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Ornamentals & Turf

GROUND STEMS OF KENAF (*Hibiscus cannabinus* L.) AS A BULKING COMPONENT IN GREENHOUSE GROWTH MEDIA
Wallace Pill and Bing Shi, Plant and Soil Sciences, University of Delaware, Newark, DE 19717-1303

Kenaf stems were ground and sieved to yield fine (<2mm), medium (2 to 6 mm) or coarse (6 to 12 mm) grades. These grades were mixed at 25, 50 or 75% volumes in sphagnum peatmoss and then provided standard basal fertilization. Tomato and impatiens shoot fresh weights 4 weeks after transplanting (50 mg N.liter⁻¹ daily liquid feed) were greatest in 25% medium kenaf, being 68 and 89%, respectively, those in peat-lite (ProMix BX). In a further study, medium kenaf was soaked for 3 days in 5000, 10000 or 15000 mg N.liter⁻¹ from 20N-4.3P-8.6K then mixed at 25% volume in peatmoss. Tomato seedlings transplanted into these media were provided 0, 100, 300 or 500 mg N.liter⁻¹ daily liquid feed (LF) from 20N-4.3P-8.6K. With ≥ 100 mg N.liter⁻¹ LF, soak solution concentration had no effect on shoot fresh weight. With 0 mg N.liter⁻¹ LF however, kenaf media soaked in 10000 or 15000 mg N.liter⁻¹ yielded greater shoot fresh weights than ProMix with 100 mg N.liter⁻¹ LF.

MINERAL ORE CO-PRODUCT (IRON OXIDE) AS A GROWTH MEDIUM COMPONENT

Garrett Goyette and Wallace Pill, Plant and Soil Sciences, University of Delaware, Newark, DE 19717-1303.

The utility of Ironrich (IR), a tertiary mineral co-product from TiO₂ production, as a growth medium component was investigated. All complementary bulking components (10 to 50% volume) gave reduced shoot fresh weights of tomato, impatiens or perennial ryegrass relative to Fairgrow (FG, co-composted solid waste and sewage sludge). Shoot fresh weights of impatiens and tomato grown in 50% IR with FG were similar to those grown in commercial peat-lites. When provided 200 mg N litre⁻¹ daily, chard shoot fresh weights, beet root fresh weights, and tomato fruit fresh weights from plants grown in 50% IR plus 50% FG were not significantly different from those grown in 50% silt loam plus 50% FG. Tissue Cd, Cr, Ni, and Pb concentrations from plants grown in 50% combinations of FG with IR or silt loam were below the limits of detection. IR plus FG with N-P-K fertilization provided a satisfactory greenhouse growth medium. We project that IR + FG will constitute a satisfactory synthetic topsoil.

WILDFLOWER MEADOW ESTABLISHMENT IN MEDIA PREPARED FROM MINERAL ORE CO-PRODUCT AND COCOMPOSTED SOLID WASTE PLUS SEWAGE SLUDGE

David Devenney, John Frett, Wallace Pill, and Gary Smith, Plant and Soil Sciences, University of Delaware, Newark, DE 19717-1303

Ten 10 wildflower species grew satisfactorily in a 1:1 (vol.) mix of Ironrich (IR, mineral co-product of the titanium dioxide industry) and Fairgrow (FG, co-composted sewage sludge and solid waste). Shoot fresh weights in the low fertility IR and in the high fertility FG averaged 35% and 157%, respectively, those grown in IR+FG. Wildflower establishment in 10cm-deep outdoor seedbeds of IR, FG, or IR+FG were compared to those in soil (control) plots. Maximum percentage seedling emergence and emergence rate and synchrony were lower in FG than in IR, values in IR+FG being intermediate and similar to those for control plots. Shoot fresh weights, however, were greater from the IR+FG than from IR, FG or the control plots. Total shoot dry weights of wildflowers from 1 m² subplots after 3 months were FG > IR = IR+FG > control, being respectively 8.4, 8.5, 5.1 and 1.1% those of total shoot dry weights of weeds.

PELLETIZED SEWAGE SLUDGE AS A TURFGRASS FERTILIZER.

S. A. Mackintosh and R. J. Cooper, Department of Plant and Soil Sciences, University of Massachusetts, Amherst, MA 01003

Environmental concerns associated with traditional methods of sludge disposal have spurred research exploring alternate avenues of disposal. A potentially significant alternative is the beneficial use of sludge as a turfgrass fertilizer. Studies were initiated during 1991 to compare a commercially available pelletized sludge to urea; 12-4-6; Ringer Lawn Restore; and Milorganite. Fertilizers were evaluated for their effect on turfgrass quality, color, and growth rate. Treatments were applied to a stand composed of 65% Kentucky bluegrass (*Poa pratensis* L. 'Baron') and 35% Perennial ryegrass (*Lolium perenne* L. 'Manhattan II') in South Deerfield, MA. Urea and 12-4-6 were applied at 49 kg N ha⁻¹. Ringer Lawn Restore and Milorganite were applied at 98 kg N ha⁻¹. Pelletized sludge was applied at 98, 196, 294, and 392 kg N ha⁻¹ with all rates providing acceptable to good turfgrass color throughout the season. Rates of 294 or 392 kg seldom provided quality better than the 196 kg rate. While urea initially produced quality superior to pelletized sludge, all rates of sludge resulted in quality equal to or better than urea beginning one month after application and lasting approximately 11 weeks. Turf receiving similar rates of either pelletized sludge or Milorganite performed similarly. No sludge application rate produced burning or foliar discoloration. Clipping production was directly related to sludge application rate. Pelletized sludge applied at 98 kg N ha⁻¹ resulted in growth comparable to similar applications of Ringer Lawn Restore and Milorganite. In summary, using pelletized sewage sludge as a turfgrass fertilizer promotes healthy turfgrass while creating an alternate avenue of sludge disposal.

MINERAL NUTRITION OF RED SPRUCE SEEDLINGS IN AN ACIDIC FOREST SOIL

Baerbel Hoelldampf and Allen V. Barker, Plant and Soil Sciences, Univ. of Mass., Bowditch Hall, Amherst, MA 01003.

