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# Abstracts of the ASHS Southern Region 57th Annual Meeting

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## J.B. Edmond Undergraduate Competition

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### The Effect of UV-B Lamp Light on the Growth of Three Bedding Plant Species

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The effect of UV-B fluorescent lamp light on seedling elongation was investigated using three species: marigold (*Tagetes* sp.), cucumber (*Cucumis sativa*), and tomato (*Lycopersicon esculentum*). Seedlings were exposed to light supplied from two unshielded and unfiltered 40-watt UV-B fluorescent lamps. In two experiments, seedlings were placed a distance of 45 cm below the light for varying lengths of time, while seedlings were placed 60 cm below the light in a third experiment. For marigold, seedlings were shorter when germinated under the UV-B lamp than when germinated under natural light in a glasshouse. Two hours of exposure just after glasshouse germination (cotyledons unfolded) was effective in reducing height of cucumber seedlings, whereas 6 hours was required to significantly reduce the height of tomato seedlings. Treatments were still effective when the last measurements were taken 12 to 14 days after germination. Exposure of seedlings to UV-B lamp light provides a possible alternative means of preventing excessive seedling elongation instead of relying on chemical plant growth regulators.

### Impacts of Inundation on Tree Species in a Semiarid Region

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The geographically uniform Texas Panhandle is dotted with shallow, ephemeral water bodies (playas), that quickly expand and contract in size. Numerous playas have been incorporated into the storm and surface-water management plan for the City of Lubbock, Texas; these playas often are surrounded by public parks. In the past, trees were planted around playas without regard to their flood tolerance. For these reasons, the objectives of this study were to catalogue trees around city playas and to determine which of these tree species survived inundation. The trees in the flood zones of eight city parks were catalogued by species in 1995, immediately after a 5-inch rain event. The water levels in all parks were monitored for the subsequent 4-month period to determine inundation time for each tree. The health of these trees was visually assessed annually. Bald cypress, mulberry, American elm, and sycamore improved in health, while the other tree species declined. Surprisingly, weeping willow and corkscrew willow, along with cedar elm, suffered the greatest decline in health.

### Effects of Preemergence Applied Herbicides on Pampas Grass

C.K. Palmer, C.H. Gilliam, G.J. Keever, J.W. Olive, and D.J. Eakes, Department of Horticulture, Auburn University, AL 36849

Pampas grass seedlings in 72-cell pack containers were transplanted into containers with a root observation window (17.8 × 10.2 cm) and treated with selected preemergence applied herbicides. Root numbers were counted in the upper and lower 8.9 cm of the viewing window until 16 days after treatment (DAT) when the windows became full of roots. Root growth in both the upper and lower window was suppressed with application of Factor 65 WG and Pendulum 60 WDG at the X and 2X rates at 16 DAT. Ronstar 2G and Pendulum 2G at the recommended rates and nontreated control plants had similar root numbers at 16 DAT. At 16 DAT, the greatest number of club roots formed on plants treated with the dinitroaniline herbicides; Pendulum 2G, Pendulum 60 WDG, and Factor 65 WG. Shoot growth was not affected by treatment.

### The Wiley-Boone Aviary: A Bird Garden

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The Wiley-Boone Aviary is a collection of domestic/exotic birds established at the Morgan Poultry Center at Clemson University in the mid-1970s. The area receives 3000 visitors per year, mostly school children. To make the site more aesthetically pleasing and conducive to educational programs, a new design was necessary. The Aviary was selected for redesign as an independent project in Fall 1995. Objectives of the design were: 1) creating an area conducive to housing, attracting, and viewing birds; 2) educating visitors through interactive display areas; 3) creating a bird garden that will attract and educate the public while providing natural food sources, cover, and nesting sites. Plants such as *Pyracantha coccinea*, *Amelanchier arborea*, and *Juniperus virginiana* provide winter berries production and protection from predators. Final plans feature: 1) individual aviary structures for exotic, game, and domestic birds; 2) open habitats for mallards and song birds; and 3) an amphitheater for educational purposes. Project steps include research, site analysis, preliminary design, and final master plan. As part of fund-raising activities, the master plan was displayed at the spring festival of the South Carolina Botanical Garden. This, combined with publications, will stimulate community awareness and participation as we approach the implementation phase of the project in Spring 1997.

### Oak Savannah Restoration—The First Year After a Control Burn

Brian Irish\* and Laurin Wheeler, Department of Horticulture, 316 Plant Sciences, Fayetteville, AR 72701

A control burn was conducted in a mixed black oak–white oak–post oak stand to determine the effectiveness of fire at removing midstory and understory trees. The midstory and understory was predominately invading species of red maple, dogwood, black cherry, black gum, and mockernut hickory with lesser amounts of canopy

species—black oak, white oak, post oak, and blackjack oak. A total of 17,000 stems/ha were top killed. All stems below 10 cm (15,600 stems/ha) were killed and all of the invading species were all top killed. Large black oak (greater than 20 cm) were killed by hypoxylon which may or may not have been related to fire. Soil pH increased from 4.6 (before) to 5.7 after the burn. The litter layer was almost completely removed. The biomass of the litter layer the year after the burn was 23% of the biomass before burning. Herbaceous plants began to invade the site in the first summer.

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## Norman F. Childers Graduate Competition

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### Disease Incidence on Old Garden Roses in the South

Beth Clendenen\*, B.K. Behe, and K.L. Bowen, Alabama Agricultural Experiment Station, Department of Horticulture, 101 Funchess Hall, Auburn University, AL 36849-5408

Eleven rose cultivars were field planted and evaluated weekly for disease, defoliation, and overall vigor in order to compare natural resistance to blackspot (*Diplocarpon rosae*). Alternative treatments were also compared for efficacy in low-maintenance disease control. Treatments included a bimonthly application of chlorothalonil, a bimonthly application of a horticultural oil, an application of chlorothalonil based on rain events, and a no-treatment control. Cultivars showed significant differences in disease severity, defoliation, and overall performance, with old garden rose varieties showing more natural disease resistance than modern susceptible varieties included in the study. Chlorothalonil applied on a 14-day spray schedule did provide a significant decrease in blackspot disease severity when compared to other treatments. A significant incidence of secondary disease including *Cercospora rosicola* and *Botrytis cinerea* occurred on old garden rose varieties. No treatment differences were found for these diseases. 'Belinda's Dream', 'The Fairy', and 'Red Mediland' ranked highest in overall performance throughout the season.

### The Use of Film-forming Antitranspirants to Control Rose Blackspot Disease

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Five antitranspirant materials, a horticultural oil, the fungicide chlorothalonil, and an untreated control were applied to rose plots using one of four application schedules. After 12 weeks, treatments were evaluated for their effectiveness in control of blackspot. Disease ( $P=0.0022$ ) and defoliation ( $P=0.0008$ ) showed significant treatment differences, while vigor and flowering were unchanged. Two antitranspirants, Stressguard 0.05% applied every 2 weeks and NuFilm 17 1% alternated with chlorothalonil around rain events, gave similar disease control to weekly chlorothalonil applications. One antitranspirant, Vapor Gard, 1% alternated with chlorothalonil around rain events, gave similar defoliation control to weekly chlorothalonil applications. These results indicate that blackspot disease can be effectively managed with fewer applications of chlorothalonil.

