Abstracts

Contributed Papers (Poster and Oral)
Workshops
Colloquia

94th Annual International Conference of the American Society for Horticultural Science

Salt Lake City, Utah, USA
23–26 July 1997

The Abstracts that follow are arranged by type of session (Posters first, then Orals, Colloquia, and Workshops). The Poster abstract numbers correspond to the Poster Board number at which the Poster will be presented.

To determine when a paper is to be presented, check the session number in the Program Schedule or the Conference at a Glance charts. The Author presenting the paper is indicated by an asterisk.

48 POSTER SESSION 1A (Abstr. 001–006)
Culture & Management—Small Fruit/Viticulture

001 Nitrogen Transformation in Low pH Soils for Cranberry
Teryl R. Ropet* and Armand R. Krueger, Dept. of Horticulture, University of Wisconsin–Madison, Madison, WI 53706

Cranberry plants exclusively utilize ammonium forms of nitrogen. Nitrification of applied ammonium and subsequent leaching through sandy soils is a potential problem for growers. Peat, sand, and striped soils were collected in cranberry beds in central Wisconsin and soil pH was adjusted to 3.5, 4.5, or 5.5. Twenty-five grams of dry soil was placed in flasks and half the flasks were sterilized. Distilled water was added to half of the samples, and the other half received 15N-labeled ammonium. Flasks were incubated at 20°C for up to 70 days. Striped soils showed no nitrification at pH 3.5 or 4.5 during the 70 day incubation. At pH 5.5, nitrification began at 20 days and was almost complete at 70 days. Nitrification did not occur at any pH in sandy soils. This research suggests that ammonium fertilizer applied to cranberry is likely taken up before nitrification would occur.
002 Living Mulch for Strawberry Production Fields
C.L. Gupton*, USDA-ARS, Small Fruit Research Station, P.O. Box 287, Poplarville, MS 30940

Annual ryegrass (Lolium multiflorum), which grows prolifically during the strawberry production season in the Gulf South, has the potential to serve as a living mulch if its growth is controlled. Sublethal dosages of Embark, a plant growth regulator, and the herbicides Poast and Rely were determined on ryegrass. Growth retardation was rated from 0 (no control) to 6 (dead). In 1993, all Poast dosages (2X/8 - 1X, where X = 8 ml L⁻¹) were lethal. Embark regulated ryegrass growth, but its study was discontinued because of the unlikelihood that it could be labeled for use on strawberries. Results of the 1994 study suggested that prime oil in the spray may cause an inordinate amount of vegetative browning. In 1995, three levels of oil (1/25X, 1/6X, and 1/32X, where X = 8 ml L⁻¹) were used with each of four levels of Poast (0, 1/32, 1/64, and 1/128X). Increased levels of oil generally caused increased browning at each level of Poast, but no browning occurred where oil only was applied in the spray. In contrast to results in 1995, oil at 1/32X with no Poast caused considerable browning (score = 3.25) in 1996. The most desirable control (score = 2.75) was accomplished by a spray containing 1/128X Poast and 1/64X oil. The most desirable control by Rely (score = 3.25) was accomplished by 1/64 and 1/32X sprays. Rely is not labeled for strawberries although it is labeled for other fruit crops. Chemical names used: 2,4-D (2,4-dichlorophenoxyacetic acid, 2,4-D); 3,5,6-trichlorpyridazine; and acetalide (Embark); ammonium-Di-homaloin-4-yl-(methyl) phosphonate (Rely).

003 Root Distribution of ‘Gulfcoast’ Southern Highbush Blueberry
J.M. Spiers*, USDA-ARS, Small Fruit Research Station, P.O. Box 287, Poplarville, MS 30940

A field study was conducted to evaluate individual and collective influences of three soil moisture-supplementing practices (irrigation, incorporated peatmoss, and mulching) on root system development in ‘Gulfcoast’ southern highbush blueberries. Root growth was least in plants not mulched and greatest in plants receiving all three supplements. Ranking of individual treatments on root dry weight production was mulch > incorporated peatmoss = irrigation. Mulching resulted in uniform root distribution from the plant crown outward and in root growth concentrated in the upper 15 cm of soil. Other practices (peatmoss > irrigation) tended to concentrate the root system near the crown area and resulted (peatmoss = irrigation) in greater root depth. Soil moisture appeared to be the major factor influencing root distribution.

004 Ice-nucleation-active (INA) Bacteria: A Deterrent to Strawberry Flower Survival during Low-temperature Exposure
Michele R. Warmund* and James T. English, Dept. of Horticulture and Plant Pathology, Univ. of Missouri, Columbia, MO 65211

Experiments were conducted to determine the temperatures at which different densities of INA bacteria incite ice crystallization on ‘Fotem’ strawberry flowers and to determine if there is a relationship between densities of INA bacteria on strawberry flowers and floral injury. Primary flowers were inoculated with Pseudomonas syringae at 10⁶ cells/ml buffer, incubated at 25°C day/10°C night and 100% RH for 48 h, and exposed to −2.0°C. No ice nucleation occurred on these inoculated flowers and all of the flowers survived. However, when inoculated flowers were subjected to lower temperatures, ice nucleation occurred at −2.2°C and few of the flowers survived. In contrast, ice crystals formed on the surface of most non-inoculated flowers at −2.8°C and 21% of the flowers survived exposure to −3.5°C. When INA bacterial densities were 10⁶ colony forming units/ml dry wt, floral injury occurred at a warmer temperature than to flowers that had lower bacterial densities.

