting shoots. Picking conditions and harvest efficiency were best where wires had been spread at bloom.

Identifying an Appropriate Pruning System for 'Royalty' Purple Raspberry
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A 4-factor completely randomized design was used to assess the effects of pricomecchio tipping, cane or branch length, cane density and time of cane thinning on yield, yield components, and their distribution in 'Royalty' raspberry. Cane density and cane or branch length were positively associated with yield, although fruit yield and the number of flowers per bud decreased with increasing length. Pinching pricomecchios increased branching and the total number of buds per plant, especially at low densities. Pinched pricomecchios were difficult to harvest, and also became infected with cane blight at the pinching wound by 1988. This practice may prove advantageous to growers, especially if adequate cane numbers (12 or more per plant) can be maintained. Time of thinning had no effect of plant performance.

Although the various treatments resulted in marked differences in plant canopy architecture, both the amount of fresh weight allocated to fruit and the interactions among yield components were consistent. Path analysis revealed a strong positive direct effect of bud number per cane on yield, but a negative effect on flowers per lateral and berry weight. Reducing bud numbers will increase fruit size, but at the expense of yield.

Interactions Between Soil-Applied Phosphorus, Boron and Zinc in Earliglow® Strawberry
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A central composite design was used to measure the main effects and interactions of phosphorus, boron, and zinc on growth and reproduction in field grown strawberries. Phosphorus levels ranged from 11 to 125 kg/ha, zinc from 2.9 to 45 kg/ha, and boron from 0.2 to 4.5 kg/ha. Treatments were replicated 3 times each at pH levels of 5.5 and 6.3. Individual plants were excavated from treatment plots at monthly intervals and separated into root and leaf blades. Dry weight and mineral composition of component parts, leaf number, leaf area, crown number and runner number were determined for each date. At harvest, yield components and achenes per fruit from the surface area were determined. Leaf levels of phosphorus, boron and zinc increased with soil levels, although foliar concentrations of phosphorus and zinc were reduced with increasing boron. At the high pH level, yield was strongly affected by phosphorus, boron and their interaction. Reduced yield occurred at extremes in the soil phosphorus, boron ratio. Yield component analysis indicated that fruit number per truss was influenced significantly by this interaction. A different set of interactions occurred at the lower soil pH. Fruit levels of nutrients were not significantly different from those of plants with foliar levels. Data reveal the complexity of interpreting foliar nutrient levels.

The Nature of Strawberry Fruit Malformation Caused by the Tarnished Plant Bug
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Tarnished plant bug feeding on strawberry blossoms results in characteristic injury to the mature fruit, described as "spiral seediness". An experiment was designed to determine the nature of this damage by applying treatments to blossoms (48 hours post-anthesis) which mimic the feeding processes of tarnished plant bug. These treatments included: the destruction of achenes, the destruction of receptacles, the destruction of receptacles and pectinase applications. Examination of the mature fruit indicates that a combination of mechanical and enzymatic damage to the achenes is responsible for tarnished plant bug symptoms on strawberries. Auxin treatments induced some tolerance to tarnished plant bug damage, suggesting that feeding interferes with auxin synthesis in the achenes, or auxin transport to the receptacle tissue.

Use of Fish Hydrolysate Fertilizer on Cranberries: A Progress Report
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Field trials with fish hydrolysate fertilizer (FH) are being conducted to evaluate FH as a replacement for inorganic soluble fertilizer on cranberry bogs. FH as originally formulated (4% phosphoric acid) cannot be applied as a spraying mixture due to significant changes (compared to 10-20-10) in set, floral induction or flowering. However, when 2% formic acid was added as a stabilizer, yield was reduced. This effect was most apparent when the FH was applied early in the season (bud swell). The possibility that the formic acid damaged flower buds will be discussed. In large scale field trials, FH (phosphoric acid) did not decrease productivity. If this preliminary result can be confirmed, cranberry growers may have an alternative to easily leached inorganics. Furthermore, FH could be applied through existing irrigation systems, avoiding the need for aerial application of granular fertilizer.

Telecommunications for Horticulturists
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Horticulturists often have the need for rapid and accurate telecommunications with colleagues located in distant geographical areas. Microcomputer-based telecommunications provides several means by which these communications can take place.