### Performance of *Cornus florida* L. Selections in the Southeast

R.B. Hardin\*, D.J. Eakes, C.H. Gilliam, and G.J. Keever, 101 Funchess Hall, Department of Horticulture, Auburn University, AL 36849

In a full-sun Auburn, Ala., field study, 23 cultivars and 1 forma of *Cornus florida* L. were evaluated for growth from 1994 to 1996 and bract characteristics in Spring 1996. The selections were divided into

three groups for analyses: 1) white bracted with green foliage, 2) red or pink bracted with green foliage, and 3) variegated foliage. Among the white bracted cultivars with green foliage, 'Weaver' and 'Welch Bay Beauty' had the greatest height and stem diameter increases, 'Autumn Gold' the least. 'Cloud 9' had the largest bract size. 'Welch's Junior Miss' had the greatest height increase, while 'Stokes' Pink' had the greatest stem diameter increase for the red or pink bracted cultivars with green foliage, and f. *rubra* the least. 'Red Beauty' had the largest bract size. There were no differences among the variegated cultivars in height increase or bract size; however, 'First Lady' had the greatest stem diameter increase.

### Experiments with Locust and Willow Diffusates on Rooting Cuttings

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Aqueous diffusates of either *Salix erythroflexus* (contorted willow) or *Robinia pseudoacacia* (black locust) were tested as a root-promoting substance on woody plants and *Vigna radiata* (mung bean). On 8 July 1995 water diffusates were prepared from fresh chopped terminal stems of either willow or locust (680 g) that were steeped in 4 liters of water for 24 hours. Semihardwood cuttings of *Chionanthus retusus* were double wounded, steeped in either willow, locust, or water for 24 hours followed by a treatment with 3.0% IBA in talc. One additional group of cuttings was treated with 3.0% IBA only. After 75 days, cuttings treated with willow diffusate and IBA produced the greatest number of roots, followed by the locust diffusate and IBA treatments. A similar test using willow diffusate and IBA on softwood cuttings of *Chionanthus virginicus* resulted in an 80% success rate. A modified mung bean bioassay was used to partially characterize and verify the effects of the diffusates. Diffusates were made from chopped frozen locust or willow terminal stems (10 g/300 ml H<sub>2</sub>O), stirred for 24 hours. Mung bean cuttings treated with either locust or willow diffusate (5 ml/10 ml H<sub>2</sub>O) plus 80 ppm IBA produced more roots than IBA or either diffusate alone. A dose response test showed a significant increase in rooting as concentrations increased (H<sub>2</sub>O, 10%, 50%, 75%, and 100%) for both diffusates. Ethyl acetate extractions of each diffusate at pH 3.0 produced more roots than extracts at pH 7.0. A thermal stability test (20 min at 100 °C) on the diffusates showed willow maintained its root-promoting activity, while locust did not.

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## Education

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### Pizza Farm Presents Agriculture to Youth

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A circular garden, divided into eight sections or "slices," was established for the purpose of demonstrating agriculture to youth. Each section of the garden represents a form of agriculture associated with the consumption of pizza. Soybeans were planted to represent oil, wheat to represent flour, vegetables to represent tomato sauce and vegetable toppings, herbs to represent spices, and pine trees to represent paper and cardboard products. A dairy cow, beef cow, and pig were fenced within separate sections to represent cheese, beef, and pork, respectively. The idea originated in Madera, Calif., from Thank-a-farmer, Inc. and was used with permission. The garden is an ongoing cooperative effort between research and extension personnel of Mississippi State University, local county officials, and area schools. The project has garnered support from the Mississippi Cattle Industry Board (start-up and maintenance funds), Heritage Vinyl Products (fencing), D.P. Fence Co. (construction), and Dominoe's Pizza (pizza lunches for the youth). We anticipate at least 1000 school children to visit the "Pizza Farm" each year, and we expect the community to continue to support and take pride in this project.

## Visits to Public Gardens: Its Meaning for Avid Gardeners

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This study examined how avid gardeners experience a public garden. Phenomenological interviewing was the qualitative research method used to collect data from six avid gardeners who frequently visited a public garden. Data about the gardener's beliefs and actions regarding their gardening history, gardening practices, and involvement with public gardens were gathered. From an inductive analysis, a conceptual model of a gardener's world was delineated. This study found that a gardener's world is composed of four dimensions that include: 1) personal history, 2) social connections, 3) human well-being, and 4) learning experiences. The dimensions of a gardener's world are the personal learning constructs through which gardeners experience their plant world. It is through these dimensions that the avid gardeners in this study experienced a public garden. Each of the four dimensions of an avid gardener's composition influenced how participants experienced a public garden. Participants used a public garden to socially interact with others, enhance their human well-being, strengthen their gardening background, and extend their gardening knowledge and skill. Several categories of activities and events emerged within the four dimensions of an avid gardener's world to inform us how gardening plays an integral role in gardeners' lives.

## Extracurricular Activities Enhance Landscape Horticulture Programs

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Strong academic abilities and practical work experience are important to employers of horticulture graduates. In greatest demand are students with competent personal and leadership abilities and technical skills. Increased class size and increased university core curriculum requirements hinder our capacity to develop these added skills within our curriculum. However, through extracurricular offerings we can offer students ways to develop skills that are not fully expressed in the academic arena. Student interaction in the traditional horticulture club requires practicing interpersonal relation and often conflict resolution skills. Students learn to work as a team to accomplish goals that they have set for themselves as a group. The Associate Landscape Contractors of America (ALCA) Student Career Days experience offers a highly effective means for reinforcing cognitive skills gained in the classroom and laboratory, as well as supplementing academic learning opportunities with technical activities beyond those offered in the curriculum.

## Cooperative Education and Internships at the Birmingham Botanical Gardens

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The BBG is a facility of the City of Birmingham Park and Recreation Board and operates as a coalition of the City's professional staff and resources as well as those of the Botanical Society (Friends), Alabama Cooperative Extension System (both groups maintaining offices at the BBG), 2 local community colleges, 12 specialized plant societies (that aid in the maintenance of collections), 100+ garden clubs, numerous related groups, and a strong community support. Current discussions with the University of Alabama in Birmingham will lead to certified programs at the Gardens. There are no formal contracts but informal agreements that are formed for each project. The Society sponsored the 1980 Master Plan and updates it every 10 years, employs a professional educator, and sponsors numerous special activities and programs, many in conjunction with the previously mentioned groups. Internships are hired and paid through the City. Students are rotated weekly through the various operations of the Gardens, including administration, education, taxonomy, and the Library. A special project is done in the area of interest to the student.