005 Study of the Regular and High Application of Water with Drip Irrigation and Its Effect in the Floral Buds of ‘Thompson Seedless’ Grapes
Addin Fimbres Fontes*, Raul Leonel Grijalva Contreras, Manuel de Jesus Valenzuela Ruiz, and Gerardo Matinez Diaz, Apartado Postal No. 125, Caborca, Son. Mexico 83600

The region of Caborca is actually the largest grape-growing area in Mexico, with 14,000 ha. The main problem in this zone is the lack of water, and it is important to use this resource rationally. During 1990 and 1991, a drip irrigation experiment in ‘Thompson Seedless’ table grapes was conducted. The four treatments were 120%, 166%, 206%, and 250% of the evaporation from a evaporation pan type A. The crop coefficients (Kₜ) applied were 7.5%, 15%, 52.5%, and 80% from the beginning of budding until 1 week after harvest, and 7.5% after harvest (postharvest). The results indicated that the best treatments were 120% (105 cm of water applied) and 166%, with no reduction in the floral buds (5.4 per cane for 120); however, 206% and 250% (200 cm of water applied) got the lowest number of floral buds (0.50 per cane) for the following year, and, because of that, the lowest clusters per cane.

006 Dry Mass and Nitrogen Distribution in Papaya Seedlings in Response to Varied Fertilization of Divided Root Systems
Thomas E. Marler* and Haluk M. Disoceto, College of Agriculture & Life Sciences, Univ. of Guam, Mangilao, GU 96923

Known You ‘p’ papaya seedlings were grown in split-root containers and fertilizer was applied to one (1/2) or two (2/2) halves of the root system to determine the influence on transport of assimilates from canopy to roots and transport of nitrogen from fertilized roots to non-fertilized roots and canopy. Following 6 weeks of growth, the plants were bare-rooted and the root system halves and canopy were dried to constant mass at 70°C. Tissue was then analyzed for total nitrogen content. Fertilization increased root mass more than 250% and total plant mass 300% compared with control plants, which received no fertilization during the 6 weeks. Total root or plant mass did not differ between the 1/2 and 2/2 plants. Roots were evenly distributed between the two halves for 2/2 plants, but the fertilized half in the 1/2 plants accounted for 60% of the total root mass. Nitrogen content of roots and canopy was increased by fertilization. Nitrogen content of the non-fertilized roots of 1/2 plants was different from that of the fertilized roots. These results indicate that fertilizing a portion of the papaya root system increased the sink activity of that portion and that the absorbed nitrogen from that portion is efficiently transported throughout the plant.

48 POSTER SESSION 1B (Abstr. 007-025)
Weed Control—Cross-commodity

007 Watermelon Weed Control: Current and Future Possibilities
Warren Roberts*, Jim Shrefler, Jim Duthie, Jonathan Edelson, and Wes Watkins, Agricultural Research and Extension Center, Oklahoma State Univ., Box 128, Lane, OK 74555

Watermelon is the major fresh-market vegetable grown in Oklahoma, but growers have few labeled herbicides from which to choose. Grower surveys in Oklahoma have identified weed control as the major production problem facing watermelon producers. In 1995 and 1996, various mechanical and chemical weed control strategies have been explored. "Allsweet" watermelons were grown with various combinations of labeled and unlabeled herbicides, as well as mechanical control treatments. Treatments included bensulfide, clomazone, DCPA, ethalfluralin, glyphosate, halosulfuron, napropamide, naptalam, paraquat, pendimethalin, sethoxydim, and trifluralin. Certain chemicals were used in combination. Paraquat and glyphosate were used as wipe-on materials. Glyphosate and paraquat could not be applied until weeds were taller than the watermelon foliage, causing serious weed competition. In general, superior results were obtained from hand-weeded plots, trifluralin, and DCPA. Halosulfuron gave superior control of broadleaf weeds, but had a negligible effect on grasses. Napropamide gave good control of grasses and broadleaf weeds other than solanaceous weeds. No chemical, when used alone, gave satisfactory control throughout the growing season. Early cultivation, followed by chemical application at layby, appears to be one of the better treatments.
326 Procedures for the Determination of Lipase Activity and Percent Trivernolin in Vernonia galamensis spp. galamensis using Gas Chromatography
M.A. Sieberg*, D.K. Stump*, and D.T. Ray*
1Dept. of Plant Sciences, The Univ. of Arizona, Tucson, AR 85721; 2Bioresources Research Facility, Office of Arid Lands, The Univ. of Arizona, Tucson, AZ 85706