Facsimile transmission provides the simplest means of transmitting manuscripts and other text materials. Binary files require more complex means and require a modem, tele-
COMMUNICATIONS SOFTWARE AND ERROR CHECKING PROTOCOLS. LONG DISTANCE TRANSMISSION COSTS CAN BE MINIMIZED BY USING HIGH SPEED MODems AND FILE COMPRESSION.

Long distance networking can also be accomplished by packet switching networks. These networks, and an overview of the electronic bulletin board system run by the American Society for Horticultural Science, will be discussed.

ROBOTIC AUTOMATION OF TISSUE CULTURE MEDIA PREPARATION.

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Preparation of tissue culture media is a relatively simple process that is, however, repetitive, tedious and time consuming. Procedures that are simple, require precision and involve a fixed succession of steps that are routinely repeated benefit from automation due to both to the robot-automation of tasks and the training-up of skilled personnel. A modular, robotic work cell has been designed that contains an IBM-PC, an RTX robot arm, a beaker station, a connecting station, a dispensing and holding station, a pH and rinsing station, and a shelving station.

HEIGHT CONTROL OF POINSETTIAS BY PREPLANT SOAK OF ROOTED CUTTINGS IN SUMAGIC

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Rootzones of Euphorbia pulcherrima cv. 'Brilliant Diamond' plants rooted in Oasis rootcubes were soaked for 15 min in solutions containing 0, 0.1, 1.0, or 10 mg l⁻¹ of Sumagic. The rootzones were irrigated 0, 24, or 36 h prior to soaking in Sumagic. One plant was potted per 15 cm saucers pot filled with peat-vermiculite medium. All plants were pinched 2 weeks later. Average plant height, and inflorescence number and diameter were recorded at anthesis. Most acceptable height reduction occurred in plants soaked in 0.1 mg l⁻¹ Sumagic 24 h after rootzone irrigation. This treatment produced plants comparable to those treated with Cycocel. Excessive height reduction resulted from 1 and 10 mg l⁻¹ soaks in Sumagic and the 0.1 mg l⁻¹ soak 36 h after rootzone irrigation. Inflorescence number and diameter were reduced by 1 mg l⁻¹ Sumagic plant rootzones (rootcubes) soaks with Sumagic provided an effective method for controlling plant height while reducing the quantity of chemical and the time required for treatment.

A MAJOR PROBLEM AFFECTING THE ACCURACY OF ESTIMATES OF GENE NUMBER OBTAINED BY THE INBRED-BACKCROSS METHOD

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Use of the inbred-backcross method for estimation of gene number has depended on binary classification of lines into parental and non-parental types on the basis of probability ellipses or intervals. The term confidence interval has been used improperly in the literature to designate probability intervals. The confidence interval is the appropriate method for binary classification. Using a confidence interval instead of a probability interval results in far fewer lines being classified as parental types. A test based on rectangles rather than ellipses is proposed as a more valid test in two dimensions in the absence of paired data. An example of the major change in gene number estimated using confidence rectangles, two-sample t significance rectangles, and probability rectangles based on three quantitative trait scores was shown for six quantitative traits in tomato. Many genes are involved in all six traits and probably in all traits previously studied using the method. Estimates of gene number similar to those published for the inbred-backcross method have been obtained using other methods, suggesting that these methods may also be flawed.

COAL ASH AND PINE WOOD CHIPS AS COMPONENTS OF POINSETTIA ROOT MEDIA

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Rooted 'Brilliant Diamond' poinsettia cuttings were potted in 15 cm standard plastic pots filled with 1 peat:1 vermiculite (by volume) in which coal ash, pine wood chips, or 1 chip:1 ash (by volume) were mixed at 0, 20, 40 or 60% by volume. All plants were pinched 6 weeks later and harvested at terminal capitulum. Water capacity declined with addition of each component. Air capacity was increased by chips and chip:ash and decreased by ash. Increase in ash or aschips caused a linear decrease in plant height, dry weight, and number of inflorescences. However, no decrease in branch length was noted at any ash concentration. Dry weight, height and branch length were increased at 20% chips. Height decreased at 60% chips.