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## Extension

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### Networking with Industry for Professional Certification

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The North Carolina Landscape Contractors Association and the North Carolina Association of Nurserymen have cooperated with the NCSU Horticulture Department Extension Landscape Specialist in providing study resources, a demonstration garden, training seminars, and workshops to the landscape and nursery industry. The Certified Plant Professional Program certifies nursery and garden center employees on plant identification and ornamental plant care. Over 350 woody ornamentals, herbaceous perennials, and annuals are in the study guide. A total of 893 folks have been certified since the program began in 1986. County agents teach classes on a regional level. Three tests are given annually. The Certified Landscape Technician's exam is given annually, after many workshops and training sessions are offered. The professional standards of the industry are being improved by the results of the networking with the industry associations.

### Georgia Center for Horticulture: A Statewide Network for Serving Urban Clientele and Environmental Horticulture Professionals

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A proposed Center for Horticulture within the College of Agricultural and Environmental Sciences of The University of Georgia will target both Environmental Horticulture professionals and homeowners. To be headquartered at the Georgia Experiment Station in Griffin, Ga., with satellite units in Atlanta, Athens, Tifton, and Savannah, the Center will utilize advanced communications technology in developing and delivering educational outreach programs for clientele. Distance learning via fiber optics telecommunications will be used to provide educational short courses and seminars to clientele across the state. Distance imaging will be used for plant problem solving and plant identification. Newsletters, pest alerts, program announcements and other information will be sent electronically to clients via fax, e-mail, or the World Wide Web. Marketing of Georgia-grown crops will be a major thrust of the Center. A second component of the Center will be a public outreach unit, staffed by trained Master Gardeners, professional coordinator, and computer technician housed at the various satellite units. Citizens throughout the state will be able to phone one of the satellite units to get their gardening questions answered. Information will be sent directly to clients via fax, e-mail, or from the local county Extension agent when prompted via the computer to send the client an informational bulletin. A central server and database of information to support the Center will be maintained at the Georgia Experiment Station. The Center will utilize an interdisciplinary approach, involving teaching, research, and Extension personnel in responding to industry and consumer needs.

### Providing Extension Information Electronically—Easing the Transition From a Paper-Based System

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Cooperative Extension has relied heavily on the distribution of printed materials to accomplish its mission of providing research-based educational materials to agricultural producers and consumers. As the costs of print media have escalated and budgets have been reduced, Extension has continually sought more efficient and effective alternatives. World Wide Web information servers are central to this task, since they are relatively inexpensive to set up and operate, and can deliver high-quality materials for on-screen viewing or printing on demand. Recent developments (specifically the WebTV network) indicate the Web to be the medium of choice for Extension delivery systems. In addition to providing electronic versions of publications,

slide shows, and video clips, most Web browsers also support e-mail and interactive forms for obtaining information from the client. Analysis of Web server logs and guest registers can be used to determine client use patterns to address issues of access and accountability. The current and next generations of most word processing, page layout, and presentation software offer Web-ready layout as one saving option.

### Master Gardening at a Distance

David H. Nagel, Plant and Soil Sciences Department, Mississippi State University, Box 9555, Mississippi State, MS 39762

Master Gardener was taught by distance learning through the Mississippi Community College Network (CCN) in 1995 and 1996. Specialists delivered information from a studio on campus while the Master Gardeners were in classrooms in Clarksdale, Fulton, and Moorhead. The interactive video format was well accepted by most of the clientele. Specialists appreciated having to present each lecture once rather than traveling to each location and deliver each topic three times. The use of interactive video is currently being reevaluated due to two major factors: the increased use of CCN by Community Colleges has made scheduling the required weekly 4-hour block very difficult; and, the cost-ineffective method for delivering the training. Current Master Gardener training programs in Mississippi are being implemented through traditional classroom and field methods.

### Teaching Pruning through Television

R.F. Polomski\*, D.W. Bradshaw, R.H. Head, and G.L. Reighard, P.O. Box 340375, Department of Horticulture, Clemson University, Clemson, SC 29634

Two interactive pruning teleconferences were produced, each comprised of videotaped segments and in-studio pruning demonstrations. In the first videotaped conference, viewers received step-by-step instructions for pruning four small and tree fruits. Twelve woody ornamentals were pruned in the second conference. The "how-to-prune" segments were performed by Extension personnel and videotaped by University Electronic and Photographic Services. Each of the 2-hour conferences was broadcast live from a classroom television studio with a total of 30 in-studio participants and 178 county extension agents, Master Gardeners, and residents at downlink sites statewide. A toll-free number was available throughout the conference to encourage two-way communication. These teleconferences culminated in the creation of a library of "how to prune" videotapes, which are available to county agents, Master Gardeners, or residents. Also, several of these segments were aired on *C.U.E. Magazine*, a monthly, half-hour Extension-sponsored cable television program, and on *Making It Grow!*, a bimonthly, hour-long Clemson Extension program that is broadcast on SC-Educational Television.

### Using Video to Reach and Teach Radio Listeners about Horticulture

Robert F. Polomski\* and Robert E. McAnally, P.O. Box 340375, Department of Horticulture, Clemson University, Clemson, SC 29634

Although horticulture lends itself to videotaped instruction, I effectively used audiotaped "how to" pieces recorded via a television camera to enhance the educational impact of a live, call-in radio program. This monthly program (SCETV-Radio [91.3 WLTR FM]), which had an audience of 14,000 listeners in South Carolina and parts of North Carolina and Georgia, allowed me to educate listeners about horticulture and to respond to their gardening questions. In each hour-long program I included a 3- to 4-minute in-the-field segment of a specific horticultural practice, such as plant selection, soil preparation, planting, or pruning. In the absence of visuals, I relied on descriptive dialogue and in-the-field sounds to enhance the presentation, thereby enabling listeners to visualize the activity. A broadcast quality beta-cam television camera used to videotape horticultural pieces for television broadcasts (*Extension videotapes*, *C.U.E. Magazine*, and *Making It Grow!*) doubled as a recorder for radio. Using the television camera for video- and audiotaping maximized personnel time and equipment, in addition to improving the quality and content of the radio program.

### Computer Programs for Generating Weather-related Production Management Decisions

Arle A. Powell and Karl Harker, Auburn University, AL 36849

It is always challenging to develop innovative Extension programs delivery methods. The development of a winter chilling model (Modified 45) for Alabama, the evaluation of a growth regulator (Dormex—hydrogen cyanamide) to replace lack of chilling in peaches and the establishment of a computerized weather program allowed us to create a superior expert program for grower application. Access through a personal computer is all that is required to monitor chilling accumulation and determine the most ideal time for application of Dormex (which is very critical). This information (formerly available from NWS) is now accessible through a private weather firm. The development of a chilling hour/heat unit (growing degree hour) for peaches is showing promise of providing growers still another useful product (via their PCs) in improving orchard management via better timing of practices.