Vernonia galamensis spp. galamensis is a short-season oilseed plant naturally producing an epoxy fatty acid, vernolic (cis-12, 13-epoxy-cis-9, 10-octadecenoic) acid. Trivernolin, a triglyceride with three vernolic acid moieties, is the highest-quality oil produced by vernonia. Industrial interest in vernonia oil includes use for metal coating and as a non-volatile oil in paint. Seed lipase causes production of free fatty acids (FFA) from triglycerides (TG) in pre- and post-crushed seeds, thereby decreasing the quality of vernonia oil. Consequently, production of FFA can be used as a measure of lipase activity. Our research has developed a technique for detecting the production of FFA and the accompanying di- and monoglycerides. We are able to quantify FFA in relation to total seed lipid. FFA were measured at time of crushing and at selected time intervals thereafter. This allowed us to assess FFA in intact seeds and in seeds that have been crushed with the lipase able to hydrolyze the TG. Significant differences were found between accessions for all times tested. This procedure was developed to enable us to screen plants in our breeding program for seed lipase activity. We are also screening our germplasm for triglyceride composition to select those plants producing the highest percentage of trivernolin. We will use this data to describe the genetics of both traits.

327 Inheritance of Male Sterility in Lesquerella fendleri
D.A. Dierig*, P.M. Tomasi, and T.A. Coffelt* U.S. Water Conservation Laboratory, USDA/ARS, 4331 East Broadway Road, Phoenix, AZ 85040

Lesquerella fendleri (Gray) Wats., Brassicaceae, is a potential oilseed crop native to the southwestern U.S. The seed oil contains hydroxy fatty acids, similar to castor. Unique properties of the oil, along with coproducts, allow additional applications that would not be in competition with castor. Plants with vestigial anthers were discovered in a bulk population growing in the greenhouse in 1993. The inheritance of the trait was investigated the following three crop seasons. Crosses were made among sterile and fertile plants and reciprocals among fertile plants. Chi-square results indicate the male sterility trait is expressed by a recessive nuclear gene with cytoplasmic influence restoring fertility. Cytoplasmic male sterile lines can be utilized for development of hybrids. Development of lines without male sterility should lead to higher yields than current bulk populations of lesquerella. Hybrid plants and higher yields will enhance the commercialization potential of this new, alternative crop.

328 Response of Arabidopsis by Mutants Grown in Lower Day/Higher Night Temperatures (−DIF)
Gary R. Backman* and Margaret J. McMahon, Dept. of Horticulture and Crop Science, The Ohio State Univ., 2001 Fyffe Court, Columbus, OH 43210

It is theorized that photoperiodic reductions in stem elongation are similar to thermomorphogenic plant response, i.e., increased red/far-red light response is similar to −DIF (day temperature < night temperature). The long hypocotyl (hy) mutants of Arabidopsis thaliana Landsberg are phytochrome mutants that are less responsive to light quality than wild type. These include mutants of phytochrome biosynthesis (hy1, hy2, hy6), phytochrome B (hy3), blue-light receptor (hy4), and signal transduction (hy5). These mutants were grown in growth chambers with temperatures of 18°C day/24°C night (−DIF) and 24°C day/18°C night with a 14-h photoperiod. Lighting consisted of both incandescent and fluorescent lamps. Growth measurements of five of the mutants were consistent with reported effects of DIF. The height of these plants were significantly greater in the −DIF regime when compared to +DIF. The hy5 mutant showed little difference in the height measurements of plants grown in either −DIF or +DIF. This mutant has a phytochrome signal transduction deficiency. This result indicates that a functional photoreceptor is required, even in reduced quantities as in the phytochrome biosynthesis mutants, to signal perception of DIF temperature conditions.

329 Influence of Fertility on Plant Growth and Postharvest Quality of Pot Sunflowers
Shravan K. Dasola* and Brian E. Whipker, Horticulture Hall, Iowa State Univ., Ames, IA 50011

Pot sunflowers (Helianthus annuus cv. "Pacino") were fertigated on ebb-and-flow benches with 100 or 200 mg liter−1 of N to determine the influence of fertility level on plant growth and postharvest quality in interior conditions. The fertilization rates were held constant from potting until day 45, then the fertilization rates were continued, decreased, or ceased on day 45 and day 55, giving a combination of nine fertilization subtreatments. At bloom, the number of days from potting to flowering, plant height, plant diameter, flower diameter were recorded, and the root medium of five replicates per treatment were analyzed to determine the nutrient status. Five replicates of each treatments also were moved into interior conditions with artificial lighting and were graded 5, 10, and 15 days after moving to evaluate the postharvest quality. There was no significant difference among fertilizer treatments for the number of days to flower, plant height, or flower diameter. Plants fertilized with 100 mg liter−1 N from potting until day 45, in combination with a ceasing of fertilization on day 55, had significantly better plant grades when compared to plants grown with 200 mg liter−1 N. Plants fertilized with 100 mg liter−1 N also had a longer postharvest life and the number of days before the flowers wilted were significantly longer. Good-quality plants with longer postharvest life were produced with 100 mg liter−1 N and by terminating fertilization 55 days after potting.