Coniferous forest trees showing chlorosis and dieback appear to be deficient in Ca and Mg. These deficiencies may be induced by nitrogenous nutrients borne in the atmosphere. This study assessed the roles of nitrogen nutrition and soil on nutrient accumulation by red spruce (*Picea rubens*, Sarg.) and radishes (*Raphanus sativus*, L.). Plants were grown in the greenhouse in acid O or A horizons (Typic Haplorthod) collected from a red spruce forest. Plants were grown with a complete nutrient solution with 15 mM N of which NH₄ was 0,

3.75, 7.5, 11.25, or 15 mM with the remainder being NO₃⁻. After 120 days, the spruce needles became chlorotic with 11.25 or 15 mM NH₄⁺. Radishes exhibited NH₄⁺-toxicity after 28 days. Radishes were larger in the 0 horizon than in the A horizon. As NH₄⁺ was increased, radishes had lesser dry weights and accumulated less foliar Ca. Foliar Ca also was lower in spruce with the higher NH₄⁺. Magnesium concentrations in leaves of red spruce and radishes were not affected significantly by increasing NH₄⁺ supply. Radishes are suitable indicator plants to study the effect of nitrogen form on mineral nutrition of spruce because each species responded similarly to the treatments.

Fruit Crops

LATE PLANTING OF STRAWBERRIES IN THE HILL SYSTEM USING PLUG OR DORMANT BARE ROOT PLANTS

M.J. Lareau* and M. Lamarre, Agriculture Canada, St-Jean-sur-Richelieu, Quebec, Canada, J3B 3E6.

Plug or bare root strawberry plants were planted on raised beds with black plastic mulch from mid-June to early-August. The early plantings gave the most developed and productive plants but these required several derunnerings to avoid overcrowding. Due to the unavailability of runners, it was not possible to establish plug plants before mid-July. Field losses of dormant bare root plants were high for the July planting. The use of a perforated polyethylene rowcover from October to May increased yield and fruit size.

EFFECTS OF WEED CONTROL METHOD ON GROWTH, YIELD AND FRUIT QUALITY OF 'MCINTOSH' APPLE TREES.

John J. McCue* and James R. Schupp, Highmoor Farm, Dept. of Plant, Soil and Environmental Sci., Univ. of Maine, Monmouth, Maine 04259

The growth and fruiting of 10-year-old 'McIntosh'/'M.7 apple trees were compared under the following weed management systems: 1) untreated control; 2) herbicide spray (paraquat + oryzalin); 3) rotary tilling applied in May, June and July; 4) rotary tilling plus herbicide (oryzalin); 5) rotary tilling plus oats sown in August. All weed control methods increased tree growth compared to the untreated control over three years. Yield and fruit size were increased by the herbicide and the rotary tilled treatment. Rotary tilling plus herbicide increased yield but fruit size was larger than controls in 1990 only. Rotary tilling plus oats produced yield and fruit size equivalent to the control. In 1989 and 1990 rotary tilling alone provided less weed control compared to the herbicide treatment, while in July 1991, the reverse was true. Rotary tilling with herbicide and with oats have demonstrated weed control comparable to or better than the herbicide treatment except for the rotary tilled plus oats treatment in 1990. There were no differences among treatments in fruit color, maturity and percent soluble solids.

PREHARVEST CONDITIONS, ENDOGENOUS ANTIOXIDANTS AND SCALD DEVELOPMENT

Cynthia L. Barden* and William J. Bramlage, Dept. of Plant and Soil Sciences, Univ. of Massachusetts, Amherst, MA 01003

During the harvest season apples ripen and develop scald resistance. In the Northeast they usually are also exposed to cool temperatures as they mature and ripen. Experiments were conducted to study the effects of cool temperature, light and maturity on the endogenous antioxidants and subsequent scald development in Cortland and Delicious apples. Total lipid-soluble antioxidant activity in apple peel at harvest generally increased as scald incidence after storage decreased. Yet, α tocopherol, ascorbic acid and total water-soluble reducing capacity were not closely related to scald development. The absence of light (bagged fruit) decreased all measured antioxidants and increased scald development. However, ethephon applied in mid-August to induce ripening increased the levels of these antioxidants but had little effect on scald incidence in the absence of cool temperatures (hours <10°C). Cool temperatures, which decreased scald

susceptibility, increased lipid-soluble antioxidant activity but had little influence on the other measured antioxidants. These data suggest that the endogenous antioxidants may be only partly responsible for natural scald resistance.

CHARACTERISTICS OF UV ABSORBANCE BY HEXANE EXTRACTS OF APPLE SURFACES SUGGEST A MODIFIED HYPOTHESIS ON THE ROLE OF CONJUGATED TRIENES IN SCALD DEVELOPMENT ON APPLES

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

Much correlative data support the hypothesis that superficial scald on apples results from oxidation of α farnesene to conjugated trienes (CT) in the coating of apples. However, these associations are poorly defined both chemically and physiologically. α Farnesene and CT are measured as OD 232 and OD 281-290, respectively, of a hexane extract of the fruit surface. During assays, we observed anomalies in absorbance characteristics of extracts from fruit with different scald potentials, particularly in the region of 258 nm. Results suggest that absorbance near 258 nm might represent a metabolite of CT, which may be further metabolized. It appeared that under different conditions, CT metabolism could be altered, resulting in changed ratios of OD 258/OD 281. Higher ratios correlated with lower scald development, regardless of CT concentration. Thus, CT metabolism, rather than its concentration, may determine if scald occurs.

SAMPLING METHOD AFFECTS MINERAL ANALYSES OF DELICIOUS APPLE FRUIT

Sarah A. Weis* and William J. Bramlage, Plant and Soil Sciences, Univ. of Massachusetts, Bowditch Hall, Amherst, MA 01003

Fifty four trees in a block of 'Sturdeespur' Delicious on M.106 rootstock were given soil applications of various combinations of boron and gypsum. Twenty 2.9 to 3.0 inch diameter fruit and 20 unsized randomly chosen fruit were separately weighed and analyzed for Ca, Mg, K, and B concentrations. The coefficient of variation among fruit weights was greater for unsized than sized samples. Analyses of variance showed similar treatment effects for the two sampling methods. However, by using both sized and unsized fruit, effects of treatment on fruit size, and effects of relationships between fruit size and fruit mineral concentration may be separated.