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## Floriculture/Ornamentals

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### Influence of Bark, Dolomite, and Fertilizer Sources on Leachate pH of Nursery Medium

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Leachates were collected at 3-month intervals over 12 months to determine the influence of bark, controlled-release fertilizer, and dolomitic lime sources and dolomitic lime application rates on pH of nursery media. The randomized complete-block design was arranged as a factorial and included three bark sources (pinebark, hardwood, and pinebark + hardwood), two fertilizer sources (Nutricote 17–7–8 and SierraBlen 18–7–10), and two dolomitic lime sources (micro-encapsulated granular and pulverized). Dolomitic lime application rates were 0, 5, 10, and 15 pounds per cubic yard. Leachate pH was influenced over the one-year evaluation period by fertilizer source, bark source, and application rate of dolomitic lime. Dolomitic lime source was not a significant factor in adjustment of leachate pH. Pinebark medium had lower leachate pHs than hardwood medium and the medium containing hardwood and pinebark. Dolomitic lime influenced leachate pH of pinebark medium more than the other bark sources. SierraBlen was more acid-forming than Nutricote.

### Dolomitic Limestone Form and Rate in Container Production of Woody Ornamentals

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Uniform liners of Soft Touch Holly (*Ilex crenata* 'Soft Touch') and Fashion azalea (*Rhododendron* 'Fashion') were potted into trade gallon containers of a 3 : 1 by volume pinebark : peat moss medium amended with 8.3 kg of 17–7–12 Osmocote and 0.9 kg of Micromax per m<sup>3</sup>. Dolomitic limestone rates were 0, 3, and 6 kg per m<sup>3</sup> of medium applied as a finely ground or pelletized product. Medium solution pH increased with increasing rate of dolomitic limestone. Ground dolomitic limestone had a greater impact on medium solution pH than pelletized dolomitic limestone and differences increased as rate increased. Addition of ground dolomitic limestone at 6 kg per m<sup>3</sup> reduced foliar color and growth of azalea. Amending with dolomitic limestone had little or no effect on holly foliar color or growth, regardless of rate.

### In Situ Measurement of the Rate of NO<sub>3</sub> Release from Controlled-release Fertilizers

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Controlled-Released Fertilizer (CRF) has a great potential for applications in the nursery container industry. However, the specific

mechanisms of the control are proprietary. The longevity claimed by manufacturers are unclear. The longevity of one CRF is claimed to be 2 to 3 months at 80 °F, resulting in a deviation of 30%. Thus, the actual release rate will have a 30% deviation from the claimed longevity. A preliminary study was conducted to test the longevity of two types of RCs. 1.00 g (7.7% NO<sub>3</sub>-N, fast release) and 1.30 g (5.9% NO<sub>3</sub>-N slow release) of CRF was added to 500 ml distilled water in separate flasks and stirred continuously at a low speed during measurement period. A nitrate electrode and a reference electrode were set in the solution. The nitrate electrode responded to the increase in nitrate concentration caused by nitrate release from the CRFs. The response analog signal from the nitrate sensor was input to a 16-bit analog/digital converter with 1-minute interval for each measurement. The results indicated that 9% of the nitrate from the fast CRF (2- to 3-month longevity) was released in 10 hours. About 11.5% of the nitrate from the slow CRF (8- to 9-month longevity) was released in 260 hours. Based on the observed release rates, a 2- to 3-month longevity CRF will last about 111 hours in the stirred distilled water at room temperature. A CRF with 8 to 9 month longevity will last about 94.2 days. Even though field conditions are different from the experimental conditions, the real longevity of CRF in the fields may have to be further investigated. In the tropical southern Florida climate, the release rates of nutrients from CRFs are likely to be enhanced.

### Real-Time Measurement of NO<sub>3</sub> and NH<sub>4</sub> Leaching from Plant Nursery Pots

Tianguen Wang\* and Stephen K. O' Hair, The University of Florida, Tropical Research and Education Center, 18905 SW 280th Street, Homestead, FL 33031

Concerns relating to pollution from nitrogen fertilizers leaching into ground water are increasing. This is especially important in southern Florida because the pollution threatens fragile ecosystems in Biscayne Bay, and the two National Parks that abut agricultural areas. The current research is focused on the development of an automatic system which can monitor NO<sub>3</sub> and NH<sub>4</sub> leaching from plant nursery pots. NO<sub>3</sub> and NH<sub>4</sub> electrodes and a load cell were used for real-time measurements of NO<sub>3</sub>, NH<sub>4</sub>, and leachate volume. The leachate was directed to pass the sensing areas of NO<sub>3</sub>, reference, pH, and NH<sub>4</sub> electrodes. It was collected and weighed in a container placed on a load cell. The analog signals from the electrodes and load cell were digitized through data acquisition technology using a 16-bit A/D converter and a self-developed software program. With this system the volume of the leachate and concentrations of NO<sub>3</sub> and NH<sub>4</sub> in the leachate were determined in situ. Based on this design, the dynamics of NO<sub>3</sub> and NH<sub>4</sub> leaching from pots can be observed. This system can be used to 1) determine soil (or media) holding capacity of NO<sub>3</sub> and NH<sub>4</sub>; 2) evaluate the effects of nitrogen fertilizer formulations on water quality; 3) develop best management practices of nitrogen application in containerized plant production; and 4) determine the soil-holding capacity to optimize the use of water. The advantages of the developed system are 1) low labor cost for sample collection and analysis and 2) high measurement resolution resulting from a minimization of errors that occur during sampling and other manual operations.

### Responses of Nine Containerized Perennials to Sumagic

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Nine perennial bedding plants were screened for responsiveness to the plant growth retardant, Sumagic (uniconazole-P). Two weeks after planting, plugs were treated with one foliar spray of Sumagic at 0, 40, 80, 120, or 160 ppm at the label-recommended volume. Plant growth of *Gaillardia grandiflora* 'Goblin' was not reduced by Sumagic. Height of *Achillea* x 'Moonshine' was reduced 8% to 12% at 4 weeks after treatment (WAT), and the reduction persisted through 8 weeks after planting (WAP) to the landscape. *Phlox paniculata* 'Joliet' responded linearly to increasing Sumagic rate with a maximum height reduction of 32% at 160 ppm. *Coreopsis grandiflora* 'Sunray', *Rudbeckia fulgida* var. *Sullivantii* 'Goldsturm' and *Monarda didyma* 'Blue Stocking' responded significantly to Sumagic with 30% to 60% height reductions at 4 WAT, but no persistent effects at 8 WAP. Height

of *Veronica alpine* 'Goodness Grows' was reduced 32% to 68% at 4 WAT, but all Sumagic rates resulted in persistent reductions in plant height at 12 WAP. Plant height of *Alcea rosea* mix and *Echinacea purpurea* were excessively reduced (up to 79%) at 4 WAT, but there were no persistent effects on height of *Alcea* in the landscape. All rates of Sumagic resulted in persistent reductions in height of *Echinacea* at 8 WAP, but only plants treated with 120 and 160 ppm Sumagic were still significantly shorter than controls at 12 WAP