330 Growth of Poinsettia in Potting Media Amended with Ground Kenaf Stem Core
Harvey J. Lang*, Dept. of Horticultural Sciences, Texas A&M Univ., College Station, TX 77843-2133

Euphorbia pulcherrima Willd. 'V-14 Glory Red', 'V-17 Marble', and 'Jingle Bells 3' were grown in various peat-based potting media amended with ground, non-composted woody stem core of kenaf (Hibiscus cannabinus L.) and fertilized at every irrigation with a 17N–2.2P–13.8K fertilizer at 300 ppm N. Kenaf is an annual tropical species grown in several Gulf Coast states as a fiber crop. Growth and overall quality of all cultivars was best in media containing 50% to 70% coarse grind of kenaf (by volume) and was similar to a commercial soilless control medium (Sunshine #1, SunGro Horticulture, Inc.). Media containing greater than 70% fine grind kenaf resulted in significantly smaller plants with chlorosis of both lower and upper leaves, and also resulted in undesirable shrinkage of media in the containers. Addition of 19N–2.6P–10K Osmocote to kenaf-amended media at a rate of 3.5 kg/m3 resulted in significantly better plants with less chlorosis than similar media without Osmocote. Media containing kenaf also resulted in significantly less water-holding capacity than Sunshine #1 and required more-frequent irrigation to sustain the growth of plants.

331 Poinsettia Stem Strength
Jeff S. Kuehny*, Patricia Branch, Dept. of Horticulture, Louisiana State Univ., Baton Rouge, LA 70803-2120

Lateral branches of poinsettia tend to break from the main stem as plants reach maturity. The cause of poor stem strength is not known; however, suggested factors implicated in poor stem strength are: rate of nitrogen fertilizer used, type of plant growth regulator used, crowding of plants, or stem diameter of the cutting. Four different experiments were conducted to determine if these factors affected stem strength of poinsettia. Experiment 1: 'Freedom Red', 'Success', 'V-17 Angelika Red', 'Red Sails', 'Nutcracker Red', 'Cortez', 'Maren', and 'Red Splendor' poinsettia were fertilized with 20N-1P0-20K at 75, 125/200, or 200 ppm N drip fertigation with zero leachate. Experiment 2: Three plant growth regulators were applied to 'Pearl' and 'Jolly Red' poinsettias. Experiment 3: 'Freedom Red' plants were grown in a 625, 900, 1225, or 1600 cm2 area. Experiment 4:
332  
**Response of Three Poinsettia Cultivars to Root Media Containing Coal Bottom Ash**

James Gibson and Bradford C. Bearce*, West Virginia Univ., Morgantown, WV 26505

Poinsettia (Euphorbia pulcherrima Willd. ex Klotzsch) cultivars ‘Dynasty Red’, ‘Nutcracker Pink’, and ‘Annette Hegg Topwhite’ were planted in 15-cm azalea pots containing peat: vermiculite (1:1, v/v) in which coal bottom ash sieved through 6-mm mesh was mixed in proportions of 0%, 25%, or 50% by volume. Planting date was 23 July 1996, and pinch date was 25 Aug. Harvest date at anthesis was 20°C after 7 weeks of treatment. Results on flowering percentage, date of visible bud and flowering, node count, flower bud count, and plant height at flowering will be presented.

333  
**High Soluble Salts Affects Water Loss and Bract Necrosis of Poinsettia**

Bernard B. Riley and Richard J. McCavy*, Dept. of Plant Science, Univ. of Connecticut, Storrs, CT 06269-4067

‘Angelika White’ poinsettias (Euphorbia pulcherrima Willd. ex Klotzsch) were grown hydroponically with modified Hoagland’s solution concentrations of 2 or 8 mS·cm⁻¹. The 8-mS·cm⁻¹ rate was imposed by proportionate increases in Ca(NO₃)₂, KN₀₃, and MgSO₄. Water use, whole plant fresh mass, and pan evaporation were measured gravimetrically twice weekly over a 2-week period beginning 12 Oct. 1995. Poinsettia leaf water loss (g H₂O/dm² of estimated leaf area) was 0.30 and 0.22 times pan evaporation (g H₂O/dm² of pan area per day) for the plants in the 2 and 8 mS·cm⁻¹ solutions, respectively (a 25% reduction in water loss for plants in the 8 mS·cm⁻¹ solution), as compared to plants in the 2 mS·cm⁻¹ solution. At initiation, an additional transfer of plants between the 2 and 8 mS·cm⁻¹ solutions was used to investigate the time when plants were sensitive to high soluble salts for bract necrosis. Other plants were maintained throughout the experiment in the 2 and 8 mS·cm⁻¹ solutions. On 15 Jan. 1996, plants were harvested and total lamina surface of leaves and bracts, number of necrotic bracts, and dry mass of leaves, bracts, stems, and roots were recorded. The results indicated that exposure to high soluble salts (8 mS·cm⁻¹) prior to anthesis significantly increased the percent incidence of bract necrosis and decreased root growth. The smaller the root dry mass as a percent of total plant dry mass the greater the incidence of bract necrosis (Y = 0.0972X² - 3.78X + 38.7, R² = 0.69).

