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Utilizing Public Television and the Internet for Horticultural and Environmental Education: The “If Plants Could Talk” Gardening Series and World-wide Web Site

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The “If Plants Could Talk” (IPCT) gardening television series was created by Rutgers Cooperative Extension faculty and staff in 1999. Fifteen 30-minute episodes have aired monthly on the New Jersey Network (NJN) Public Television since Feb. 2000. Episodes regularly air on the first Saturday of each month at 12:30, following “This Old House,” a very popular PBS television series. Programs are often repeated on Sunday evenings at 6 PM. Nielsen ratings for the IPCT program average 10% to 20% higher than other nationally recognized gardening programs normally aired by NJN during the same time slot. Ninety percent of viewer responses, via letters, emails, and internet evaluations, indicate that viewers enjoy the television series and web site, and have learned new information that is useful to them. Rutgers Univ. faculty and other experts provide horticultural and environmental information in a practical and entertaining manner. Program topics include tips on proper plant selection and care, IPM, nutrition and health, and environmental stewardship. NJN has a potential audience of more than 8 million viewers throughout New Jersey and parts of Pennsylvania, New York, Connecticut, and Delaware. The success of the IPCT television series has resulted in 4,793,943 hits and 244,712 visits on the IPCT world-wide web site at <http://ifplantscouldtalk.rutgers.edu>, from 18 Feb. 2000 to 2 Nov. 2002. The web site provides visitors with educational slide shows, streaming videos and research-based fact sheets on a variety of topics covered in the television series. The IPCT team hopes to partner with horticultural faculty throughout the Northeast to expand the television series and create educational CDs, DVDs, and videos on a variety of horticultural and environmental topics. The IPCT television series and web site provide a practical method to deliver research-based horticultural and IPM information to a very large and diverse audience throughout the state and region via public television and the internet.

Food Safety Begins on the Farm: A Comprehensive Education Program for Growers, Packers, and Farm Workers

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In recent years, there has been an increase in produce-associated foodborne illnesses. These illnesses not only result in sickness and sometimes death, but also negatively impact the economy of the produce industry. There have been outbreaks linking *Cyclospora* with raspberries, *E. coli* 0157:H7 with unpasteurized apple cider and let-

tuce varieties, hepatitis A virus with tomatoes and frozen strawberries, and *Salmonella* with cantaloupes. These are only a few examples of outbreaks associated with produce, and suggest that no commodity is immune to the problem. Because of these concerns, an increasing number of buyers are insisting on third-party audits to verify that good agricultural practices (GAPs) are being used on the farm and in the packinghouse. Understanding produce food safety issues and knowing how to reduce microbial risks is important for growers who want to stay competitive in the marketplace.

To assist growers, packers, and farm workers with understanding produce food safety issues and with implementing GAPs on the farm, an educational program called “Food Safety Begins on the Farm” has been developed. With collaborators at land grant universities in 25 states, the National GAPs Program has created a large portfolio of educational materials, including a booklet, brochures, CDs, and posters, with several other materials nearing completion. Preventing microbial contamination is more effective than reacting after contamination has occurred. Avoiding contamination by identifying risks on the farm and modifying practices to reduce the microbial risks is what good agricultural practices are all about.

Internet Technologies for On-line Pesticide Safety Training and Recertification

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Distance education efforts provide a variety of educational forums, addressing the constraints modern lifestyles have placed on available time for consumers and professionals to attend “traditional” Extension programs. At the same time, licensed professional pesticide applicators require new delivery systems to provide easy access to educational information leading to a more successful licensing and recertification procedure. This project developed an Internet site, www.ifplantscouldtalk.rutgers.edu/pesticide_education, dedicated for training on the proper use and storage of pesticides while attaining license credits for commercial growers and applicators. The web site features written and narrated script along with digital imagery designed for growers and other New Jersey-licensed applicators to attain Core credit. According to WebTrends Analysis Suite 7.0, this pesticide education/recertification site has had 1531 on-line views, 963 Internet visitors, and 29 New Jersey-licensed applicators who attained Core credits since June 2002. This site is located within the “If Plants Could Talk” consumer horticulture web site of Rutgers Cooperative Extension, and these numbers further reflect the need for both credit and noncredit on-line pesticide information and training. The development of this site was partially funded through the 2001 Research, Group Study, and Professional Improvement Grant program of the New Jersey Chapter of the National Association of County Agricultural Agents (NACAA). Site expansion will focus on new Core and Category learning modules for regional training and recertification requirements.

Effectiveness of a Farm Market and Garden Center Marketing Campaign

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Union County, N.J., has a population of nearly a half-million people living within a 103-square-mile area, presenting a marketing challenge to area farm markets and garden centers—how to reach consumers with diverse income levels. The Union County Board of Agriculture, in cooperation with Rutgers Cooperative Extension, has participated in the New Jersey Dept. of Agriculture's "Jersey Fresh" marketing promotions since 1995. The promotion consists of brochures, cable television commercials, displays, nutrition education programs, and a web site. In 2001–02, Rutgers Cooperative Extension conducted a marketing survey to evaluate the effectiveness of the promotion and to study how much consumers in the Union County area spend on produce and ornamental plants. The brochure, followed by a survey, was randomly mailed to 200 county residents. The survey was also administered to 43 visitors to a "Jersey Fresh" display, and on the promotion's website, www.unioncountyfresh.com; 180 people completed the survey. Eighty percent (145) of the respondents indicated that they visited businesses advertised in the promotion. People visited an average of three farm markets/garden centers. Most consumers (68) reported that they spend \$11–20 on an average visit to a farm market or garden center. Survey respondents were asked to identify all the ways they found out about the "Where to Find 'Jersey Fresh' in Union County" promotion. The results were as follows: 61% brochure, 23% commercial, 22% display, 7% completed the web site survey, 8% indicated nutrition education programs and other sources, and 5% read about it in newspapers. Thirty-nine (22%) of the respondents indicated they would consider using public transportation to visit a farm market or garden center. The top seven items purchased by survey respondents were annuals, vegetables, fruits, perennials, vegetable transplants, trees and shrubs, and pumpkins. Most of the survey respondents spend \$11–20 on fresh vegetables and fruits per visit. The consumers spend \$1–10 on pumpkins. Of the ornamental crops, respondents indicated they spend >\$50 on annuals, perennials, and trees and shrubs. Respondents spend \$11–20 on vegetable transplants.