### Arbitrary Signatures From Amplification Profiles (ASAP) Distinguishes Somatic and Radiation Induced Mutations in the 'Charm' Series of Chrysanthemum

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Four chrysanthemum (*Dendranthema grandiflora*) spontaneous and radiation-induced sports from the cultivar 'Charm' and phenotypically differing only in flower color were individually characterized using arbitrary signatures from amplification profiles (ASAP). ASAP analysis is based on a two-step arbitrary primer amplification procedure that produces "fingerprints of fingerprints." In the first step, 'Charm', 'Dark Charm', 'Dark Bronze Charm', 'Salmon Charm', and 'Coral Charm' were fingerprinted by DNA amplification fingerprinting (DAF) with standard octamer arbitrary primers. Diluted products from three monomorphic fingerprints for each cultivar were subsequently reamplified using four minihairpin decamer primers. Each of the 12 ASAP profiles revealed about 30% polymorphic loci and some were used to uniquely identify cultivars and estimate genetic relationships. The ASAP technique permits identification of previously genetically indistinguishable plant material and should facilitate marker assisted breeding and protection of ownership rights.

### Stabilization of Chimeral African Violet Clones by In Vitro Inflorescence Culture

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The pinwheel-flowering African violet 'Silver Summit', a periclinal chimera, has bicolor flowers with violet-blue corolla segment margins and white central stripes. Several off types were produced during in vitro culture of 'Silver Summit'—solid violet-blue flowering from leaf or petiole explants, solid white flowering from petiole core explants, and two reverse pinwheel flowering types. The reverse pinwheel types varied in color; one had deep violet-blue stripes (DR, dark reverse) and the other had lighter stripes of the same color (LR, light reverse). Plantlets derived from inflorescence culture (Murashige and Skoog medium containing 0.1 mg/l NAA, 0.1 mg/l BA) were grown on to flowering. Of 55 plants from LR inflorescences, 51 were true-to-type. The remainder were solid violet-blue flowering. Of 64 plants from DR inflorescences, only 8 were true-to-type, 17 were solid violet-blue flowering, one was white flowering, and 38 were mixed flowering. In vitro inflorescence culture can be used to clone pinwheel flowering African violets; however, chimeral stability of the plants produced varies between clones.

### Use of a Small Hydroponic System to Grow Marigolds in the Greenhouse

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Styrofoam ice trays were used to grow 'Discovery Yellow' marigolds transplanted 4 weeks after seeds were germinated and then grown in two nutrient cultures. The cultures were Hoagland at the rate of 1/2 ml/6 gal water and nutrient culture (20-10-20) at 2.4 ozs/6 gal water. Half containers were aerated and other half were not aerated. Data collected were root, stem, bloom fresh and dry weight, and stem length and number of blooms and leaves. Results showed that stem length, and number of leaves and blooms were significantly greater when grown in Hoagland solution. Fresh and dry weight of roots,

stems, and blooms were significantly greater when grown in Hoagland solution. Nonaerated treatments performed significantly better than aerated treatments for either hydroponic solutions.

### Cost Comparisons of Three Tree Species Using Three Alternative Production Methods

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In-field (IF) and above-ground (AG) container production of landscape ornamentals are both conventional methods which were compared to a newer production method, pot-in-pot (PIP). Our objective was to determine costs and economic feasibility for each method. Model nurseries were synthesized to represent a 4-ha nursery utilizing 2 ha of production area operating over a three-year period. Finished plant material were grown in 40-L containers for above-ground and pot-in-pot production, and 2 m ball and burlapped material for in-field production. One budget was constructed to reflect costs for *Lagerstroemia indica*, *Cornus florida*, and *Cupressocyparis leylandii* under each production method. Capital requirements and annual fixed costs for all three species were lowest for IF and highest for PIP production. Variable costs for all tree species were lowest for IF and highest for AG with PIP intermediate. With better utilization of a given production area, PIP had the lowest total cost of production, followed by AG and IF methods.

### The Use of a Variegated Plant to Determine Adaptations to Altered Light Levels

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Variegated *Dracaena sanderana* plants were grown under 47%, 63%, 80%, and 91% shade cloth. Prior to that, plants were grown under uniform light levels in a greenhouse. Morphological changes which manifested the adaptation to different light levels were not evident until all four leaves present in the apical whorl had expanded. Changes first appeared in a leaf which was 5–15 mm long when plants were placed under the different shade levels. The changes were recognized as alteration in the amount of leaf variegation which gradually changed as new leaves unfolded. After development of four leaves no further morphological changes were apparent. The first 'transition' leaf had variegation similar to the preceding leaf and the last 'transition' leaf had variegation comparable to the next successive leaf. The amount of variegation was quantified and the changes under different light levels determined. The use of a variegated plant enabled us to readily observe the morphological changes related to light adaptation and showed that a plant is an integrated system which adapts to altered environment over an extended period of time.

### Seasonal Interactions Among Genotype, Root Regeneration Potential, and Field Performance of Transplanted Container-grown Sycamore

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Seven half-sib families of *Platanus occidentalis* L., either genetically improved selections (TFS-09, TFS-24, WV-10, WV-14) or non-improved selections (Brazos-C, Brazos-D, Putnam), were grown outdoors in 2.3-L to 9.1-L containers, then transplanted in fall, spring, or summer to assess root regeneration potential (RRP) and initial (2 year) post-transplant landscape growth. TFS-09, TFS-24, Brazos-C, and Brazos-D were Texas selections, while WV-10, WV-14, and Putnam were from Tennessee and Kentucky. Generally, local half-sib families grew more rapidly than geographically distant families and some genetically improved selections grew more rapidly than non-improved selections, both in the landscape and nursery. Rapid growth of new roots and transplanted root dry matter were more consistently associated with successful transplant establishment across families than other measures of RRP. Survival was reduced after summer vs. spring or fall transplant.

### Are 'Barton' and 'Cloud 9' the Same Cultivar of *Cornus florida*?

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Ten cultivars of *Cornus florida* (Barton, Cherokee Princess, Cloud 9, First Lady, Fragrant Cloud, Plena, Purple Glory, Rubra, Springtime, and Welch's Jr. Miss) were evaluated for horticultural characters of canker incidence, susceptibility to spot anthracnose and freeze damage, bloom number, bract length, and phenology. Of the ten cultivars, only 'Barton' and 'Cloud 9' were similar for all characteristics studied. DNA amplification fingerprinting (12 standard primers) and Arbitrary Signatures from Amplification Profiles (four minihairpin primers) were used to test our hypothesis that 'Barton' and 'Cloud 9' were genetically distinct, but phenotypically similar. Polymorphisms were not observed; therefore, we could not reject the null hypothesis that 'Barton' and 'Cloud 9' are the same genotype.