CONTROL OF FLOWERING IN SOYBEANS (Glycine max (L.) Merrill), the response to photoperiod must be better understood. We examined flower initiation and development in 'Clark' and 'Johnston' grown in a greenhouse at 25±2°C. Sowings were made every 2 weeks to give changing daylength environments. The flower initiation phase in 'Johnston' was simulated exactly by using a daylength of 14.7 hr in decreasing daylength conditions as a switch between 2 rates of daily progress toward initiation. Flower development in 'Johnston' was simulated to ±2 days by making daily progress a function of the difference between daylength and 14.7 hr. For 'Clark', the floral initiation phase was simulated to ±3 days by making daily progress a function of direction of change in daylength and the magnitude of the difference between daylength and a reference daylength. Progress in floral development was simulated to ±3 days using the same logic except when daylength fell below 14.7 hr, developmental progress was constant. Simulations suggest that both floral initiation and development respond to daylength and direction of change in daylength but that each phase responds differently.

COMPARISON OF IBA AND NAA FOR THE ROOTING OF PLANTS IN THE HAMAMELIDACEAE

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This experiment was designed to determine if the rooting response of plants in the Hamamelidaceae is better with naphthaleneacetic acid (NAA) or indolebutyric acid (IBA). Stem cuttings of Cornus alternifolia L. were cut into 10 cm pieces and treated with 0, 10, 100 or 1000 mg l⁻¹ IBA or NAA. Cuttings were rooted in peat-lite medium, emergence characteristics and seedling shoot weights from unprimed and primed seeds stored in the peat-lite were similar to those of seeds not stored in peat-lite. After 4 weeks of storage in IBA sheets, primed tomato seeds (~1% polyethylene glycol, 15%, 1 week) gave higher seedling emergence and greater seedling shoot fresh weight than unprimed seeds stored 4 weeks in IBA sheets. While 200 to 1000 mg l⁻¹ IBA had no effect on tomato seedling emergence or shoot fresh weight, 1000 mg l⁻¹ IBA reduced the rate and synchrony of seedling emergence.

Several post-rooting treatments followed by heat may improve rooting in this genus. Post-rooting treatments followed by heat may improve rooting in this genus.

Posters

INFLUENCE OF CHANGING DAYLENGTH ON FLORAL INITIATION AND ON FLORAL DEVELOPMENT IN SOYBEANS

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To predict time of flowering in field-grown soybeans (Glycine max (L.) Merrill), the response to photoperiod must be better understood. We examined flower initiation and development in 'Clark' and 'Johnston' grown in a greenhouse at 25±2°C. Sowings were made every 2 weeks to give changing daylength environments. The floral initiation phase in 'Johnston' was simulated exactly by using a daylength of 14.7 hr in decreasing daylength conditions as a switch between 2 rates of daily progress toward initiation. Flower development in 'Johnston' was simulated to ±2 days by making daily progress a function of the difference between daylength and 14.7 hr. For 'Clark', the floral initiation phase was simulated to ±3 days by making daily progress a function of direction of change in daylength and the magnitude of the difference between daylength and a reference daylength. Progress in floral development was simulated to ±3 days using the same logic except when daylength fell below 14.7 hr, developmental progress was constant. Simulations suggest that both floral initiation and development respond to daylength and direction of change in daylength but that each phase responds differently.
A POSSIBLE RELATIONSHIP BETWEEN FRUIT CALCIUM AND GIBBERELLIN A4 RESPONSE ON 'DELICIOUS' APPLE.
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Calcium modifiers, verapamil (V) or Trifluoperazine (TFP), were applied alone or in combination with gibberellin A4. Treatments were foliarly applied 8 days after full bloom in 1987 and 14 days after full bloom (FB) in 1988 to randomly selected limbs of a spur-type 'Delicious'/M.26 apple tree. Developing fruit were collected at FB+25 days in 1987 and at FB+42 and FB+37 days in 1988 and analyzed for fruit calcium, magnesium and potassium. In 1987, GA4 decreased fruit calcium at harvest. Since fruit size was not influenced, decreased fruit calcium was not due to dilution in larger fruit. Fruit width was increased only when GA4 was applied alone. In 1988, length/diameter ratios were enhanced with applications of either GA4 or GA4 plus V. Lower levels of calcium were found in developing fruitlets treated with GA4 both in 1987 and 1988. Magnesium in developing fruit was reduced in 1987 in GA4 treated fruit. There is an indication that V and TFP decreased bitter pit in fruit treated with GA4. In 1988, V and TFP reduced magnesium in developing fruits (FB+24 days) not treated with GA4. Harvest and preharvest fruit ion data will be discussed in relation to calcium modifier influence on the response to GA4 application.