New Jersey 2002 Ornamental Kale Variety Trial Results

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Ornamental kale has become an important landscape planting for fall and winter in cold regions. A fall crop of 12 ornamental kale varieties was seeded in the greenhouse at the Rutgers Snyder Research and Extension Farm on 21 June 2002. Transplants were field set using a water wheel transplanter on bare ground on 31 July. The varieties in the study included: 'Nagoya White', 'Nagoya Rose', 'White Peacock', 'Red Peacock', 'White Crane', 'White Sparrow', 'Red Sparrow', 'Osaka Pink', 'Osaka White', 'Osaka Red', 'Sunset', and 'Sunrise'. Three varieties, 'White Crane', 'Sunset', and 'Sunrise', were cut-flower types and are becoming popular in the floral industry. These types either produced a single long stem or produced multiple stems from axillary bud growth. All cut-flower types resembled a miniature heads of immature loose cabbage. 'White Crane' and 'Sunrise' were white centered and expressed a hint of pink when exposed to late-season cold temperatures. 'Sunset' had a bright, light purple center. There are great variations in ornamental kale varieties. Some are smooth leaf types and others are curly leaf types. 'White Peacock' and 'Red Peacock' had a cut-leaf pattern and were larger than other varieties. 'Osaka Pink', 'Osaka White', and 'Osaka Red', were smooth leaf types and grew taller than some other varieties. 'Nagoya White', 'Nagoya Rose', 'White Sparrow', and 'Red Sparrow' varieties were curly leaf types. All varieties displayed vibrantly colored centers after exposure to cold temperatures later in the growing season.

Uptake and Accumulation of Ca in Kale (*Brassica oleracea* L., *Acephala* group)

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Ensuring adequate calcium (Ca) consumption has become an important nutritional concern. Sufficient consumption of Ca can help achieve and maintain maximum levels of bone mineral density. Kale is a leafy green vegetable with high levels of Ca and low oxalate content, which can prevent absorption of Ca. The objectives of this study were to measure the effects of increased Ca fertility on: 1) Ca depletion from nutrient solutions; 2) Ca partitioning among plant tissues; and 3) Ca accumulation in leaf tissues of 'Winterbor' kale. Plants were grown in nutrient solutions under 1.0, 2.5, 4.0, 5.5, and 7.0 mmol Ca. Plants were harvested every 2 weeks and separated into roots, stems, and leaf tissues. Depletion of Ca from nutrient solutions was measured by comparing initial and depleted water samples at harvest times. Elements were measured in all samples using ICP analysis. Mean total Ca depletion from solutions was significantly greater for the three highest Ca levels at the final harvest date compared to the two lowest levels. The three highest levels were not significantly different from one another at final harvest. Similarly, Ca accumulation in leaf tissues was significantly higher for the highest three levels at the final harvest date compared to the lowest two levels. There were greater levels of Ca in leaves than in stems or roots at all levels at the last sampling date. Leaf tissues contained 54% of the accumulated Ca, stems contained 24%, and roots contained 20% when averaged over all Ca treatments. Ca in the leaves of kale decreased from 66% to 44% from the lowest to the highest treatment and increased from 14% to 32% in roots from lowest to highest treatments. Results indicate it is possible to enhance Ca levels in kale by increasing the concentration of Ca in the nutrient solutions.

Inheritance of Root Rot Resistance to *Phytophthora fragariae* var. *rubi* in Red Raspberry (*Rubus idaeus*)

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Phytophthora root rot has been recognized as the most destructive biotic disease in raspberry cultivation in North America and Europe. The fungus, *Phytophthora fragariae* var. *rubi*, thrives in heavy, poorly drained soils that remain waterlogged for extended periods of time. Resistance to the pathogen appears to be quantitatively inherited. The objectives of this study are to: 1) elucidate the inheritance of root rot resistance by evaluating several populations derived from a cross between 'Latham', a highly resistant cultivar, and 'Titan', a highly susceptible cultivar, including backcrosses to each parent as well as to F₂ progeny; and 2) position resistant loci on a molecular map via bulk segregant analysis (BSA). Plant material was screened hydroponically in a growth chamber with 14-hour days at 20 °C. Two grams of each isolate, M14 and NY 588, were introduced into the basin as a mycelial slurry harvested from liquid culture. Segregation ratios of 3:1 (susceptible: resistant) in the F₁ and backcross to the susceptible parent indicated that resistance was conditioned by two recessive genes. However, expected segregation ratios were not obtained in the F₂ progeny, indicating that either multiple genes (polygenic) or the interaction of a few genes (oligogenic) resulted in aberrant ratios. BSA yielded 16 putatively linked RAPD markers. The bulk DNAs represented nine resistant and nine susceptible individuals from the backcross population to 'Titan', which consisted of 120 individuals and segregated in a 3:1 ratio for susceptibility or resistance. A linkage map was generated for the F₁ parent using JoinMap 3.0™. Seven of the 16 linked markers were placed on the linkage map and clustered on two linkage groups (L1 and L4).