334  
**The Response of Long-day Herbaceous Perennials to a Night-interruption at Low Night Temperatures**

Alison Frane*, Royal Heins, Art Cameron, and William Carlson, Dept. of Horticulture, Oklahoma State Univ., Stillwater, OK 74078

Rooted cuttings of four woody cut species, Buddleja davidii ‘Black Knight’ (butterfly bush), Forsythia x intermedia ‘Lynda’s Gold’, Salix chaenomeloides (Japanese pussywillow), and Salix matsudana ‘Tortuosa’ (corkscrew willow) were planted outdoors in 23 Apr. 1992. During the next year, forsythia, pussywillow, and corkscrew willow plants were either unpruned or pruned to 30–45 cm above the ground: 1) during dormancy or immediately after harvest (winter); 2) 3 to 4 weeks after start of shoot growth (spring); or 3) in early June (summer), and number and length of stems harvested was recorded for three years. Butterfly bush was either unpruned or pruned to 8 cm above the ground during: 1) winter or 2) spring, and number and length of stems recorded for 2 years. Stem length and number increased each year for all four species, and all species produced harvestable stems within 1 year after planting. For forsythia, no differences due to treatment were found, although year by treatment interactions were noted. The unpruned control produced the longest and greatest number of stems for pussy willow. Winter or spring pruning produced the longest and greatest number of stems for corkscrew willow. For butterfly bush, spring or no pruning produced the greatest number of stems, and year by treatment interactions were noted.

335  
**Plant and Pinch Number for Alternative Hanging Basket Crops Affect Quality and Scheduling**

Terri Woods Slaman*, Millie S. Williams, and James E. Faust, Dept. of Ornamental Horticulture and Landscape Design, Univ. of Tennessee, Knoxville, TN 37910-1071.

The objective was to determine the optimum number of plants and the number of pinches required to market a basket for hanging basket production using alternative floriculture species. The number of plants per pot varied from one to four, and the number of manual pinches per basket ranged from 0 to 2. Several species were evaluated in spring of 1996 and heat tolerance was assessed throughout the summer. Plugs (50–95 plugs per flat) were transplanted into 25-cm hanging baskets in a 22/18°C (venting/night temperature set points) glasshouse. Three to four plants were necessary for Scaevola aemula ‘Fancy Fan Falls’ and Eulovius gloriosus ‘Blue Daze’ to produce a marketable basket. One plant per pot was sufficient for Abutilon hybrid ‘Apricot’, Portulaca oleracea ‘Apricot’, and Tabichona ‘Spanish Shaw’ without sacrificing quality; however, an additional 1 to 3 weeks production time was needed in comparison to the four plants per pot treatment. Abutilion and Portulaca required one pinch, while Tabichona did not require pinching. All plants x pinch combinations produced quality baskets with Sutera cordata ’Mauve Mist’ and Diascia hybrid ‘Ruby Fields’, therefore, production methods should be based on growers’ scheduling and cost analysis. Abutilion, Eulovius, Portulaca, Scaevola, and Tabichona performed well in hanging baskets throughout the summer. Two species in the trial, Orthosiphon stamineus ‘Lavender’ and Tabernanontana coronaria, displayed upright growth habits and would be best for uses other than hanging basket production.

336  
**Pruning Method Influences Stem Length and Number of Four Woody Cut Species**

John M. Dole*, Janet C. Cole, and Vicki Stambach; Dept. of Horticulture and Landscape Architecture, Oklahoma State Univ., Stillwater, OK 74078

Rooted cuttings of four woody cut species, Buddleja davidii ‘Black Knight’ (butterfly bush), Forsythia x intermedia ‘Lynda’s Gold’, Salix chaenomeloides (Japanese pussywillow), and Salix matsudana ‘Tortuosa’ (corkscrew willow) were planted outdoors in 23 Apr. 1992. During the next year, forsythia, pussywillow, and corkscrew willow plants were either unpruned or pruned to 30–45 cm above the ground: 1) during dormancy or immediately after harvest (winter); 2) 3 to 4 weeks after start of shoot growth (spring); or 3) in early June (summer), and number and length of stems harvested was recorded for three years. Butterfly bush was either unpruned or pruned to 8 cm above the ground during: 1) winter or 2) spring, and number and length of stems recorded for 2 years. Stem length and number increased each year for all four species, and all species produced harvestable stems within 1 year after planting. For forsythia, no differences due to treatment were found, although year by treatment interactions were noted. The unpruned control produced the longest and greatest number of stems for pussy willow. Winter or spring pruning produced the longest and greatest number of stems for corkscrew willow. For butterfly bush, spring or no pruning produced the greatest number of stems, and year by treatment interactions were noted.

337  
**Unblended or Co-blended Composts for Production of Potted Chrysanthemum**

Catherine S.M. Ku* and John C. Bouwkamp, Dept. of Natural Resource Sciences and Landscape Architecture, Univ. of Maryland, College Park, MD 20742-5611

Blending compost from various feedstocks may increase the beneficial effects of compost as potting substrate. A factorial treatment combinations included 10 compost combinations, Sunshine Mix and Pro Gro 3005 as controls, three compost levels, and three chrysanthemum cultivars. The compost combinations were Compco (CP), poultry litter (PL), PS2 polymer dewatered biosolids (PS2),...
yard trimmings (YT), CP:PL, CP:PSG, CP:YT, PL:PSG, PL:YT, and PSG:YT; all blends were on a 1:1 ratio (v/v). The compost levels were 50%, 75%, 100%, and chrysanthemum cultivars included ‘Boaidi’, ‘Cherry Davis’, and ‘Yellow Favor’. All treatments were replicated six times. Plants were fertilized with 100 mg/L N from 20N–8.6P–16.9K twice weekly. All compost substrates, except PSG blends produced plants that were shorter than the controls. All compost blends produced similar or greater number of flowers than the controls. Plants grew in substrates containing PSG and/or CP produced dark green or green foliage; and other substrates produced plants with pale green leaves. The PSG:PL and PSG:YT blends produced premium-quality plants. All other compost blends produced good-quality plants that were similar to the controls.