STRAWBERRY FRUIT MALFORMATION AS A RESULT OF FROST INJURY

David T. Handley*, University of Maine, P.O. Box 179, Monmouth, ME 04259

Frost injury on strawberry flowers (cv. Redchief) was studied in a field over two seasons. During the first season, a light frost during anthesis caused varying degrees of injury to blossoms. Five grades were assigned to the blossoms according to the degree of injury observed. The resulting fruit malformations correlated to the severity of blossom injury, ranging from no development (blossom death) when flower receptacles were completely black, to slight dimpling when only a portion of the receptacle had been discolored. During the second season, a colder frost occurring at the bud stage caused generally greater injury to the blossoms. The range of injury was less variable, therefore only three grades were assigned to the blossoms. The resulting fruit malformation again related to the intensity of blossom injury. Frost has long been understood to kill unprotected strawberry blossoms. This study has shown that nonfatal frost injury to strawberry blossoms can result in a variety of fruit malformations which previously may have been attributed to other causes.

ESTIMATING FERTILIZER NEEDS FOR LOWBUSH BLUEBERRIES: LEAF OR SOIL SAMPLES?

John M. Smagula, Plant, Soil, and Environmental Sciences, University of Maine, Orono, ME 04469.

Concentrations of nutrient elements in randomly selected soil samples taken at a 3-inch depth or the depth of the surface organic pad correlated poorly ($R^2 = < 0.34$) with leaf nutrient concentrations randomly selected from the same fields. Average leaf N concentrations in 74 of 79 fields sampled were above the 1.6% standard, while leaf P was below the 0.125% standard in 62 of the 79 fields. Leaf K, Ca, and Mg concentrations were above the standards 0.400%, 0.270%, and 0.130%, respectively in all fields. The average depth of the organic pad was 2.23 cm, ranging from 0 to 10.16 cm. Seventy five percent of the fields had organic pads 0.127-2.54 cm thick and 20% greater than 2.54 cm.

In an attempt to improve correlations, leaves within a 0.01M² quadrat were sampled from 110 clones in 10 commercial blueberry fields and leaf nutrient concentrations compared with nutrient concentrations in 3-inch soil samples taken directly beneath the quadrat. The strongest correlation was between soil Mn and leaf Mn ($r^2 = 0.59$). Leaf samples, although more expensive than soil samples, appear to be a better indicator of lowbush blueberry fertilizer requirements than soil samples.

USING PREHARVEST TEMPERATURES TO PREDICT SCALD DEVELOPMENT ON APPLES IN NEW ENGLAND AND NEW ZEALAND

William J. Bramlage*, Department of Plant and Soil Sciences, University of Massachusetts, Amherst, MA 01003, and Christopher B. Watkins, D.S.I.R., Fruit and Trees, Mt. Albert Research Centre, Auckland, New Zealand

Preharvest temperature (hrs. below 10°C) is a predictor of scald development on North American apples after long-term storage. In Mass., these variables are highly negatively correlated for both 'Delicious' and 'Cortland' apples. However, this predictor was not generally applicable for scald development on 'Delicious' or 'Granny Smith' apples in New Zealand. There, the relationship between temperature and scald varied greatly among districts for both cultivars, with scald resistance often occurring with far fewer hrs. below 10° than in Mass. Yet, in two cases when the temperature : scald relationship for 'Granny Smith' was similar to that for 'Cortland' and 'Delicious' in Mass., temperature patterns during fruit ripening were similar to that in Mass. In all other cases, more moderate temperature changes occurred. These results suggest that the true base temperature for developing resistance to scald may be between 10° and 15°C, rather than 10°.

INFLUENCE OF CANOPY POSITION ON CHROMATICITY OF PEACH FRUIT.

Bernard B. Bible* and S. Singha, Department of Plant Science, University of Connecticut, Storrs, CT 06269

The objective of this study was to determine the difference in color development between exposed and shaded fruit of 'Loring' and 'Raritan Rose' peach (*Prunus persica* L. Batsch). Chromaticity values ($L^* a^* b^*$) were measured with a Minolta CR-200b colorimeter on 10 tagged fruit on each of 3 trees of each cultivar. Five fruit were fully exposed to sunlight and 5 were shaded. Measurements were made on each fruit from July 17, 1991 through harvest. Differences in the a^*/b^* ratio between shaded and exposed fruit were observed at the first sampling date and increased towards maturation; shaded fruit approached a^*/b^* values similar to exposed fruit at a significantly later time. Shading reduced relative fruit color development more in 'Loring' than in 'Raritan Rose'.

PROMISING PROCESSING APPLE CULTIVARS FOR THE MID-ATLANTIC AREA

George M. Greene, Department of Horticulture, The Penn State Univ., Fruit Research Laboratory, Biglerville PA 17307-0309

The Mid-Atlantic area has a long, warm growing season and a reputation for grainy or firm, yellow apple products. There is interest in varieties that are large, firm, yellow-fleshed, that store and process well. The attributes of four NY selections, grown in PA, are described. NY 179 (Loop Red Rome X Yorking) fruit firmness (FF) dropped from 9 to 8.5 kg from 270 to 300 Julian days (JD). Over this same period, soluble solids (SS) rose from 13-15%. At 270 JD dropped fruit (DF) ranged from 0-5% while at 300 JD they ranged from 0-10%. Mean fruit weight was 285 g. NY 180 (Loop Red Rome X Yorking) averaged 351 g and FF was similar to NY 179. From 270 to 300 JD SS rose from 12-15%. Dropped fruit rose from 0-10% at 270 JD to 35% by 285 JD but to 95% by 300 JD. NY 88 (Melrose X Monroe) had a FF of 8.5 kg at 255 JD which decreased to about 7.5 kg at 300 JD. Over this same period SS rose from 13-14.5%. At 255 JD DF were 0%; they ranged from 0-10% at 300 JD and never exceeded 10%. NY 151 (Red Spy X Yorking) averaged 171 g. At 270 JD FF was 12 kg falling to 11 kg at 330 JD. Over this period SS rose from 11-16%. Drops increased from 0% at 270 JD to 10-20% at 330 JD. These selections are undergoing regular and CA storage and processing tests.