FRUCTIPOTENTIALS FOR GERMINATION AND EMERGENCE OF 'PACKMAN' BROCCOLI
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'Packman' broccoli (Brassica oleracea var. italica) seeds were germinated at constant temperatures in the range of 5 to 40 C with 15 hour daylength changes in the range 5 to 42 C. Practical germination of 90% and emergence of 75% occurred within 14 days in the range of 10 to 25 C. Germination was defined in this study as protrusion of the radicle from the seed coat and emergence as elongation of the radicle to a minimum of 10 mm. Diurnal temperature changes did not improve overall germination, but may extend the practical limits to 5 and 30 C. Inhibition at high temperatures produced drastic reductions in emergence vigor without equivalent reductions in germination.

ABSTRACT WITHDRAWN

EFFECT OF CPPU ON FRUIT SET, FRUIT CHARACTERISTICS AND PRE-HARVEST DROP OF APPLES
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CPPU (N-(2-chloro-4-pyridyl)-N-phénylurea) was applied at 3 different times to evaluate its effect on fruit shape, fruit size and set, and preharvest drop. CPPU applied at kingdom to spur-type 'Delicious' at 0 to 20 mg liter-1. All CPPU concentrations increased the L/D ratio comparably from a control level of 0.95 to 1.03. Flesh firmness was increased linearly by CPPU from 71.1 to 78.9 kg. 'Oregon Spar Delicious' were treated at full bloom (FB) or petal fall (PF) with 0 to 15 mg liter-1 CPPU 25 mg liter-1 Promalin. Fruit set was enhanced only when CPPU was applied at FB. CPPU increased fruit L/D ratio comparably when applied either at FB or PF, whereas Promalin was effective only at the FB timing. 'Empire' apples were sprayed with 0 to 40 mg liter-1 CPPU 16 days after bloom. No thinning occurred but fruit size was increased up to 29%. Methylsiladene (BA) at 100 mg liter-1 thinned and increased fruit size, but CPPU was more effective at increasing fruit size. CPPU was applied to 'Early McIntosh' just prior to the start of preharvest at 50 or 100 mg liter-1. Drop was retarded for 8 days with 100 mg liter-1. NAA at 20 mg liter-1 controlled drop longer and more effectively than CPPU.

EFFECTS OF AUTUMN APPLICATION OF 15N-UREA ON NITROGEN STORAGE AND REUTILIZATION IN APPLE
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Effects of autumn foliar or soil application of 15N-urea on N storage and reutilization in young apple seedlings (Malus 'Pumpkin Mill') were studied. Foliar applications (15N-urea, referred to as FT) and soil applications (15N-urea 1.00 g per plant, referred to as ST) had no significant influence on leaf N retranslocation and the level of stored N. Compared to FT, a higher proportion of applied 15N was absorbed during autumn application and LT enabled higher percentage of 15N to be in above-ground parts of plant after application, which consequently preferred to produce more growth during the following seasons. The stored N was unquestionably in the form of protein N regardless the treatments. 15N applied either by soil or by foliar in autumn of 1985 could be detected in plant during whole 2 years experiment.