338 Zinc Uptake by Pelargonium x hortorum Grown in Shredded Tire Rubber-amended Media

Mohammad Baof* and Richard L. Harkess; Dept. of Plant and Soil Sciences, Mississippi State University, Box 9555, Mississippi State, MS 39762.

On 2 Feb. 1996, rooted cuttings of Pelargonium x hortorum L. H. Bailey cvs. Tango and Blues were planted in 750-cm³ (14 cm in diameter) pots containing peatmoss mixed with shredded tire rubber (2–6.0 mm particle size) at 0%, 20%, 40%, 60%, or 80%. Plants were irrigated by hand, drip, or ebb-and-flow, and were arranged in a split-plot experimental design. A wetting agent (Aqua Gro 2000 L, Aquatrols Corporation, Cherry Hill, N.J.) was mixed at the rate of 6 ml per 3750 ml of water and 120 ml of solution was applied to each plant. Greenhouse studies indicated that geraniums could be grown successfully in media containing up to 20% shredded tire rubber by volume when irrigated by hand. Plants grown in media containing more than 20% rubber were observed to be slow-growing and chlorotic. Tissue analysis of the plants indicated significantly increased levels of zinc in plants grown in media containing high percentages of rubber. Geraniums grown in media containing 80% rubber and irrigated using ebb-and-flow benches had the significantly highest levels of foliar zinc. Media porosity, percent air space, and bulk density increased, while water holding capacity decreased with increasing amounts of shredded tire rubber added to the media.

339 Geranium and Marigold Response to Fish Waste Compost as a Container Growth Medium and Nitrogen Source

Rita L. Hummet*, Shiou Kuo, Diane Winters, and Eric Jellum; Washington State University. Puyallup Research and Extension Center, Puyallup, WA 98371-4998

A fish waste/hemlock-fir sawdust compost (FWC) was evaluated as a container growth medium and N source for the greenhouse production of marigold (Tagetes patula 'Queen Sophia') and geranium (Pelargonium x hortorum 'Sprinter Scarlet') in 10-cm containers. Treatments were a factorial set of three Douglas-fir bark (B)/three FWC mixtures (100% FWC: 50% FWC/50% B; 100% B) and three rates of N fertilizer (0, 300 and 600 ppm N) applied every 2 weeks. After the initial irrigation, plants were drip-irrigated to negate leaching from the containers. Weekly measurements of leachate conductivity, pH, and inorganic N were made on additional replications of the 0-ppm N plants in all growing media. Plant height and width were measured at 2-week intervals and, at the end of the production cycle, flower number, shoot fresh and dry weight, visual quality, and root dry weight were measured. The growing medium by N interaction was significant for all variables. Results indicated that plants receiving 0 ppm N in 100% FWC were larger and of higher quality than plants in 100% B receiving 600 ppm N. In 100% FWC, marigold shoot growth, dry weight, and quality were not influenced by N rate. The observed geranium and marigold growth response indicated that FWC was an effective N source and growing medium when leaching was minimized with drip irrigation.

340 Cell-pack Size and Spacing Requirements for the Transplanted Floral Meadow

Kathryn S. Hahn* and Richard L. Harkess; Dept. of Plant and Soil Sciences, Box 9555, Mississippi State University, Mississippi State, MS 39762

The Transplanted Floral Meadow is a culture technique designed to provide an herbaceous planting of continuous seasonal bloom beginning about 1 month after transplanting to the landscape. The technique requires little or no maintenance once the plants have become established. The meadow consists of a seed mix of annual flowers that are started in the greenhouse in mixed plugs and transplanted to the landscape. In this study, plugs of the annual transplanted floral meadow seed mix were started by broadcasting the seed mix over flats of standard nursery cell-packs filled with a commercial growing medium. The plugs were grown in the greenhouse and transplanted to plots 4 weeks after sowing at 30 x 30, 30 x 45, or 30 x 60-cm spacing. The plug sizes used were 801, 1801, 804, or 1804 cell-packs. The plugs were transplanted to 2.25-m² plots with three replications, each plot being a replication. Plug size and spacing were evaluated based on the rate of canopy closure measured biweekly as the amount of photosynthetically active radiation penetrating the canopy. Close transplant spacing with large plug sizes provided the quickest site coverage. The 1801 and 801 plug sizes provided the greatest species diversity. The 1804 plug size reduced the number of seedlings present at the time of transplanting and did not cover the site until late in the season. The 801 and 1801 plug sizes at 30 x 30- or 30 x 45-cm spacing resulted in the best floral display. The results of this research will be used to standardize the transplanted floral meadow technique for use as a new product in the nursery trade.