Cross-commodity

SURVEY OF FIELD EXPERIMENTS CONDUCTED TO ESTABLISH MEDICINAL CROPS IN QUEBEC

Nicolas Tremblay*, Marie-Hélène Michaud, René Crête and André Gosselin, Agriculture Canada Research Station, 430 Gouin Blvd, St-Jean-sur-Richelieu (Que.) J3B 3E6, Canada

With the increase in popularity of natural medicine there is an ever growing market for the production of medicinal plants. In the last decade, screening trials of a number of species were conducted. The species currently under study are: angelica (*Angelica archangelica*; biennial, roots harvested), thyme (*Thymus vulgaris*; perennial, shoot harvested), German chamomilla (*Matricaria recutita*; annual, flowers harvested), horehound (*Marrubium vulgare*; perennial, shoot harvested) and dandelion (*Taraxacum officinale*; considered as a biennial, roots harvested). In 1990 the species were grown on three soil types (clay-loam, sandy loam and histosol) with different fertilization and irrigation practices. In 1991 two distinct trials were undertaken. The first considered herbicide efficiency and planting density. The second dealt with organic management strategies. Depending on the species, treatments of compost amendment, plastic mulch and implantation techniques were compared.

CLONING AND EXPRESSION OF THE IPT GENE

Sandra L. Barbour*, D.A. Schaff and J.J. Frett, Department of Plant and Soil Sciences, University of Delaware, Newark, Delaware, 19717

Cytokinins are involved in *in vitro* shoot initiation, although little is known about their mode of action. As the first step in localizing cytokinin synthesis, we present a cloning and expression strategy for the isopentenyl transferase (*ipt*) gene. The source of the *Agrobacterium tumefaciens ipt* gene was a 7.2 kb *Eco* RI fragment isolated from pBREF7 (Dr. Ann Smigocki, USDA, Beltsville, MD). The *ipt* gene was amplified by polymerase chain reaction (PCR) and cloned into pMAL-cRI (New England Biolabs, Beverly, MA). Using the pMAL-cRI expression and purification system, the isopentenyl transferase protein will be purified for antibody production. These antibodies will be used in future work to localize the isopentenyl transferase enzyme.

APRT SELECTION SYSTEM IN PLANTS

Sunita K. Agarwal*, David J. Schultz and Dennis A. Schaff, Plant and Soil Sciences, Univ. of Delaware, Newark, DE 19717-1303.

Most cells have an active turnover of many of their nucleic acids (particularly some types of RNA) which through degradative processes result in the release of adenine, guanine and hypoxanthine. These free purines are converted to their corresponding nucleotides through salvage pathways. Adenine is converted to its nucleotide form AMP by Adenine phosphoribosyltransferase (APRT) which is one of the enzymes associated with the purine salvage pathway. Since all organisms have a *de novo* pathway for the formation of AMP, APRT is classified as a 'salvage enzyme'. The APRT enzyme, in general, does not show a high degree of specificity for the exact structure of adenine and can also act on cytokinins and adenine derivatives like 2,6-diaminopurine, 2-fluoroadenine and 6-methylpurine. The APRT enzyme can utilize adenine analogues as substrate and convert them into their nucleotide forms which are toxic. Plants that lack APRT activity (APRT⁻ plants) survive in the presence of these analogues. The amount of adenine analogue used for selecting APRT⁻ plants is such that it kills all APRT⁺ (wild type) plants. APRT⁺ plants survive when grown in the presence of azaserine and alanosine that block *de novo* synthesis of AMP. APRT⁻ plants transformed with the wild type cloned gene can be selected from a mixture of transformed and non-transformed plants by selecting in the presence of adenine, azaserine and alanosine. The presence of APRT activity can be confirmed by assaying for the APRT enzyme. APRT activity has been detected in many plant species. The presence of a positive forward and backward selection system can thus allow the use of APRT as a selectable marker in plant gene transfer systems.

APRT EXPRESSION IN PLANTS

David J. Schultz*, Sunita K. Agarwal, and Dennis A. Schaff, Plant and Soil Sciences, Univ. of Delaware, Newark, DE 19717-1303.

Adenine Phosphoribosyltransferase (APRT, EC 2.4.2.7) is an enzyme in the adenine salvage pathway. This enzyme is a catalyst for the conversion of adenine and phosphoribosyl pyrophosphate (PRPP) to adenosine monophosphate (AMP) and inorganic phosphate (PP_i). We are using the APRT gene to develop a gene transfer selection system in plants because the APRT gene has been shown to be expressed in numerous plant families, the gene is small (approximately 3 kilobases), the enzyme pathway is well characterized, and positive selection systems are readily available for the presence or absence of the functional APRT protein. Additionally, an APRT assay system has been worked out

for the detection of the protein product. In order to develop a gene transfer selection system, we are currently isolating the APRT cDNA clone from *Glycine max* L. (Soybean). The initial step of this research was to show what tissues of soybean the enzyme activity is found in by using the APRT assay. This assay showed that the enzyme is being expressed in the embryo, radicle, and developing seeds. Furthermore, the assay showed that there is no APRT activity found in immature or mature leaves of soybean. This may be due to an inhibitor in the leaf crude extract. When crude extracts of leaves and developing seeds are mixed in equal volumes, no APRT activity was detected in contrast to the half activity of developing seeds which was expected. Currently, our research has focused on isolating a fragment of the APRT gene from genomic DNA using the polymerase chain reaction (PCR). This fragment will then be used to isolate the cDNA clone from a Lambda Zap II cDNA library made from developing seeds.

THE SEARCH FOR IMPROVED LIMA BEANS YIELDS: A STARTING POINT Tracy Wootten, University of Delaware, Georgetown, DE 19947

Delaware lima bean yields have averaged 1700 lbs per acre for the last 30 years. California averages 3500-4000 lbs per acre. Varieties M-15 and 1072 are used by both states for production. In an effort to increase lima bean yields in Delaware, the evaluation of the effect of weather events on plant development, the relationship of ethylene and abscission of reproductive structures, and the comparison of both California and Delaware lima bean production is being conducted. Preliminary observations of 1991 data show a difference in plant size and population between the two states. Although pods per plant are the same in both states, the number of pods per acre is greater in California. California yielded 4303 lbs. per acre and Delaware 1651 lbs. per acre. The average maximum and minimum temperatures in California was 92.7 and 60.7 degrees Fahrenheit respectively compared to 83.1 degrees and 61.2 degrees Fahrenheit in Delaware.