Iron Form and Concentration Can Alleviate Micronutrient Deficiency Symptoms for Plants Grown at High pH

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Iron deficiency is a common problem when iron-inefficient crops, such as *Calibrachoa xhybrida* 'Trailing White' Cerv., are grown in soilless media at an excessively high media-pH (>pH 6.4). The objective was to determine whether iron form and concentration affected

micronutrient deficiency symptoms in *Calibrachoa*. Three Fe forms [ferric ethylenediaminedi(o-hydroxyphenylacetic) acid (Fe-EDDHA), ferric ethylenediamine tetraacetic acid (Fe-EDTA), and ferrous sulfate (FeSO₄)] were applied at five concentrations (0.0, 0.5, 1.0, 2.0, or 4.0 mg·L⁻¹) in a water-soluble fertilizer with each irrigation. The fertilizer also contained 200N–29P–223K–191Ca–46.3Mg–0.5Mn–0.5Zn–0.26Cu–0.30B–0.09Mo. Plants were grown in a 70% peat/30% perlite medium amended with hydrated dolomitic lime to raise media-pH to 7. The 0.0 mg·L⁻¹ Fe treatment resulted in severe Fe deficiency symptoms, including stunting, and chlorosis and necrosis in new leaves. The greatest shoot DW, chlorophyll content, and tissue Fe content resulted with Fe-EDDHA at ≥1 mg·L⁻¹ Fe, with no difference between 1 and 4 mg·L⁻¹ Fe. With Fe-EDTA, DW and chlorophyll increased with Fe concentration, and 4 mg·L⁻¹ Fe was required for comparable growth compared with Fe-EDDHA. Even when FeSO₄ was applied at 4 mg·L⁻¹, Fe deficiency symptoms were severe. The efficacy of Fe-EDDHA > Fe-EDTA > FeSO₄ as an iron source at pH 7 corresponds to the order of decreasing solubility at high pH. Results suggest Fe-EDDHA would be an effective iron source for growing *Calibrachoa* and other iron-efficient species, and may expand the acceptable upper limit for media-pH.

Carotenoid Accumulation and Mineral Uptake in Spinach due to Temperature

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In plants, temperature can regulate metabolism, determine enzyme activity, and affect the production of secondary plant compounds. Carotenoids are secondary plant compounds involved in light harvesting, photoprotection, and control of free radicals. Consumption of specific carotenoids has been shown to be important for human health. Spinach (*Spinacia oleracea*) is a commonly consumed vegetable that contains high dietary levels of carotenoids (lutein and β-carotene) and elemental minerals. The objective of this experiment was to determine the effect of four different temperatures on carotenoid accumulation and mineral uptake in spinach. 'Melody F1' spinach was grown at 10, 15, 20, and 25 °C in environmental growth chambers using a modified Hoagland's nutrient solution. The biomass production differed significantly between the temperature treatments, with the 20 °C temperature resulting in the largest biomass. Regression analysis showed the ideal temperature for biomass production was 21.3 °C. The mineral accumulation was significantly different due to temperature treatments for all except for Zn and Mo. Lutein and β-carotene were significantly different on a fresh-weight basis between the temperature treatments, but were not when calculated on a dry-weight basis. Growing spinach under different temperatures can significantly affect total minerals, lutein, and β-carotene levels.

Variability in Peduncle Maturation in Jack O'Lantern Pumpkin (*Cucurbita pepo* L.)

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Jack o'lantern pumpkins are an increasingly important horticultural crop in North America and are gaining popularity in Europe. For commercial acceptability of pumpkins, the fruit stem or peduncle (often called the handle) should be sturdy and exhibit minimal shrinkage after harvest. Growers have no scientifically based guidelines for determining when peduncles reach a suitable stage of maturation for harvesting pumpkins. In 2001 we conducted a preliminary study of pumpkin stem maturation in several cultivars at the Woodman Research Farm in Durham, N.H. Based on those results, a more comprehensive study was undertaken in 2002 at the Kingman Research Farm in Madbury, N.H. We compared the time-course of peduncle maturation in four hybrid cultivars representing different size classes: 'Hybrid Pam' (1.5–3.5 kg pie pumpkin), 'Orange Smoothie' (2–4 kg), 'Racer' (5–9 kg), and 'Jackpot' (6–11 kg). The experimental design was a split plot with cultivars as main plots and time of harvest as subplots. Fruit were harvested at 20, 30, 40, or 60 days after pollination (DAP). Data were collected on peduncle fresh (FW) and dry weight (DW),

pericarp FW and DW and on peduncle shrinkage. Peduncle cross sections were stained with phloroglucinol for observing extent of lignification. Pericarp and peduncle % DW peaked at 30 DAP, prior to full pumpkin skin coloration. Peduncle shrinkage (%) following fruit harvest was not a consistent indicator of peduncle sturdiness and commercial acceptability. There were significant differences among cultivars in time of peduncle maturation and degree of lignification. 'Orange Smoothie' had the highest % DW of peduncles and earliest peduncle maturation. Conversely, Jackpot had the lowest % DM of peduncles and the latest peduncle maturation. The highest degree of lignification was observed in 'Orange Smoothie' and lowest in 'Jackpot', with 'Hybrid Pam' and 'Racer intermediate'.