341 Assessment and Evaluation Program for the Australian Native Flower, Ixodia achilleaoides

Gail E. Bard*, South Australian Research and Development Inst., Adelaide, South Australia

A research program is being conducted to support the development of superior varieties of Ixodia achilleaoides for cut flower production. This species is an everlasting daisy in the Asteraceae, which is produced on a woody perennial bush and is currently both harvested from the wild and cultivated in Southeastern and Western Australia. Ixodia shows a high degree of variation in plant form, flower characteristics, and flowering dates throughout its geographic distribution. In our assessment program, seedlings are screened for a range of morphological and flowering characteristics, and clonal selections are established under cultivation to assess suitability to row culture. The goal is the development of selections with known flowering characteristics and disease tolerance for fresh and dried flower markets and for flowering pot plants. Description is given of assessment criteria for selection of varieties for dried and fresh markets. Seventy selected varieties are currently being assessed in randomized block plantings at two sites in South Australia. Preliminary results and descriptions are presented for superior selections made for dried flower markets. The postharvest performance of selections for fresh markets will be discussed. Research on control of flowering will be presented.

342 Late-season Establishment of Annuals

Lynn Bunney* and Richard L. Harkess; Dept. of Plant and Soil Sciences, Box 9555, Mississippi State University, Mississippi State, MS 39762

Maintaining annual color throughout the long summer season in warm temperate regions has become an interest to landscapers and nursery operators. Some colorscaping companies have begun implementing a second summer planting season. There is little information available concerning suitable cultivars and species of bedding plants for establishment in late summer. This study examined plant establishment in two container sizes and three dates of transplanting to determine late season establishment in Starkville, Miss. (33°27' latitude, 88°49' longitude). Seeds of 27 different cultivars were grown in plug flats in the greenhouse and transplanted into jumbo 605 or 10-cm square containers. The plants were grown in the greenhouse until transplanting on 16 Aug., 30 Aug., or 13 Sept. 1996. The plants were transplanted into plots containing nine plants with three replications per planting date. The plants were spaced on 20-cm centers among and between plots. The earliest two plantings resulted in better plant establishment and floral display. Some of the cultivars and species were more tolerant of the late season temperature and humidity establishing and providing a good color display from 6 weeks after transplanting until frost, 2 Nov. 1996. Cultivars that performed well included: Impatiens walleriana 'Deco Crystal', Expo Lavender Bush, 'Dazzler Salmon', Begonia semperflorens 'Varsity Bronze Scarlet', Zinnia 'White Pinwheel', Tagetes erecta 'Marvel Gold', and Tagetes patula 'Bonanza Harmony'. Cultivars that did not establish well under these conditions included: Verbena hybrid 'Romance Pink' and Salvia splendens 'Salsa Salmon'. The container size did not significantly affect plant establishment.

343 Effect of Rootstock on Nitrogen and Water Use in Apple Trees


One-year-old 'Fuji' apple trees on six rootstocks (Mark, M.9, M.26, M.7A, MM.106, and MM.111) were compared for N and water uptake and utilization. The trees were potted in sand and subjected to a 75-day N-deprivation period (supplied with modified Hoagland's solution lacking N) to deplete their N reserves. Thereafter, they were supplied with a complete modified Hoagland's solution. Uptake of water and N differed by rootstock. Water and N uptake were positively related to tree dry weight (r = +0.97, P = 0.001). Trees that had the highest N concentrations at planting were the last to set bud during the N-deprivation phase. Tree size after one growing season depended largely on rootstock girth and whole-tree-N-concentration at planting (r = 0.80, P = 0.0001) regardless of rootstock. Water and N uptake efficiency (filter of water or mg N absorbed per g root dry weight, respectively) differed among the rootstocks, being highest for trees on MM.111 and lowest for trees on M.7A rootstock. Nitrogen and water utilization efficiency (g dry weight gained per mg N or per liter of water absorbed, respectively) were not influenced by the rootstock.

344 Uptake Patterns of 11 Elements of Orange Trees in Solution Culture

H.K. Wulfscher*, USDA/ARS, U.S. Horticultural Research Laboratory, 2120 Camden Rd., Orlando, FL 32803

Three trees each of 'Valencia' orange (Citrus sinensis L. Osbeck) on rough lemon (C. limon L. Burm. f.) rootstocks that had been grown in solution culture since July 1989 were grown in two solutions from Oct. 1995 to Sept. 1996. Solution 1 was a soil extract made by boiling field soil (1:2 soil:water) for 20 min and filtering. Solution 2 was a complete nutrient solution. The solutions were analyzed every 7 days and changed every 28 days. At each solution change, the newly prepared solutions were analyzed for 11 elements and their depletion was determined by weekly analysis. Nearly all the N, K, and Mn in Solution 1 was absorbed in the first 7 days after each solution change; in Solution 2, N and Mn were also absorbed in 7 days, but K absorption was variable; single trees sometimes needed 4 weeks to absorb all the potassium. Calcium and Mg were never completely absorbed and in contrast to Mn, traces of Fe, Zn, and Cu remained in both solutions after 4 weeks.