DISTORTED MENDELIAN INHERITANCE OF THE FUSED VEIN TRAIT IN *CUCURBITA PEPO* L.: A CASE FOR GAMETIC SELECTION

R. Bruce Carle* and J. Brent Loy, Department of Plant Biology, University of New Hampshire, Durham, NH 03824

The recessive leaf trait, fused vein (fv), in *Cucurbita pepo* L. is expressed by the sixth leaf stage and then throughout vegetative growth. It is characterized by the partial fusion of the lateral leaf veins to the main central vein. Consequently, the dorsal leaf surface is distinctively puckered. Use of fv as a genetic marker in hull-less seeded pumpkin lines is hampered, however, by a low recovery of fv plants in segregating populations. Homogeneity Chi Square analysis of 11 F₂ (3:1 X² = 72.05 P < 0.005) and 16 BC (1:1 X² = 120.12 P < 0.005) populations indicated significant heterogeneity between populations for fv recovery. Recovery ranged from 0 to 35.5% for 11 F₂ populations and from 6.8 to 75.4% for 16 BC populations. There was a significant reduction, 35%, in seed yield/fruit when fv pollen was used to hand pollinate fv, normal (N), and F₁ flowers as compared to pollinations with N pollen. In pollen competition studies, reduced competition at low levels of F₁ or 50:50 fv/N pollen increased fv recovery in F₂ and BC populations. These results are consistent with the hypothesis that the fv trait confers gametic subvitality resulting in distorted Mendelian segregation.

CHARACTERIZATION OF SEGREGATING POTATO PROGENIES FOR TUBERIZATION RESPONSE TO PHOTOPERIOD IN CONNECTION WITH GENETIC MAPPING.

J.H. van den Berg¹, M.W. Bonierbale², E.E. Fwing¹, R.L. Plaisted², and S.D. Tanksley², ¹Dept. of Fruit & Vegetable Science, and ²Dept. of Plant Breeding & Biometry, Cornell University, Ithaca, N.Y. 14853.

Tuberization and stolonization of cuttings were used as a model system to assess response to photoperiod in segregating potato progenies. The progenies were from backcrosses of a diploid hybrid between *Solanum tuberosum* and the short day requiring *S. berthaultii* to both parent species. Restriction Fragment Length Polymorphism (RFLP) analyses had been performed on these progenies as a part of other investigations. The RFLP maps were used to identify the loci controlling the photoperiod responses characterized by the cuttings. In the *S. berthaultii* backcross population, one locus appeared to control the response of cuttings only under long photoperiods, and coincided with a locus detected for stolonization on whole plants; a second locus was effective for tuberization under short photoperiods but was not detected with certainty under long photoperiods. Data analysis for the second backcross population is currently underway.

Vegetable Crops

EARLIER VEGETABLE CROPS WITH NEAR INFRA-RED TRANSMITTING MULCH

Brent Loy* and Otho Wells, Plant Biology Department, University of New Hampshire, Durham, NH 03824

Near infra-red (NIR)-transmitting plastic mulches transmit between 30 to 50% of the total solar energy to the soil, but block most photosynthetically active radiation (PAR). These mulches warm the soil more effectively than black plastic, but less effectively than clear mulch. Weed growth under NIR-transmitting mulches is suppressed through a combination of lowered light intensity and high temperatures under the mulch surface. With bell pepper and melons, IRT-76, a blue green, NIR-transmitting mulch, enhances growth to about the same extent as black mulch plus a floating rowcover. In turn, rowcover performance is enhanced by IRT-76 as compared to black mulch. In melons, early yield is about doubled and total yields increased by 20 to 30% with IRT-76 as compared to black mulch. Pepper yields are generally higher with IRT-76 as compared to black mulch, but the yield response to IRT-76 is less consistent than with melon.

CULTURAL PRACTICE ADAPTATION FOR MECHANICALLY HARVEST PICKLING CUCUMBERS

Ed Kee, University of Delaware, Georgetown, DE 19947

Mechanically harvested pickling cucumbers are a once-over destructive harvest system. Gynocious hybrids are planted at high populations to obtain high yields and to concentrate maturity. Population, row width, plant spacing, and uniform emergence all affect yield and maturity.

65,000 plants/acre in 26 inch rows were found to optimize yield and provide the highest percentage of fruit at the desired uniform size.

WINTER-KILLED LEGUMINOUS COVER CROPS FOR SWEET CORN

Francis X. Mangan* and Stephen J. Herbert, Dept. Plant and Soil Sciences, Bowditch Hall, University of Mass. Amherst, Mass. 01003

Field research was conducted in Deerfield, Mass. to study the effects of leguminous cover crops on sweet corn yield. Oat was planted alone and in combination with four leguminous cover crops August 8, 1990. Cover crop residue was disked once and sweet corn seeded April 23, 1991. Each cover crop combination had three rates of nitrogen added in two applications. Sweet corn seeded into stands of hairy vetch (*Vicia villosa*) yielded the highest of the cover crop combinations. All leguminous cover crop treatments yielded higher than oat alone or no cover crop when no synthetic nitrogen was added. Cover crop combinations were seeded again in the same field plots August 12, 1991. Oat biomass in November was greater where there had been leguminous cover crops or high rates of synthetic nitrogen. Legume growth was retarded in the plots that had previously received high nitrogen. It is thought that legume growth was reduced in the high nitrogen treatments due to increased oat growth and higher soil nitrogen levels which could inhibit root nodulation.

PREDICTING OPTIMUM PACKAGING CONDITIONS FOR MODIFIED ATMOSPHERE PACKAGES OF TOMATOES

Sannai Gong* and Kenneth A. Corey, Department of Plant and Soil Sciences, University of Massachusetts, Amherst, MA 01003

Procedures for predicting optimum packaging conditions of modified atmosphere packages (MAP) of tomato ('Heinz 1370') were developed. The relationship between O₂ consumption rate and O₂ concn (RR_{O₂}) was determined using O₂ depletion data collected by enclosing tomatoes in jars and sampling head space O₂ concn over time. The fitted function was then used in conjunction with other input variables: (1) film permeability to O₂ (P_{O₂}), (2) film surface area (A), and (3) fruit weight in packages (W_p) to develop the final predictive equation based on Fick's law of gas diffusion. Predictive power of the equation was tested by comparing the steady state O₂ concn achieved experimentally with those predicted for a wide range of packaging conditions. Packaging conditions included film surface area, weight of fruit in packages, and O₂ permeability of the film (0.0426 and 0.0620 ml/kg hr). Prediction curves showing steady state O₂ concn vs. packaging ratio (A/W_p) closely resembled the best fit curves of data. The effect of

temperature on steady state O₂ concn in MA bags was also examined. Increasing temperature from 20°C to 28±2°C had little effect but decreasing temperature to 10°C led to higher in-package O₂ concn. Results indicate that predictive equations can be used to select appropriate films and optimize packaging ratios to achieve desired steady state O₂ concn for MAP of tomatoes.