### Implications of Using Kenaf Stalk Core and Coconut Coir Pith as Nursery Container Media

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Four underutilized small trees, *Chilopsis linearis*, *Rhus lanceolata*, *Acacia wrightii*, *Chitalpa tashkentensis*, and a commercial control *Fraxinus velutina*, were grown outdoors in 15-L containers. Four media combinations, 3 pine bark : 1 sand, 3 pine bark : 1 coconut coir pith, 3 kenaf stalk core : 1 sphagnum peat, and 3 kenaf stalk core : 1 coconut coir pith (v/v), were amended with Sierrablen 18N–2.6P–10K at three rates, 3.6, 7.1, and 10.7 kg·m<sup>-3</sup>. *Fraxinus velutina* and *C. linearis* seedlings were transplanted to the field to evaluate initial landscape establishment. Growth was typically reduced, in both the field and container, when kenaf media was used during production. EC was greatest early and with higher fertility rates. Leachate pH decreased over time, and was lower at high fertility rates. Soil particle size >6.0 mm decreased substantially in kenaf media over time. Water holding capacity increased, while air space and total root volume decreased in kenaf media. Physical characteristics and growth responses were similar with coconut coir and peat moss.

### Growth of 'October Glory' Red Maple in Multiple Locations in the Southeast

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Limited information exists for container production of red maple cultivars. The objective of this study was to evaluate first-year growth of container-grown 'October Glory' at 3 locations with disparate climates in Georgia and Alabama (Tifton, Ga., Blairsville, Ga., and Auburn, Ala.). Rooted cuttings were planted in 9.2-L containers in one location in the same substrate in April 1995. Trees were transported to each location in mid-June and irrigated from overhead risers at 1.3 cm/day for 6 months until dormant, then transported to a single location for harvest. Despite weather differences among locations, final heights were not different (Blairsville 59.8 cm; Auburn 53.0 cm; and Tifton 60.2 cm). Shoot diameter increase and shoot dry weight was greatest at Tifton (8.4 mm, 17.5 g), least at Blairsville (6.3 mm, 9.2 g), with Auburn similar to both locations (6.8 mm, 12.2 g). Root dry weight and root : shoot ratio was greater in Tifton (17.2 g, 0.97) than Blairsville (14.9 g, 0.51) and Auburn (7.0 g, 0.64).

### The SFA Arboretum: The First Ten Years

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The SFA Arboretum is evidence that small horticulture programs can capitalize on what's right outside the back door of the building. Initiated in 1985 as a lab project in a landscape plant materials course on the south side of the Agriculture building, the collection has grown to over 3000 taxa displayed in a ten-acre public garden setting. The Arboretum's mission is to 1) promote the conservation and use of

native plants, 2) evaluate “new” landscape plant materials, and 3) serve as a living laboratory for students in Horticulture, Agriculture, Biology and Forestry. Funding improvements in the last two years and the creation of a Board of Advisors and a Volunteer Corps organization has addressed problems in routine landscape maintenance and getting “new” garden developments off the ground. A “Plants with Promise” program acquires, tests, propagates, distributes and promotes superior “new” woody plants. Outstanding performers include *Bignonia capreolata* ‘atrosanginea’, *Campsis grandiflora*, *Cinnamomum chekingensis*, *Euschaphis japonica*, *Scutellaria suffretescens* ‘pink’, *Sinojackia rehderiana*, *Taxodium mucronatum*, *Viburnum propinquum*, various *Styrax* species and varieties, several *Michelia* species, *Illicium henryi*, three Mexico oaks, and many others. AutoCAD maps and a plant inventory database tracks plant location and acquisition data. A just-completed GIS-based analysis of the university forest paves the way for a campus-as-arboretum effort. The premise of this paper is that high-visibility, easy-access display/evaluation gardens offer Horticulture Departments the opportunity for enhanced student recruitment, community involvement, external funding, environmental education, and the potential for significant contributions to the nursery industry.

### Factors Affecting the Resistance of *Buddleia* Species to the Two-Spotted Spider Mite

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*Buddleia* species are attractive ornamental shrubs whose major cultural problem is infestations of the two-spotted spider mite. Two factors, drought stress and leaf pubescence, were examined for their effects on spider mite infestations. Drought stress was examined by placing 20 plants into a randomized block design and stressing ten of the plants. No differences in mite life parameters were found, although there was more uninfested area in nonstressed plants. This was probably due to the nonstressed plants’ ability to outgrow the spider mite infestation. Leaf texture was examined by placing four female spider mites on 5 leaf disks of 37 cultivars and species of *Buddleia* and counting the number of eggs laid after 96 hours. There was a strong correlation between leaf pubescence and number of eggs laid. In a second experiment, using a shell vial with a leaf placed underneath the lid and five female spider mites in the vial itself, leaf pubescence was either removed with facial peel or left. In all cases but one, the removal of pubescence increased the number of eggs laid by the spider mites.

### Effect on Blueberry Quality as Affected by Various Types of Padded Surfaces

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‘Climax’ and ‘Tifblue’ blueberry cultivars were harvested, cooled, and later warmed to room temperature for use in individual berry dropping experiments. Surfaces used were concrete, “Softer NoBruze” and “Poron #7R70-Grey.” Berries in the check were not dropped. Three groups of 25 berries were dropped individually from various heights ranging from .5 ft to 7 ft. Initially, berries were cut to determine percent flesh showing bruising. Later, berries were rolled between fingers and assigned a firmness: firm, medium firm, or soft. The first two firmnesses are considered marketable. Fruit tended to bruise more when harvested later in season. More bruising occurred with higher drop heights. More marketable fruit resulted from thicker padding. Repeated dropping increased bruising. “NoBruze” was superior to “Poron” at any thickness. Many berries in the mechanical harvester have to drop over a foot onto a metal surface; padding these surfaces should increase percent of marketable (undamaged) berry yield.

### Water Relations of *Acer rubrum* in Response to Summer Digging

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Two experiments were conducted on *Acer rubrum* L. to determine the influence of root severance on sap flow, stomatal conductance, leaf

water potential ( $\Psi$ ), and stem xylem embolism. Experiment 1 utilized 3-year-old trees, and experiment 2 utilized 2-year-old trees. Sixteen-mm sap flow gauges were installed on both groups. Trees for experiment 1 were harvested on 31 May 1996 with a root ball diameter of 30.5 cm. Sap flow was reduced within one day after plants were harvested and was still lower 1 week after harvest. On 7 June 1996, harvested trees had lower stomatal conductance measurements, compared to not-harvested trees, but  $\Psi$  were similar. A second experiment was initiated on 20 Aug. 1996, using the same protocol as in experiment 1. Sap flow was reduced within 2 h after harvest for harvested trees compared to not-harvested trees. Leaf stomatal conductances were reduced within 4 h of harvest. Leaf water potentials were not influenced on the day that the trees were harvested. Embolism levels were increased by harvest within 24 h. These results indicate that transplant stress begins shortly after harvest and not at the actual time of transplant.