Development and Analysis of a Zinc-contaminated Soil

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For phytoremediation studies to be conducted a contaminated soil must be accessible. If an in-situ soil is not available a contaminated soil must be developed. The focus of this experiment was to develop a Zn-contaminated soil. Concerns in developing a Zn-contaminated soil are determining the amount of Zn to add and an incubation period that will allow sufficient time for the added Zn to react with the soil. Two soils of the Hadley series were used for this experiment each with a textural classification of silt loam. Soil 1 has a higher sand content (39%) than soil 2 (23%) and soil 2 has a higher organic matter content (11%) than soil 1 (4%). About 1-kg portions of soil were placed into 6-inch pots, and zinc sulfate was added and mixed with the soil to give Zn at 125, 250, 500, 1000, and 2000 mg·kg⁻¹. Soil samples were taken after 7, 14, 21, and 28 days and extracted with Morgan's universal solution. Soil samples taken after 7 and 21 days were also sequentially extracted with water, Morgan's solution, and Mehlich 3 solution. All of the extracts were analyzed for Zn by atomic absorption spectroscopy. Morgan's extractable Zn increased linearly as the treatment levels increased, ranging from 41 mg·kg⁻¹ Zn, at a treatment of 125 mg·kg⁻¹ Zn, to 648 mg·kg⁻¹ Zn, at a treatment of 2000 mg·kg⁻¹ Zn. Mean Morgan's extractable Zn concentrations were highest at Day 7. The total concentrations of Zn, calculated from sums of the sequential extractions, increased linearly as treatment levels increased, ranging from 51 mg·kg⁻¹ Zn, at a treatment of 125 mg·kg⁻¹ Zn, to 719 mg·kg⁻¹ Zn, at a treatment of 2000 mg·kg⁻¹ Zn. The removal of Zn by Morgan's solution or by sequential extraction was not significantly different between the two soils; however, percent recoveries of Zn were higher for soil 2 (42%) than in soil 1 (34%). Also, as the incubation period progressed, the percent recoveries of Zn added decreased from 44%, on day 7, to 32%, on day 21. A viability study was conducted to assess the germination of *Brassica juncea* and *Festuca arundinacea* in Zn-contaminated soils. *Brassica juncea* germinated without mortality up to 1000 mg·kg⁻¹ Zn. *Festuca arundinacea* germinated without mortality up to 2000 mg·kg⁻¹ Zn. It was concluded that an appropriate incubation period would be 7 days, since any further incubation periods gave no significant differences in extractable Zn concentrations. Also, it was determined that soil Zn concentrations up to 1000 mg·kg⁻¹ Zn would be suitable for phytoextraction studies with *B. juncea* and *F. arundinacea*.

Iron Fertility Affects Chlorophyll and Carotenoid Pigments in Kale

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Iron (Fe) deficiency causes specific reductions in photosynthetic pigments and has been shown to reduce antenna carotenoid pigments. Lutein and beta-carotene are two important dietary carotenoids and kale (*Brassica oleracea* L. Acephala Group) can supply significant amounts of both to human diets. The objectives of the current study were to identify the effects of different Fe treatments on: 1) carotenoid and chlorophyll pigments; and 2) elemental concentration in the leaf tissues of kale. Three kale cultivars were greenhouse grown in modified

Hoagland's nutrient solutions under 2.0, 1.0, 0.5, 0.25, and 0.125 mg Fe per L. Kale cultivars differed in biomass accumulations, with one cultivar decreasing in FW ('Winterbor') and one cultivar increasing in FW ('Redbor') in response to increasing Fe treatments. Significant increases for the important dietary nutrients of Ca, Mg, and S were reported for some kale cultivars under increasing Fe treatments. In general Fe concentrations in the leaf tissues of the cultivars decreased in response to decreasing Fe treatments, but no significant trends were observed. Lutein and beta-carotene carotenoid concentrations differed among kale cultivars. Significant decreases in lutein and beta-carotene under decreasing Fe treatments were found for 'Redbor', but Fe treatments had no effect on the carotenoid pigments in 'Winterbor' and 'Bona'. Similar results were found for the chlorophyll pigments. Iron deficiency conditions can result in decreased carotenoid concentrations. However, the current study may indicate that kale carotenoid pigments remain stable at Fe fertility above deficient concentrations. The nutritional value of kale carotenoids would therefore be maintained over a wide range of media Fe concentrations.

Magnesium Fertility Affects Elemental Content but Not Carotenoid Pigments in Kale

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Magnesium (Mg) is an essential element in plants, important for chlorophyll production and stability. Carotenoids are secondary plant compounds found in thylakoid membranes that function in light harvesting, photoprotection, and free radical scavenging. When consumed in the human diet, both Mg and carotenoids have been shown to be beneficial for health maintenance. Kale (*Brassica oleracea* L. Acephala Group) has been identified as a good dietary source of Mg, carotenoids, and other mineral elements. Therefore, the objective of this study was to investigate the influence of increased Mg fertility on: 1) Mg and other elemental concentrations; and 2) the accumulation patterns of carotenoid pigments in the leaf tissues of three different kale cultivars. 'Winterbor', 'Redbor', and 'Toscano' kale were greenhouse grown using nutrient solution culture, with Mg treatment concentrations at 3.0, 6.1, 12.2, 24.3, and 48.6 mg·L⁻¹ Mg. Plant biomass production differed among the cultivars, but was not affected by Mg treatment. Significant linear increases for leaf tissue Mg in response to increasing Mg treatment concentrations were reported for all of the cultivars. In general, tissue Ca levels decreased in response to increasing Mg treatment concentration. Even though lutein and β-carotene accumulation differed among the cultivars, no significant changes for lutein or β-carotene were found in response to Mg treatment. Exposing kale to increasing Mg concentrations can significantly increase leaf tissue Mg levels without altering lutein and β-carotene carotenoid pigments.

Response of a GA-deficient Potato Mutant to Induction as a Working Model for Tuber Initiation

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A gibberellin-deficient dwarf of *Solanum andigena* and its normal sibling were used in this study. Plants were placed in a non-inducing growth chamber (long day, warm night) and the apices of the dwarfs were treated with GA₃ solution to achieve growth similar to that of the normal plants. When requisite height was achieved, 10 dwarfs and normal sibs were treated with a 100 ppm GA₃ solution to foliar runoff and an equivalent number of these same plants received a control spray of distilled water. These plants were placed in an inducing growth chamber (short day, cool night). An additional 10 dwarfs and normal sibs were sprayed with 600 ppm paclobutrazol; an equivalent number of plants received a control distilled water spray. These plants were returned to the non-inducing chamber. After 1 week, plants were divided into apical, medial, and basal leaf-bud cuttings and their basal buds were buried in moist potting mix in a mist chamber under a 16-hour photoperiod. After 3 weeks, cuttings were evaluated for tuberization response.

Observations made were as follows: a) tuberization was observed in apical tissues of both induced and non-induced dwarfs, but only in induced segments of normal sibs; b) non-induced dwarf cuttings tuberized as well as those from normal plants receiving the anti-gibberellin treatment; c) tuber weights from induced apical cuttings of dwarfs and normal sibs were not significantly different. These and other results will be discussed in light of current literature.