EFFECT OF ANTI-GIBBERELLIN GROWTH RETARDANTS ON TUBERIZATION OF 'KATAHDIN' POTATO LEAF BUD CUTTINGS.

Alan R. Langille* and P.R. Hepler, Department of Plant, Soil, and Environmental Sciences, Deering Hall, University of Maine, Orono, ME 04469.

Non-induced Katahdin potato plants were treated with three anti-gibberellins: CCC, BAS-106 and BAS-111. Other plants were sprayed with GA₃ and placed in an inducing chamber. All treatments were repeated the following week. After final treatment, apical, sub-apical, medial and basal leaf bud-cuttings were taken from each plant and placed in a mist chamber. After two weeks, cuttings were examined for tuberization. BAS-111 and CCC were associated with 3.5 and 2 fold increase, respectively, in tuberization of cuttings over the non-induced control. Although induced control cuttings exhibited 100% tuberization, application of GA to plants grown under identical conditions, reduced tuberization 20 fold. In non-induced control cuttings and those treated with CCC, basal cuttings tuberized significantly better than those taken from higher on the stem. This pattern was reversed for plants treated with BAS-111. These results will be discussed in light of current understanding of the tuberization phenomenon.

Posters

HOREHOUND (*Marrubium vulgare* L.) PRODUCTION IN NORTHERN AMERICA: RESPONSES TO MULCH, SHADING, AND NITROGEN TREATMENT

Z.Y. Mao and Lyle E. Craker, Department of Plant and Soil Sciences, University of Massachusetts, Amherst, MA 01003

Mulch, light level, and nitrogen fertilization were tested for their effects on productivity of horehound (*Marrubium vulgare* L.). Yield of this plant increased under mulched conditions and with the addition of nitrogen fertilizer. Yield decreased with reduced light levels. Productivity of individual plants correlated with the number of branches per plant, leaf size, and leaf chlorophyll content. The number of branches per plant decreased with increased shading, but increased with increased nitrogen fertilization. The influence of mulch and shading on productivity could be due to the changes in soil temperature and in soil water potentials. Full-sun, high nitrogen, and mulch are suggested for optimum field production of horehound.

EFFECTS OF SEVERAL GROWTH CONTROLLING TECHNIQUES ON APPLE TREES

Wesley R. Autio* and Duane W. Greene, Department of Plant & Soil Sciences, University of Massachusetts, Amherst, MA 01003

In 1991, experiments were conducted to assess the effects of several growth controlling techniques on tree growth and fruit set, abscission, ripening, and other qualities. The first two experiments assessed the effects of root pruning (4-8 days after petal fall, 1 m from the trunk, 30 cm deep) in commercial orchards. Compared to controls, root pruning reduced fruit abscission from mature 'Cortland'/M.7A trees by 70% on 17 Sept. In another orchard, root pruning reduced fruit abscission from mature 'McIntosh'/MM.106 trees by 47% on 24 Sept. The third experiment utilized vigorous 'Gardiner Delicious'/MM.106 trees. Treatments included root pruning (as described above), trunk scoring (single, complete circle, approximately 40 cm from the soil), trunk ringing (single, complete circle, 1 mm wide, approximately 40 cm from the soil), ethrel spray treatment (500 ppm), and dormant-pruned and unpruned controls. Treatments were applied on 15 May, when terminal growth was 12-15 cm. No treatment affected fruit set. Trunk growth was less for ringed and scored trees than other treatments. Ringing and scoring advanced ripening compared to controls, and ethrel resulted in intermediate ripening. Treatments had no effect on fruit size, flesh firmness, or the development of bitter pit and cork spot. Fruit abscission was least from controls and root-pruned trees. Trees that were treated with ethrel in May had the most rapid abscission rate.

METHOD FOR MEASUREMENT OF GAS PERMEABILITY OF POLYMERIC FILMS

Sannai Gong* and Kenneth A. Corey, Department of Plant and Soil Sciences, University of Massachusetts, Amherst, MA 01003

A rapid steady state method for measurement of gas permeability of polymeric films was developed. Films were sealed between two equal volume chambers with pure O₂ and pure N₂ flowing through opposite sides. Oxygen concentration in the N₂ cell was measured over time until steady state was reached. The method was used to determine oxygen permeability of two different films. Results from four replications on each film indicated excellent repeatability with coefficients of variation less than 3%. The time required to reach steady state oxygen concentration was dependent upon film type, flow rate, and temperature. The higher the N₂ flow rate the shorter the time to reach steady state O₂ concentrations. The slowest measurement at the lowest flow rate of 27 ml/min took less than 3 hours to collect the data necessary to achieve steady state. Increasing temperature from 10°C to 20°C resulted in an approximately 40% increase in O₂ permeability for both films tested. The technique will be a valuable tool for measuring permeabilities of new films and the same film at different temperatures, and for selecting the appropriate material for modified atmosphere packaging of fresh produce.

GROWTH AND FRUITING OF 'DELICIOUS' APPLE ON CLONAL ROOTSTOCKS IN THE 1984 NC-140 PLANTING IN MAINE

James R. Schupp*, Department of Plant, Soil and Environmental Sciences, University of Maine, Highmoor Farm, Monmouth, ME 04259

In 1984 trees of 'Starkspur Supreme Delicious' apple (*Malus domestica*, Borkh) on 16 rootstocks were planted at 32 sites in North America according to guidelines established for cooperative testing by the North Central Regional Cooperative Project (NC-140). Tree loss and root suckering in the Maine planting have been low, similar to that of other sites. Tree size in Maine is smallest among all sites after eight seasons. Trees on Budagovsky 9 (B.9) rootstock were the most precocious, producing significantly higher flower numbers and yield in the third year. Other precocious rootstocks in this planting included C.6, M.26EMLA, M.7EMLA and P.1. After eight years, B.9, C.6 and M.26EMLA were the most productive among the dwarf trees. P.1 and M.7EMLA were the most productive among the more vigorous stocks. Heavy cropping trees on dwarf rootstocks leaned more due to hurricane winds than larger better anchored trees which lost a larger proportion of their crop. B.9, C.6 and P.1 may have potential as rootstocks for commercial apple orchards in New England.