345 Yield and Quality of ‘Anna’ Apple Trees (Malus domestica L.) in Response to Foliar Application of Ascorbine and Citrine Fertilizers

F.F. Ahmed1, A.M. Ak5, A.A. Gobara1, and A.E.M. Monsour2, 1Horticulture Dept., Faculty of Agriculture, Minia Univ., Minia, Egypt; 2Horticultural Research Dept., National Research Centre, Dokk, Egypt

The beneficial effect on yield and quality of 'Anna' apple fruits for the application of ascorbine at 0.1% and citrine at 0.6% was studied during 1995 and 1996. Results showed that two citrine sprays at start of growth and 30 days later had the most effect on yield, fruit weight, total soluble solids, and total sugars, while reducing the total acidity. Both fertilizers were equally very effective in all the studied characters. The most striking and promising treatment was the application of ascorbine at 0.1% or citrine at 0.6% twice during the growing season, i.e., growth start at 30 days later.

346 The Effects of Differing Potassium Status (K) On English Walnut Tree Growth, Yield, And Nut Quality

William H. Olson*; Univ. of California, Davis, 118 Ridgeview Lane, Davis, CA 95616

Six years of previous research in a 12-year-old English walnut orchard, with a history of potassium deficiency, created a large number of trees with different potassium status. This provided the opportunity to study the long-term effects of different potassium status has on English walnut tree growth, productivity, and nut quality. Walnut trees with a history of potassium deficiency, adequacy or luxury continued in this mode during this evaluation. Positive correlations existed between July leaf potassium levels and trunk and sectional area (TCSA), visual potassium status, percent husk potassium, yield per tree, and tree yield per TCSA. These positive correlations suggest July leaf potassium levels of 1.4% to 1.5% as being adequate. This is higher than the 1.2% leaf potassium level currently recommended as being adequate for a July sample. Poor or no correlations existed between July leaf potassium levels and percent shell potassium, shell weight, shell breaking force, percent broken shell, nut size, nut weight, percent kernel potassium, percent light-colored kernels, percent edible kernel, percent kernel yield, or percent shriveled kernel. Trees with leaf potassium levels at or above 1.5% July leaf potassium produced 80 pounds per tree more yield than trees with leaf potassium levels at or below 1.0% July leaf potassium levels. These data indicate that good tree potassium status influences tree size and tree productivity. Also the walnut husk is an important sink for the accumulation of potassium. Currently recommended adequate potassium levels for walnut appear to be lower than what this study indicates.

347 Solution pH and Papaya Seed Germination and Seedling Emergence

Robin A. DeMeo and Thomas E. Marler*; College of Agriculture & Life Sciences, Univ. of Guam, Mangilao, GU 99923

Two studies were conducted to determine the influence of pH on papaya seed germination and seedling emergence. The germination test was conducted with 'Waimanalo' and 'Tainung 1' seeds, using a double layer of filter paper disks in plastic petri dishes placed within a growth chamber. Each dish received 40 seeds, and germination was defined as when the radicle was visible. Disks were wetted daily with nutrient solution adjusted to pH of 3, 4, 5, 6, 7, 8, or 9. Germination began on day 5, and the study was terminated on day 23. Solution pH did not influence germination rate or ultimate germination percentage. 'Waimanalo' exhibited 58% germination and 'Tainung 1' exhibited 64% germination in this test. The seedling emergence study was conducted with 'Waimanalo' seeds using sand culture within a growth chamber. Thirty seeds were planted in 10-cm containers, and the sand was irrigated daily with the solutions from the first study. Emergence was defined as when the hypocotyl hook was visible above the sand. Emergence began on day 10, and the study was terminated on day 30. Solution pH did not influence seedling emergence, and mean emergence was 69% in this study. The results indicate that the seed germination and seedling emergence stages of papaya seedling growth are adapted to a wide range of substrate pH.

348 Mineral Relations and Growth of Annona muricata Seedlings as Influenced by Substrate pH

Thomas E. Marler* and Grace B. Paloma, College of Agriculture & Life Sciences, Univ. of Guam, Mangilao, GU 99923

Container-grown Annona muricata seedlings were bare-rooted and re-potted in sand. Containers were irrigated daily with a complete nutrient solution adjusted to a pH of 3, 4, 5, 6, 7, or 8, and the seedlings were grown for ~5 months. Numerous growth variables were measured, including canopy volume, increase in mass, and trunk diameter. There were no differences in growth measurements among the pH levels. Moreover, leaf tissue was analyzed for mineral content. Leaf tissue concentration of various minerals did not differ among the pH levels. Annona muricata is known for growing well in a range of soil conditions. These data verify that the species is adapted to a wide range of substrate pH.

349 The Effect of Aluminum and Media on the Growth of Mycorrhizal and Nonmycorrhizal Highbush Blueberry Plantlets


A factorial experiment was conducted to determine the effect of aluminum (0 and 600 μM) and media (sand, 1:1 sand:soil) on mycorrhizal (M) and nonmycorrhizal (NM) highbush blueberry plantlets. There were no differences in nutrient uptake and total plant dry weight between M and NM plantlets. However, more root growth, as determined by dry weight, was observed in M than NM plantlets. The plantlets growing in sand had more dry weight than those in the