Horticultural Traits of Sixteen Edamame Varieties

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For over 60 years American agronomic growers have produced soybeans (*Glycine max*) primarily for animal forage or industrial oil use. Consumption of animal feed soybeans by livestock and other animals has lost considerable profitability in the last decade. More recently, higher-value soybeans are being considered for consumption by humans, such as tofu-type soybeans in processed food and vegetable-type soybeans as raw or lightly cooked food. This vegetable-type soybean has been bred to be easily digestible by people and is referred to as edamame in Japanese or Mao dou in Mandarin Chinese. Edamame have large seeds, a light colored hilum, green seedcoat, and high sugar content. It is traditionally cultivated in China, Japan, and other Asian countries because it provides an excellent substitute for animal-based protein that avoids saturated fats and cholesterol. These beans may contain from 30% to 40% protein as well as other important vitamins and phytochemicals and can be utilized for fresh market or for the frozen food industry.

This study took place in Pittstown, N.J. (Zone 6), and compared the horticultural properties of 16 vegetable soybean varieties. Ten varieties were received from the Asian Vegetable Research and Development Center in Taiwan and six varieties were received from a small Asian seed company based in Japan. The 16 varieties of edamame grew quite vigorously throughout the season on trickle irrigated plasticulture. Ten varieties were harvestable within 90 days and the remaining six varieties were harvested within 120 days. The longer season types were from Taiwan and were long vines, up to 100 inches in length, that yielded a very large and sweet bean having excellent taste when eaten raw or blanched. These sweet tasting beans were also highly preferred by insect populations; even when compared to a nearby study with tofu type soybeans which were hardly affected. Disease incidence was very low in this hot and dry season. The horticultural traits of these 16 varieties showed considerable difference in bean size, shape, color, and weight. The average weights ranged from 1 to 3 grams per bean. All 16 cultivars appear to have the horticultural properties for successful cultivation and marketing in the mid-Atlantic region.

Variable Expression of Heterosis in Hull-less Seeded Pumpkin

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Studies were conducted in the summers of 2001 and 2002 to determine whether heterosis for seed yield is manifested in hull-less seeded, F₁ hybrids of *Cucurbita pepo* L. pumpkins being developed at the Univ. of New Hampshire. In 2001, two bush hybrids, NH1050 and NH1051, and their respective bush inbred parents, were grown at the Woodman Horticultural Research Farm in Durham, NH. In 2002, two additional hybrids, NH1051V and NH1060, and their inbred parents were compared. One of the inbred parents of NH1051V had a vine growth habit and was near isogenic to one of the bush parents of NH1051 used in 2001. Drip irrigation tubes and black plastic mulch were applied to 15 cm raised beds on 1.8 m centers. Each hybrid/inbred comparison employed a randomized complete block design with five replications, 13 plants per plot and 0.3 m between plants. Fruit were harvested at 60 to 65 days from pollination and data were collected on fruit size, fruit number, seed size, seed number per fruit, and seed dry weight (DW) per fruit. In 2002, data were also collected on leaf and plant FW and DW at flowering. In 2001, the highest yielding hybrid, NH1051 exhibited significant heterosis for pericarp, seed, and total

DW per plot, and also for seed number per fruit and seed DW per kg fruit FW. In 2002, NH1060 was heterotic for pericarp, seed, and total DW per plot. NH1060 also had greater plant FW at flowering than the inbred lines, but the difference was not statistically significant for one of the two parental inbred lines. Seed and fruit DW production of the hybrid NH1051V exceeded that of the bush parental inbred (NH1421-3), but not the vine parental inbred (NH28-23), which produced greater fruit numbers per plot.

Isolation of Differentially Expressed Genes in the Leaves of *Guzmania lingulata* Treated with Ethylene to Induce Flowering

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Guzmania lingulata 'Anita' plants require 6 hours of exposure to $100\mu\text{L}\cdot\text{L}^{-1}$ of ethylene to achieve 100% flowering. Plants treated with air or 4 hours of ethylene remained vegetative. To investigate the differences in gene expression in leaves of vegetative and florally induced plants, *G. lingulata* 'Anita' plants were treated with ethylene-free air (negative control), 4 hours of $100\mu\text{L}\cdot\text{L}^{-1}$ ethylene (a non-inductive treatment for flowering but may induce other ethylene-responsive genes unrelated to flowering), and 6 hours of ethylene. RNA was isolated from the leaves and reverse transcriptase polymerase chain reactions (RT-PCR) for differential display was conducted to compare cDNAs in the three sets of tissue, with two samples per set. Amplification of the reverse transcribed samples involved 24 arbitrary and three fixed primers, giving a total of 72 different primer combinations. Sixteen differentially expressed cDNA fragments were isolated; three fragments were present only in control plants, three fragments were present in control and 4 hour-treated plants, seven fragments were present in 4 and 6 hour-treated plants, and three fragments were present only in 6 hour-treated plants. Isolated fragments were extracted from the differential display gels; nine of them were reamplified. Resulting PCR products were cloned using the pGEM-T Easy plasmid cloning vector. The average size of the cloned fragments was 300 base pairs. To rule out multiple cDNA species of the same size on the differential display gels, plasmid inserts were reamplified through PCR and used in colony hybridization. These cDNAs are being sequenced and analyzed in order to further elucidate their role in ethylene-induced flowering.