SPRING FERTILIZATION OF WINTER INJURED STRAWBERRY PLANTS

Bertie Boyce* and David Heleha, Department of Plant and Soil Science, University of Vermont, Burlington, VT 05405

Winter injury in 'Midway' strawberry plants was brought about by not mulching with grain straw in the fall. Minimum crown temperatures in these plants was -7.3C compared to a winter minimum crown temperature of -5.1C when plants were mulched. This 2.2C colder plant temperatures resulted in injury as evidenced by a significant reduction in yield (20%), smaller fruits, reduced vegetative growth and increased browning of the medulla tissues. No significant improvement in yield could be detected from the cold injured plants by the early application of 10-10-10 fertilizer at rates ranging from 0 to 2244 kg/ha. Vegetative growth was increased however.

SOLUBLE SALTS BUILDUP AS A CAUSE OF EARLY GROWTH SUPPRESSION OF NEW GUINEA IMPATIENS

Laura K. Judd* and Douglas A. Cox, Plant and Soil Sciences, Stockbridge Hall, University of Massachusetts, Amherst, MA 01003

To test the effect of soluble salts on the growth of New Guinea impatiens (*Impatiens platypetala*), 'Selenia' was grown for 70 days in a soilless medium and irrigated with solutions of 20N-4.3P-16.6K at rates of 0.5, 1.0, 1.5, or 2.0 g·liter⁻¹. A fifth treatment was no fertilization for the first 14 days, 0.5 g·liter⁻¹ for the next 14 days and 1.0 g·liter⁻¹ till finish. At 14-day intervals shoot dry weight and growth medium soluble salts were measured. By 42 days after planting, differences between treatments were statistically significant with respect to dry weight. Over a 70-day period, growth was greatest with 0.5 g·liter⁻¹. The 1.0 g·liter⁻¹ treatment caused a similar growth response. Plants in delay treatment responded similarly to 0.5 and 1.0 g·liter⁻¹. Higher rates, 1.5 and 2.0 g·liter⁻¹, caused growth suppression and resulted in soluble salts buildup in the growth medium. Soluble salts levels of 1.5 dS·m⁻¹ and above suppressed early growth. Results show that during the first 42-56 days of growth, New Guinea impatiens are sensitive to soluble salts and levels over 1.5 dS·m⁻¹ are cause for concern.

INFLUENCE OF CULTIVAR, PLANTING TECHNIQUE AND HARVEST DURATION ON ASPARAGUS YIELD
Darlene Wilcox-Lee and Daniel T. Drost, Cornell University, Dept of Fruit and Vegetable Science, Ithaca, NY 14853

Crowns and transplants of 'Martha Washington' (MW) and 'Jersey Prince' (JP) asparagus were planted in 1985. Plots were harvested for 0, 2, 4 weeks (traditional schedule); 1, 2, 6 weeks (moderate harvest pressure); or 2, 4, 8 weeks (severe harvest pressure) in 1986, 1987, and 1988, respectively. All plots were harvested for 8 weeks after 1988. An AOV was performed to test the main effects of cv, planting technique and harvest schedules and interactions on early and total season yield of large, medium-sized and total spears. MW produced a significantly higher yield of both early and total season large spears than JP in all years. Total yields did not differ between cvs. There was no significant effect of planting technique on yield in any year. Harvest schedules imposed in the first 3 years had significant long term effects on yield. Although severe harvest pressure produced larger yields than the other schedules in 1986-1988, from 1989-1991 yields were lowest in the severe harvest pressure plots. The traditional harvest schedule produced similar yields to the moderate pressure schedule. There were no consistent interactions between cultivar, planting technique and harvest schedule. These data indicate that a slightly more aggressive harvest schedule in the early years of an asparagus planting would not have long term detrimental effect on yield. However, severe cutting pressure can reduce yields compared to traditional cutting schedules for at least 3 years after initial harvest pressure treatment.

POLYAMINE ACCUMULATION BY TOMATO PLANTS UNDER NUTRITIONAL STRESS

Jinan Feng* and Allen V. Barker, Department of Plant and Soil Sciences, University of Massachusetts, Amherst, Massachusetts 01003

Polyamine accumulation is a response of plants to various environmental stresses. Polyamine accumulation was assessed in relation to ammonium accumulation and ethylene evolution in tomato (*Lycopersicon esculentum* Mill.) under nutritional stress. Nutritional stresses were imparted on plants grown in quartz sand culture under greenhouse conditions with NH_4 -based modified Hoagland's solution or with NO_3 -based solutions without P, K, Ca, or Mg. The plants receiving NH_4 nutrition were grown with or without 10^{-5} M (aminooxy)acetic acid (AOA) or 10^{-5} M silver thiosulfate (STS). Plants on nutrient deficient solution were grown with or without the AOA. When plants appeared with toxic or deficient symptoms, the new fully expanded leaves were collected and extracted by 5% perchloric acid for polyamine analyzes by HPLC. Plants receiving NH_4 -based nutrition had high putrescine and low spermidine concentrations. High spermidine and low putrescine concentrations occurred in plants receiving complete NO_3 -based nutrition. For plants receiving NH_4 -based nutrition, application of AOA suppressed accumulation of putrescine but had no effect on spermidine, and STS had no effect on polyamine accumulation. For plants receiving NO_3 -based nutrition without P, K, Ca, or Mg, the application of AOA restricted accumulation of putrescine and spermidine. High putrescine concentration was accompanied by high ammonium accumulation, high ethylene evolution, and stress-induced symptoms, indicating an association between polyamine accumulation and other stress-related phenomena.

GA_4 AND GA_7 INFLUENCE FLOWER BUD FORMATION AND RUSSET DEVELOPMENT ON APPLE

Duane W. Greene, Department of Plant and Soil Sciences, University of Massachusetts, Amherst, MA 01003

GA_{4+7} and GA_4 substantially reduced russetting of 'Golden Delicious' in four different years. There were indications that GA_4 was more effective than GA_{4+7} at reducing russetting. The influence of gibberellins on flowering was variable and not always related to crop load. GA_4 increased flowering in one experiment, had no influence in two experiments, and inhibited flowering in two experiments. GA_7 either inhibited flowering or had no effect. There were indications that GA_4 may partially reverse the inhibitory effect of GA_7 on flowering in some instances.