LIGHT INTENSITY EFFECTS ON BLUEBERRY Mn STATUS
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Hanganese-induced chlorosis was investigated with Vaccinium corymbosum L. and V. darrowi Camp blueberries grown in solution culture under 3 Mn regimes (0.13, 48, 96 μg ml-1) and 2 light intensities (3.3 and 6.7 μE m-2 s-1) for a period of 6 weeks. V. corymbosum displayed slight terminal interseptal chlorosis only under the higher light intensity and highest Mn level. V. darrowi displayed chlorosis at the highest Mn level. Independent of light intensity, and also at the lowered light level and 46 μg ml-1. Independent of Mn treatment, fresh matter production was severely reduced at the lowered light intensity for V. darrowi. Leaf, stem or root tissue Mn concentrations were a poor indicator of Mn-induced chlorosis symptoms in blueberries. The possible Mn accumulation mechanisms of blueberries as well as the nutritional status of the plants will be discussed.

SEASONAL OCCURRENCES OF WOOD BORING BEETLES IN VIRGINIA COMMERCIAL VINEYARDS.
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A multicity trap survey for wood boring beetles was conducted in central and Virginia in 1987 and 1988. The work was begun in response to increasing reports of insect damage to vine trunks and cordonals in commercial vineyards. The most numerous species and the primary species causing damage were Xyleborus saxeensis and Xylophagus basilarius, respectively. Seasonal activity patterns and the relative abundance of captures of each species in different locations were documented. A farm level survey reflected the information of the multicounty program and showed higher capture rates in a vineyard over adjacent woodland. The technique demonstrated the utility of using ethanol as an attractant for wood boring beetles under field conditions.

ROOTING OF LOWBUSH BLUEBERRY TISSUE-CULTURE PLANTLETS INOCULATED WITH MYCORRHIZAL ISOLATES
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Softwood cuttings of lowbush blueberry clones NB-3 and ME-3 were rooted in perlite/perlite/vermiculite inoculated with one of three isolates of known ericoid mycorrhizal fungi or not biologically inoculated. Inoculants were Hymenoscyphus ericae from British heather, the same species isolated from Maine lowbush blueberry and Scytaliurn vaccinii, a species that has been shown to colonize Vaccinium angustifolium avidly in arctic culture. Inoculation did not affect
yield. Fruit yields of triazole-treated 'Triple Red' trees were greater than the TC control and equal to the budded control.

EFFECTIVENESS OF READILY AVAILABLE ADHESIVE TAPES AS GRAFTING WRAPS

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The objective of this study was to determine the effectiveness of electrical tape and duct tape as grafting wraps. Dormant scion of Golden Delicious apple (Malus domestica Borkh.) were whip grafted in April, to actively growing Antanovka seedling rootstock. Materials used to wrap the graft union included nurseryman's adhesive tape, masking tape, electrical tape, duct tape and polyethylene strips. A total of 15 grafts were wrapped with each material. All the grafts were successful, indicating that none of the materials had any deleterious effects. There were no significant differences in various wrapping materials on the stem caliper measured at the end of the growing season. The growth of the shoot (whip) by the end of the season was largest in trees where graft unions were wrapped with polyethylene strips and smallest in those with masking tape. The differences between the various wraps, however, were not large. The results show that electrical tape and duct tape are economical and readily available material for wrapping graft unions, especially for homeowners and hobbyists.

GROWTH REGULATOR EFFECTS ON SELF-ROOTED TISSUE-CULTURED APPLE TREES

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Tissue culture (TC) propagated 'Triple Red Delicious' and 'Gala' apple trees grown 1.8 m apart were treated during the 3rd, 4th and 5th growing seasons with plant growth regulators (PGRs) via spray, trunk drench and trunk paint methods to control tree size and induce early flowering. AlarFibrel spray had little effect on tree size (canopy volume), flowering or yield. Tree size of both cvs. was reduced the 4th and 5th years by triazole (Cultar and Prunit) sprays and trunk drenches. The triazole sprays had little effect on flowering and fruiting of 'Gala' but they increased 'Triple Red' fruit no. and yield the 5th season without increasing flower no. and with no fruit size reduction. Triazole trunk drenches increased 'Triple Red' yield the 4th and 5th seasons but reduced 'Gala' yield the 5th season without affecting flower no. Prunit trunk paint applied the 3rd year increased flower and fruit no. and yield of 'Triple Red' the 5th season but reduced fruit size. This treatment reduced 'Gala' yield. Fruit yields of triazole-treated 'Triple Red' trees were greater than the TC control and equal to the budded control.