Effect of Development and Sunlight on Uptake of Water and Nutrients in Greenhouse Tomato

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We examined the daily and seasonal variation in uptake of water and nutrients by tomato plants grown in a rock-wool medium and fed a complete nutrient solution. The frequency of watering depended on sunlight, and the duration of watering increased as plants increased in size, so that a relatively constant fraction of water was in excess and leaked from the slabs. Nutrients were injected into the water supply using proportioners. The conductivity and concentrations of nitrate and potassium were measured twice-weekly in the solutions supplied to the plants and that in the rock-wool slabs. Uptake of water was calculated from the amount added minus the fraction of water drained. The amount of nitrogen or potassium supplied was concentration times volume supplied. The amount leached was volume drained times concentration in the rock-wool slabs. The uptake of nutrients was the difference between amount supplied minus amount leached. The uptake of water and nutrients was calculated for each day throughout the season. The results were summed over the season, and also fit to curves based on estimated plant size and light dependence of uptake.

Over 2 months of vegetative growth and 3 months of production, a tomato plant took up ≈ 200 L of water, 20 g of nitrogen, and 25 g of potassium. Water and nutrient uptake increased slowly in the first month after transplant. There was a rapid rise in uptake during the period from fruit set to first ripe fruit. By the beginning of fruit production, water use reached a plateau of 2 to 2.5 L/day per plant. Uptake of nitrogen rose more rapidly than that for water, reaching a maximum of ≈ 0.25 g/day. Potassium uptake increased more slowly

than that for nitrogen and reached a plateau of about 0.33 g/day about 1 month after the start of fruit production.

The rate of uptake began to decline after the start of fruit production. The uptake of water was more constant than that of nutrients, and there was only a slight decline of by the end of the season. The decrease in uptake with plant age was more marked for plants fed supplemental nitrogen and/or potassium, than for those fed an amount only sufficient to prevent depletion. By the end of the season there was little difference in uptake of either nitrate or potassium between plants fed the standard dose or those fed supplemental nutrients.

Agriculture in Action—Reconnecting Farms and Families in New Jersey

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In 1999, "Reinventing Agriculture Education for the Year 2020" revealed the need to strengthen agricultural literacy, increase the value placed on agricultural careers, and educate the population of Somerset County on the region's agricultural history and current industry and production. Following this effort, the Somerset County Agriculture Retention and Development Master Plan was published in Spring 2001. Research revealed that Somerset County has nearly 24% of its land base devoted to agriculture, with nearly 50% of sales from nursery and greenhouse production. Population growth is expected to add 56,000 new residents by 2010, leading to a land conversion of between 9,000 and 28,000 acres, depending on lot size. To address these and other projections, the Somerset County Board of Agriculture (SCBA) and Rutgers Cooperative Extension (RCE) jointly host "Agriculture in Action," a regularly scheduled open house featuring a different farm or production in Somerset County. In 1999, Dutch Hollow Farm in Bridgewater (beef operation and direct marketing) hosted nearly 600 visitors in a 4-hour span. In 2000, Middlebush Farms in Franklin (dairy operation) and Everett Farm & Market in Hillsborough (hay, grain, vegetable production, and direct marketing) hosted day trips for 80 third, fourth and fifth grade students. In 2001, Suydam Farms in Franklin (pumpkins, hops, Christmas trees, hay, and cut flower production) hosted a 4-hour open house for over 900 visitors. Host farms are selected by the SCBA and RCE, based on grower participation, location and transportation, visitor facilities, highlighted production, and other featured issues. These agriculture open houses, held from noon until 4 PM on Sunday afternoons in September, include hay rides, tours of the farm hosted by the grower and other members of the SCBA, Jersey Fresh markets and sales, and pasture and watershed management efforts. Milking and other livestock demonstrations, new and antique equipment displays, corn and bale mazes, and informational displays from a variety of educational, advocacy, and commodity groups complete the day's events. Producers who willingly open their land and participate in public events such as "Agriculture in Action" will bridge the gap and reconnect the local population to be stewards of their local farms and farmers.

Green Industry Vocational Training for At-risk Youth in New Jersey

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The Green Industry Vocational Training Program was implemented in 2000 as a workforce preparation program targeting at-risk youth for employment opportunities within New Jersey's tree care and landscape industries. In cooperation with the New Jersey Youth Corps office and New Jersey's CYFAR Initiative, this program was designed to fully prepare the youth in being a contributing, responsible, and skilled worker in society. In 2000, training and employment opportunities were made available to two of the 12 New Jersey Youth Corps offices. Eighteen youth were identified for 5 days of hands-on and classroom training. Eight trainees expressed moderate interest in employment following the training, and four accepted full-time positions with tree care companies and garden centers/nurseries. Evaluations were completed

to assess knowledge gained, use of proper techniques, development of employability skills, and the training program itself. With partial grant funding, the 2001 three-day statewide training program was delivered to 35 youth at an overnight camp. Within a condensed and more intensive training format, the youth displayed a 70% knowledge gain in proper safety techniques in tree climbing, a 300% knowledge gain in fall prevention measures, and a 95% increase in electrical hazard awareness and necessary safety precautions. Twenty trainees expressed interest in employment and four accepted full-time positions. The New Jersey Youth Corps' 2002 budget included dedicated training funds three times that available for FY2000. Three regional training sessions were held throughout the state in 2002, serving a total of 87 youth. Individual evaluations following the 2002 program showed similar knowledge gains in the areas of pruning, climbing techniques, and work zone safety. Industry professionals are recruited annually to participate as qualified trainers, interviewers, and potential employers. The overall training curriculum is based on materials from the International Society of Arboriculture, the National Arborist Association, the Utility Arborists Association, and the New Jersey Nursery and Landscape Association.

Development of Edible Soybean Market on the Eastern Shore of Maryland

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Edible soybeans [*Glycine max* (L.) Merr.] (adamame) are growing in popularity as a niche crop grown by traditional grain producers. The increase of soy products in the news, publicizing health benefits, has increased the public's awareness of this traditional Asian vegetable. Research priorities of the Maryland Soybean Board in 2002 include utilization of edible soybeans and other potential market usages or avenues. Profits earned by the soy food market can be conservatively estimated at \$1.7 billion in 2002. These trends, as well as the rising popularity of Asian food as an ethnic food market, encouraged the research of eight different edible soybean varieties on both the Eastern and Western Shore of Maryland in 2002.