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## Fruit Crops

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### Treatments to Accelerate Leaf Development in Blueberries

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Poor blueberry leaf development is a serious problem in medium and low chilling regions which leads to smaller, later ripening fruit and reduced bush vigor. Dormex (hydrogen cyanamide) and Promalin or Accel (6-benzyl adenine plus gibberellins A4 and A7) were used in the experiments. Dormex 1991–1995 trials with applications at the end of the dormancy period (February) looked promising but were not uniformly successful. In 1996, applications were made starting in mid-dormancy (early-mid January) about 6–8 weeks before normal bud break. Spring vegetative bud development was greatly accelerated with minimal advance in flower development. Mid-dormancy Dormex rates of 1.5% to 2% appear promising. Dormex application after bud break or at excessively high rates will kill flower buds, but has excellent potential as a bloom thinning agent for juvenile blueberry plants. Promalin or Accel applications post bloom significantly accelerated spring leaf development. Late summer applications of Promalin significantly increased fall growth and number of side shoots.

### Three New Rabbiteye Blueberries From North Carolina

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Three rabbiteye blueberry selections, NC 1550, NC 1877, and NC 2305, will be released by the North Carolina Agricultural Research Service in Spring 1997. All three selections are self-fruitful, with fruit as large or larger than Tifblue, with good picking scars, aromatic flavor, and resistance to fruit cracking. NC 1877 is early-blooming and ripens a few days later than Premier, with similar color, firmness, and quality. Plants of NC 1877 are semi-upright and of only moderate vigor. Both NC 1877 and NC 1550 are resistant to the sharpnosed leafhopper which transmits blueberry stunt. NC 1550 blooms with or slightly later than Tifblue and is outstanding for consistent productivity, particularly on spring frost-prone sites. It ripens in early midseason to midseason, usually a few days ahead of Tifblue. Stemming was a problem in one year on overcropped plants. NC 1550 and NC 2305 have average to above color, and fruit firmness equal to Tifblue. NC 2305 blooms and ripens with Tifblue in most years. Fruit quality is at least equal to Premier and it fruits primarily on the tips of the branches. The names of these selections are ‘Ira’ (NC 1550), ‘Montgomery’ (NC 1877), and ‘Yadkin’ (NC 2305).

## Effect of N Fertilization on 'Arapaho' Thornless Blackberry

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Applications of N to blackberry plantings are a common practice in Arkansas, but fertilizer recommendations are largely based on those of other states. The need for information on fertility of a new blackberry from the Arkansas breeding program motivated this study. A three-year-old 'Arapaho' blackberry planting at the University of Arkansas Fruit Substation was used for this study. Treatments which began in 1994 and continued through 1996 were: 1) control—no N applied, 2) 56 Kg N/ha applied in a single application in early spring, 3) 112 Kg N/ha applied in a single early spring application, and 4) 112 Kg/ha applied in a split application with one-half applied in the early spring and one-half applied immediately after harvest. Fruit was harvested from the plots in June and total yield and average berry weight determined. Foliar samples were collected in August and elemental analysis conducted. Primocanes in each plot were counted at the end of the growing season. Over the three years, there was no significant treatment effect on yield, berry weight, or primocane number. A trend toward higher primocane number where N was applied was seen, however. Foliar levels of N, P, K, Ca, S, and Mn were affected by either N rate or time of application. The foliar N levels were influenced by N rate and the split application gave the highest concentration. Calcium was higher when no N was applied, Mn was greater at higher N rates while the control had the lowest foliar N level in each year.

## Mulch Color Influence on Annual Hill Plasticulture Strawberries

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The effect of seven types of plastic mulches on total, early, and late season yield was evaluated for three years in the annual hill strawberry production system. Black plastic mulches differed only from the significantly reduced yields found on unmulched bare ground treatments. Although not significantly different in any year, the top performing mulch treatments varied with production year and cultivar. In the wet and warm harvest season of 1991, the highest yielding treatments were IRT-76, clear, and ALOR-brown. In the dry and cool 1992 season, the top performers were white on black, black, and ALOR-brown. For the cool and moderately wet 1993 season, the best performance was recorded on black, white on black, and clear. Average soil temperatures from warmest to coolest were found with black, black on white, clear, IRT-76, ALOR-brown, red, silver, white on black, and bare soil treatments.

## Tissue Cultured Peach Not as Tolerant as Lovell Rootstock to Short-life Under Field Conditions

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Peach tree short life (PTSL) is a serious peach tree disease syndrome on replant orchard sites in the Southeast. *Pseudomonas syringae* pv. *syringae* is a bacterial disease often associated with tree injury and death on these PTSL sites. Rootstocks that have better tolerance to ring nematodes such as Lovell have less PTSL death. Tissue-cultured peach embryos and/or explants have shown increased resistance to *Pseudomonas syringae* and *Xanthomonas campestris* pv. *pruni*, another bacterial peach pathogen, in laboratory and greenhouse screenings. Tissue-cultured 'Redhaven' (RH), 'Redskin' (RS), and 'Sunhigh' (SH) peach cultivars on their own roots were planted with SH seedlings and RH and RS budded to Lovell rootstock on a severe PTSL site in South Carolina. Treatments beside cultivar/rootstock combination included preplant fumigation vs. nonfumigation. PTSL appeared in the third year and by year 4 significant tree death occurred. Tissue-cultured RH, RS, and SH trees had 54%, 55%, and 88% PTSL death, respectively, compared to RH

(17%) and RS (29%) on Lovell or the SH seedlings (25%). Fumigation significantly decreased PTSL in both RS combinations but not RH. These data suggest that the tolerance of the cultivar root system to PTSL-inducing factors such as ring nematodes was more important in PTSL than scion resistance to bacteria.

## Possible Role of Lipoxygenase in Plant Response to Drought Stress

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Apple leaves were shown to increase 6 volatile compounds in response to drought stress severe enough to promote senescence. Apple trees were allowed to dry to -2.0 MPa and -2.7 MPa, levels that were previously shown to reduce fruit growth by 50% and 70%, respectively. The 6 volatile compounds measured included hexanal, (E)-2-hexenal, 1-hexanol, (E)-2-hexen-1-ol, hexyl acetate, and (Z)-3-hexenyl acetate. Hexanal, (E)-2-hexenal, and 1-hexanol have been previously shown to be byproducts of lipoxygenase (LOX) activity. There is considerable information in the literature implicating LOX as a key enzyme involved in senescence, whether induced by pathogenic infection, insect feeding, or in ripening climacteric fruit and vegetables. It is reasonable to propose that LOX is also involved in promotion of senescence induced by drought stress.