FALL FRUITING RASPBERRY PRODUCTION UNDER PLASTIC TUNNELS

Michel Lamarre and Michel J. Lareau, Agriculture Canada, L'Assomption, Québec, J0K 1G0

From 1988 to 1990, the fall fruiting raspberries Heritage, Perron Red, Autumn Bliss and 3413-12 were field evaluated under two cultural systems: conventional production and production under plastic tunnel. The plastic tunnel was in place over 4 rows from early September to late October without supplemental heating. Compared to the conventional system, the tunnel contributed to a lengthening of 1 to 4 weeks in the fruiting period 2 years out of 3. In spite of the higher day temperatures, the rate of fruit ripening was not increased

under the tunnel but fruit size was increased slightly. However, the latter did not translate in higher yield per day since fruit number decreased under the tunnel. Total yield increased only one year when the first killing frost occurred a full month before the second one. Generally, night temperatures were as low in the tunnel as those outside.

POLLUTION AND DEVELOPMENT OF TOMATO POLLEN

Yuan-Hai Zhang* and Lyle E. Craker, Department of Plant and Soil Sciences, University of Massachusetts, Amherst, MA 01003

Air pollution may play a role in gametophytic selection. To estimate whether such selection was occurring, pollen grains from homozygous and heterozygous tomato plants were tested under pollution stress. Homozygous pollen could be expected to respond to pollution more uniformly than heterozygous due to the identical genotype of the pollen grains. Acid rain reduced pollen germination and tube elongation in *Lycopersicon hirsutum* LA1777 (heterozygous) and *Lycopersicon pennellii* LA716 (nearly homozygous). UV-B reduced tube length of the pollen from both plants, but ozone only reduced pollen tube length of *L. pennellii*. The responses of these two kinds of pollen to acid rain, ozone, and UV-B appears to be same in terms of heterozygosity and stress dosages, suggesting the reduction of pollen germination and tube elongation under pollution stress may be mediated through physiological or physical alterations and not a response of different genotypes.

EFFECT OF PAPER MULCH ON WINTER TEMPERATURES OF CONTAINER-GROWN NURSERY PLANTS

N. E. Pellett* and D. Heleba, Department of Plant and Soil Science, University of Vermont, Burlington, VT 05405

Five species of container-grown nursery plants were overwintered under treatments of no cover, 2 layers of microfoam, 15 or 30 cm of chopped newspaper and 15 cm newspaper or 22 cm straw between two layers of white copolymer. Temperatures were measured in the air under covers and in the center of the growing medium. Chopped newspaper moderated winter temperatures equal to or better than other cover treatments. All covers prevented winter injury. Baled chopped newspaper used by dairy farmers for livestock bedding is available at a reasonable cost.

INTEGRATED MANAGEMENT OF WEEDS IN A PERENNIAL CROP: THE EXAMPLE OF CRANBERRIES

M.J. Else, Dep't of Plant and Soil Sciences, Univ. Massachusetts, Amherst

In Integrated Pest Management (IPM), the costs of a control measure are compared to the potential for economic losses caused by a pest, with control measures being recommended only when expected costs of losses exceed costs of control. IPM models have been developed largely for insect pests, which multiply rapidly and for which timely population assessments are thus essential. Weed pests, on the other hand, multiply slowly. In the case of perennial crops, weeds may not reach populations sufficient to warrant control under conventional IPM criteria for many years. It is proposed that IPM concepts be adapted to weedy pests of perennial crops by creating models in which the long-term costs and consequences of both weeds and weed control measures are considered. These models would take into account expected increases in control costs and decreases in effectiveness of control measures over time and as a consequence consider some weeds to have effective thresholds at or near zero.

Strawberry Cultivar Evaluation in Quebec

Shahrokh Khanizadeh*, Michel J. Lareau and Deborah Buszard, Agriculture Canada, Research Station, 430 Boul. Gouin, St-Jean-sur-Richelieu, Quebec, Canada J3B 3E6 and Department of Plant Science, Macdonald College of McGill University, Ste-Anne-de-Bellevue, Quebec, Canada H9X 1C0.

During 1987-90, nineteen strawberry cultivars and one selection from Agriculture Canada/McGill University were evaluated for their fruiting and other plant characteristics. Based upon an index of

potential return which integrates percent yield at each harvest date and total yield, the following cultivars listed in decreasing order of desirability (early productivity) are recommended: 'Chambly', 'Annapolis', 'Honeoye', 'Kent' and 'Cavendish'. 'Lina', 'Lester', 'SJ83OR-2', 'Bounty' and 'Settler' have the most concentrated ripening period based upon an index of concentration. Highest yields were obtained with 'Honeoye', 'SJ83OR-2', 'Chambly', 'Kent', 'Glooscap' and 'Oka'. All had large, medium-firm fruit. Because of their tolerance to the herbicide terbacil and their large, medium-firm fruit, 'Chambly', 'Oka' and 'SJ83OR-2' appear to be potential replacements for the commercial cultivars 'Kent', 'Honeoye' and 'Glooscap' and are recommended for trials in Quebec. 'Cornwallis', 'Settler', 'Midway', 'Cavendish' and 'Redcoat' had the lowest yield variability of the cultivars on trial.

Symposium

Strawberry Cultivar Evaluation Using Mathematical Indices

**Shahrokh Khanizadeh*, Mamdouh A. Fanous,
Michel J. Lareau and Deborah Buszard**, 430 Boul.
Gouin, Agriculture Canada, Research Station, St-Jean-sur-
Richelieu, Quebec, Canada, J3B 3E6 and 21111, Lakeshore
Rd., Macdonald College of McGill University, Ste-Anne-de-
Bellevue, Quebec, Canada, H9X 1C0

Three mathematical indices were developed to estimate: a) potential for early dollar return or early ripening (IE), b) concentrated cropping (IC), and deviation or similarity of a genotype to known cultivars (ID). Early ripening genotypes with high yield early in the season will have larger IE values than late genotypes with lower yield early in the season. Genotypes with few harvests will have larger IC values than those requiring several harvests. The ID index helps to identify and group genotypes with similar characteristics. These indices condense large numbers of values or arrays of traits into single index values, thereby simplifying genotype comparisons.