Two research locations were evaluated. One site was managed organically and the other conventionally, following a traditional IPM program. Overall, yield, marketability, and pod weight were evaluated (not all characteristics were evaluated at both sites). At the conventional site, two seeding rates were also included in the study. On average, the cultivar 'Funkungaha' resulted in the highest pod weight. 'FG-1', 'Suzuyutaka', and 'Vinton-81' had the best pod marketability, and 'Suzuyutaka' and 'FG-3' resulted in the highest yield ('FG-3' at both sites). The popularity of organic vegetables at farmers' markets opens the door for expanded marketing of soyfoods, especially fresh-harvested. Manufacturers looking to include ethnic foods in their offering of high-quality, convenience foods may also look to locally grown Asian vegetables as an ingredient source.

An Overview of Ethnic Crop Research in New Jersey

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The Vegetable Research Working Group continues to make progress in evaluating the horticultural properties and market opportunities of new crops from foreign lands. New Jersey has enjoyed an increasingly large ethnic diversity of citizens and visitors, and some Garden State growers need to better connect with these newly emerging and expanding markets. These unique specialty vegetables have culinary, nutritive, and/or health benefits that may meet changing market demands and form a market niche favoring locally grown, small farm fresh produce. The Rutgers Extension specialists, agents, and researchers collaborate in a multidisciplinary effort with progressive growers, ag leaders, and organizations focusing upon Asian, Hispanic, Russian, African, and Korean vegetables in New Jersey.

Based upon the data from the year 2000 census, New York and New Jersey rank second and third in the continental United States with ethnic percentages of 20.4% and 17.5%, respectively. New York and New Jersey rank second and third behind California in having the

greatest percentage population change of ethnic groups for the last 10 years. New York has the lead in European, Asian, African, and Latino population at 3,868,133, and New Jersey second with 1,476,327 immigrant citizens, among the five mid-Atlantic states. The population data clearly distinguishes the mid-Atlantic region as being composed of a high and increasing first-generation ethnic population. Second and third generations, tourists/visitors, and non-citizens add greatly to this diverse mix, which leads to a diverse consumer food preference. The rapid growth of small, medium, and large food stores catering to this new clientele verify this data. Furthermore, these minor crops may reach the mainstream and become major food items. Better connecting with these new food customers and food consumers is a primary goal.

The crop diversification team conducts research, demonstrations, and marketing programs and is oriented towards bridging production, promotion, and purchasing of ethnic-heritage crops. Team activities are highlighted on the poster.

Can Cu Deficiency Be Limiting Lowbush Blueberry Yields?

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Many commercial lowbush blueberry fields in Maine have leaf Cu concentrations below the 7 ppm standard proposed by Trevett in 1972. To test the accuracy of this standard, we raised leaf Cu concentrations by applying Cu Keylate (Stoller Enterprises, Inc.) at Cu rates of 0.56, 1.12, 1.68, or 2.24 kg·ha⁻¹ and measuring growth and yield response. The efficacy of Micromate (Stoller Enterprises, Inc.), a product used by some growers in their fertilization program to add several micronutrients, including Cu at 0.018 kg·ha⁻¹, was also tested. Plots that received no fertilizer were used as the controls. Treatments were randomly assigned to 1.8 × 15 m, treatment plots arranged in a randomized complete-block design with seven blocks. Micromate was applied with sand as a soil treatment and Cu Keylate (5% Cu) was applied as a foliar spray in a volume of 626 L·ha⁻¹ on 12 June 2001. Analysis of composite leaf tissue samples taken 13 July from each treatment plot showed a linear increase in leaf Cu concentration, with increasing Cu rate from Cu Keylate. The lowest Cu rate, 0.56 kg·ha⁻¹, increased the leaf Cu concentration from a deficiency of 3.7 ppm to a sufficiency of 7.8 ppm. The highest rate, 2.24 kg·ha⁻¹, resulted in a leaf Cu concentration of 12.5 ppm. Micromate did not increase leaf Cu concentration. Average stem length, branching, flower bud formation, and berry yield were not affected by any of the Cu treatments, compared to the controls. Control plots had low leaf N and P, which may have masked the response to Cu. This study will be continued with a split block design in which the same treatments will be applied to half of the block along with diammonium phosphate to correct N and P deficiencies.

Effects of Planting Date and Variety on Yield of Direct-seeded and Transplanted Pumpkins

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Field studies were conducted at two locations in 2002 to determine the effect of transplanting vs. direct seeding as well as planting date on pumpkin (*Cucurbita pepo* L.) marketable yield. 'Magic Lantern' and 'Gold Bullion' were seeded into 50-cell (66 cm³) or 98-cell (23 cm³) flats 3 weeks prior to field planting. Transplants were set in the field on 10 and 24 June in Geneva, N.Y., and 6 and 20 June in Riverhead, N.Y. Seeds were planted at the same time. All plots were planted on 1.8-m centers with 1.2 m between plants. Seeded plots were thinned to a single plant. Plots at Riverhead were planted into black plastic with trickle irrigation, while plants at Geneva were grown on bare ground. Transplanted treatments resulted in earlier flowering, fruit set, and harvest as compared to direct-seeded plots. Yield was also affected. In both locations, transplants resulted in significantly greater tons/ha as well as greater fruit number/ha at Riverhead. Average fruit

size was not significantly increased with transplants. Although 'Gold Bullion' produced higher yields than 'Magic Lantern', both cultivars responded to transplanting in the same way. The largest transplant size was not significantly better than the smaller one. Planting date was nonsignificant. Although using transplants is more costly than direct seeding, this increase in yield may make the practice more economical. This is especially true as cell size is reduced, increasing the number of transplants that can be produced per unit area of greenhouse.

Trellising System Affects Yield and Fruit Composition of 'Cabernet Franc' and 'Chardonnay' Grapevines (*Vitis vinifera* L.)

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The effect of trellising system on yield components and fruit composition of 'Cabernet Franc' and 'Chardonnay' grapevines was investigated in the Niagara Peninsula, Ontario, Canada, from 1999 to 2002. Vines were planted in 1994 and trained to one of either two spur-pruned systems [Low Cordon (LC), Vertiko (VT)] or four cane-pruned systems [Pendelbogen (PB), Four-Cane Kniffen (4CK), Two-Tier Flatbow (2FB), Scott-Henry (SH)]. In both cultivars, vines in the spur-pruned systems produced the lowest yields but fruit with the highest concentrations of soluble solids, even though LC had the highest leaf layer number (LLN) of all six systems, while VT had a low LLN. LC and VT also had low cropload ratios. The cane-pruned PB system, with a high cropload ratio, produced the highest yield in both cultivars, and produced fruit low in soluble solids in 'Chardonnay'. Composition of the 'Cabernet Franc' growing on PB was variable and dependent on year. The SH, 2FB, and 4CK systems produced similar yields; however, SH tended to have a lower LLN than 2FB and 4CK. SH, 2FB, and 4CK produced fruit similar in composition. Cropload appeared to play a more important role in determination of fruit composition than LLN.

Non-pesticide Fungus Control in Grapes

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There are now wineries in all 50 states of the United States and along with this increased interest in wine is the desire to grow quality grapes. Controlling the fungal problems of grapes is critical. Although there are a raft of pesticides available, many viticulturists are looking for alternative means to control the fungal diseases that attack wine grapes. Environmental concerns, vine and soil health, and increased wine quality are reasons given for the tremendous growth in interest in new techniques of farming wine grapes. Three alternative chemicals, ECO-DYNE, CUPRI-ZIN, and Iron Blue, were tested at various rates and combinations against the traditional fungicidal controls on the 'Seyval' grape variety at the Rutgers Research and Extension Center at Cream Ridge, N.J. Fungal control efficacy was evaluated for the four major diseases in New Jersey: black rot (*Guignardia bidwellii*), botrytis (*Botrytis cinerea*), powdery mildew (*Uncinula nector*), and downy mildew (*Plasmopara viticola*). The 2002 data show that the ECO-DYNE treatments were more effective than the CUPRI-ZIN in controlling disease. High rates of the ECO-DYNE were not statistically different from the traditional fungicide applications in overall disease control. In addition, for the primary disease problems in 2002, botrytis and black rot, ECO-DYNE was as effective as the fungicide treatment. In addition, a combination of Iron Blue and recommended fungicides equaled or surpassed all treatments in the control of the four fungal diseases evaluated.

Long-term Viability of Primocane Fruiting Raspberry Cultivars in New York

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The long-term field viability of 11 primocane fruiting raspberry cultivars was evaluated based on yield, vigor, cane density, and cane height in a replicated trial that was planted in 1994 and managed using commercial practices. The cultivars include 'Amity', 'Anne', 'Autumn Bliss', 'Caroline', 'Goldie', 'Heritage', 'Kiwigold', 'Prelude', 'Rossana', 'Ruby', and 'Summit'. Significant differences among the cultivars were found for yield, vigor, and cane density but not for cane height. 'Kiwigold' had the highest yield at 3585 lb/acre, followed closely by 'Caroline' (3258 lb/acre), 'Heritage' (3227 lb/acre), and 'Prelude' (3206 lb/acre). These yields compared favorably to mean yields from 1995 to 1997 when the planting was first harvested (3850, 4320, 3703, and 3026 lb/acre, respectively). 'Anne', 'Amity', 'Summit', and 'Rossana' produced significantly lower yields than 'Kiwigold', 'Caroline', 'Heritage', 'Prelude', and 'Goldie'. 'Autumn Bliss' and 'Ruby' were intermediate in yield. Visual vigor ratings and cane density were a good indicator of yield potential but were not always accurate. 'Rossana' had the highest cane density and third highest vigor rating but had the lowest yield. This cultivar did not produce many flowers and was not suited for New York. Overall, 'Heritage and its sports', 'Kiwigold' and 'Goldie'; 'Caroline', and 'Prelude' exhibit the best potential for longevity in the field in New York.

Effect of Irrigation and Sand Application on Cranberry Growth and Yield

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A study was initiated on a commercial 'Stevens' cranberry bed to examine the interaction of sanding, nitrogen fertilization, and irrigation. Within irrigation treatments, combinations of sanding depth (0, 1.3, 2.5, and 3.8 cm) and N rate (0, 33.5, and 67 kg-ha⁻¹) were applied to individual plots. Irrigation treatments received grower-initiated irrigation (irrigated) or sprinkler irrigation only when the soil moisture dropped below 45 cm from the bed surface (cutoff). Overall, the depth of the water table averaged 20 cm deeper in the cutoff irrigation treatment compared to full irrigation. Sanding decreased the percentage of light intercepted by the canopy in the season of sanding and was associated with decreased yield. Light interception remained below that in unsanded plots until late in July in the year of sanding but then recovered.

In years 2 and 3, the average yield for the irrigation cutoff treatment was significantly higher than that for the sprinkler-irrigated treatment. The negative effects of the nitrogen treatments on yield were dramatic in the second and third years. The negative impacts of the sanding treatments on yield were not overcome until year 3. Yield continued to be significantly decreased in the 3.8-cm sand treatment in the sprinkler area in year 2. In all 3 years, the ability of flowering uprights to retain fruit was severely impacted in the wetter area. Significantly more uprights in these plots failed to set even one fruit.

After 3 years, only irrigation scheduling method and nitrogen rate continued to impact yield. Negative effects of sanding had been overcome. But, the cumulative effects of sanding were negative, particularly for rates of 2.5 cm or greater. High rates of N were associated with increased growth, high tissue N, and decreased yield. All factors were interactive in the sense that poorest performance was achieved with high N, deep sand, and a wet bog. However, it is apparent that irrigation management is a critical component in maintaining cranberry production.