## Leaf Phenolic Variation Within Apple Tree Canopies

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Light is important in the production of phenolic compounds because key enzymes in phenolic biosynthesis are induced by light, and because products of photosynthesis are used in the synthesis of phenolic compounds. It is known that light intensity decreases with increasing depth in apple tree canopies. The objective of this experiment was to determine how leaf position on a limb affects the total foliar phenolic content. Leaves from 'Stark Spur Supreme Red Delicious' on C6 and M26 rootstocks were collected on 28 July and 2 Aug. 1996. Each tree was divided into two sides, east and west. Each side was divided into 3 areas; exterior, middle, and interior. From each area, leaves were collected and PAR, SLW, assimilation, total N, and total phenolics were measured. Leaf position on a limb was a significant parameter for all of the measured variables. PAR, SLW, assimilation, total N, and total phenolics were highest in leaves at the exterior of the canopy. The total foliar phenolic content of the exterior canopy leaves was 20% higher than that found in the interior canopy leaves. There was a significant correlation between SLW and total phenolic content/cm<sup>2</sup> ( $r^2 = 0.77$ ;  $P < 0.05$ ). Assimilation may be a limiting factor in phenolics production in apple trees because of the correlation between assimilation and total phenolic content/cm<sup>2</sup> ( $r^2 = 0.56$ ,  $P < 0.05$ ).

## Small Fruit Breeding in the Southern U.S.: Progress And Prospects

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Small fruit production in the southern United States has been impacted greatly by fruit breeders this century. This workshop, co-sponsored by the American Pomological Society, includes presentations from individuals who have contributed collectively over 150 years to small fruit and grape breeding. James N. Moore has conducted breeding at the University of Arkansas, developing 30 cultivars. His presentation on brambles outlines achievements and future opportunities for improvement. Arlen Draper has been involved with the development of 61 small fruit cultivars while working with the USDA-ARS with an emphasis on blueberry. His presentation focuses on blueberry breeding and provides insights into the future of new blueberry cultivar developments. Gene Galletta has conducted small fruit breeding at North Carolina State University and USDA-ARS and has been involved with the development of 50 cultivars. His presentation reflects on the history of strawberry breeding in the South and the challenges that lie ahead. Ron Lane has served as a fruit



breeder and horticulturist at the University of Georgia Experiment Station at Griffin and his work has emphasized the development of muscadine grape cultivars. The past and future of muscadine and bunch grape breeding is discussed in his paper. Articles from all authors in this workshop will be published in *Fruit Varieties Journal* in 1997.

### **Blackberries and Raspberries in Southern United States: Yesterday, Today, and Tomorrow**

James N. Moore, University of Arkansas, Fayetteville, AR 72701

Blackberries have long been a popular fruit in the southern U.S., and they are widely grown there, with excellent potential for expanded production. Raspberries are also well-liked, but not widely grown, due to lack of adapted cultivars. Great progress has been made, particularly in the past four decades, in improving blackberry cultivars for the South, but little effort has been given to raspberry improvement. Germplasm exists within *Rubus* to provide great advances in conventional cultivar improvement in both subgenera and for creating new types of fruits through interspecific hybridization. Germplasm and breeding strategies will be discussed that would result in new cultivars to serve as the foundation on which to build much expanded blackberry and raspberry industries in the southern United States.

### **Blueberry Breeding for the Southern United States**

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The USDA blueberry breeding program was initiated in 1910 by Dr. F.V. Coville and has been continuous since that time. Plant breeders Drs. G.M. Darrow, D.H. Scott, J.N. Moore, and A.D. Draper have worked with SAES and private growers to develop the majority of cultivars presently grown for commercial production. In the South, major cooperators with the USDA include SAES in Arkansas, North Carolina, Georgia, and Texas. Recently the USDA Station at Poplarville, MS, has been instrumental in blueberry cultivar development for the South. Rabbiteye blueberry cultivars make up the majority of blueberry acreage grown in the region. A new type of blueberry, the southern highbush (SHB), has been developed by interspecific hybridization with various *Vaccinium* species. Late-blooming SHB cultivars have been developed that offer better protection from spring frosts and ripen earlier than the earliest rabbiteye blueberry. Genes required to meet future needs reside within native *Vaccinium* species. Progress has been made in plant adaptation, disease resistance, fruit quality, and season of ripening. There remains a need for greater plant vigor, insect resistance, and consistent production.

### **Strawberry Breeding for the Southern United States**

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This review briefly summarizes the status of the Southern strawberry industries during the 20th century. Objectives, contributions, and personnel of the Southern state and federal improvement programs are presented. The future of the southern strawberry industries and their reduced number of breeding programs are predicted, with emphasis on the objectives which may have to be altered to accommodate new and continuing problems.

### **Tree Fruit Rootstock Development in Arkansas**

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The Arkansas tree fruit research program has a history of involvement in rootstock development. The elements of rootstock development are rootstock cultivar testing and rootstock breeding and evaluation. Research is focused on apple and peach rootstocks. Rootstock testing is done in conjunction with the NC-140 cooperative uniform rootstock research project. Currently, there are 10 NC-140 trials in progress for apples, peaches, pears, and cherry rootstocks in Arkansas. The Arkansas rootstock breeding projects were established in the early 1970s as components of the fruit breeding program. The objectives are to develop apple and peach rootstocks which are adaptable to the

Arkansas edaphic and adaphic conditions, have size control, have some degree of pest resistance, and are efficient in production. To date, 92 apple rootstock selections have been made and 41 are still in early evaluation for propagation and growth characteristics, while 56 peach rootstocks have been selected and are in early evaluation. Arkansas apple rootstocks selections are sequentially numbered with numbers preceded by AAR (ex: AAR-92). Peach rootstocks selections are numbered with numbers preceded by APR. Data from 2 NC-140 apple rootstock trials were presented and discussed.

### **Effects of Storage on the Quality and Composition of Three New Southern Highbush Blueberry Cultivars**

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The southern highbush blueberry (*Vaccinium*, mostly *corymbosum*) cultivars Jubilee, Pearl River, and Magnolia and the rabbiteye cultivars Climax and Premier were stored for 4 weeks at 1–2 °C. Berries were held in pint “clam shell” plastic retail units and were evaluated weekly for physical and compositional quality. As groups, the rabbiteyes were higher in SSC, SSC/TA, glucose and fructose, anthocyanins, and malic, quinic, and succinic acids. ‘Jubilee’ was the southern highbush and ‘Climax’ the rabbiteye least affected by the storage. ‘Pearl River’ and ‘Magnolia’ were less firm and more shriveled than the other cultivars. ‘Magnolia’ had the highest incidence of decay; decay was slight overall.

### **Pierce’s Disease of Texas Grapevines**

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Since 1977, it was believed the grape strain of *Xylella fastidiosa*, Pierce’s Disease (PD), was limited to sites receiving less than 800 hours of winter chilling below 45 °F. Warm winters since 1992–93 resulted in numerous PD-positive vineyards in central Texas which were previously nonaffected. Vine mortality ranges from minimal to over 80% dead vines. A Davis Mountains site receiving over 1,000 hours was also severely infected in 1996. The last severe winter in Texas was 1989–90; therefore, warm winters could be contributing. This climatic change could have affected vines, vectors, bacteria, and/or hosts. Recent work based on a study of 20 PD samples, 11 from Texas and 9 from other states, including California and Florida, indicates that the samples of PD grape strain of *Xylella fastidiosa* are clonally related. ELISA tests failed to identify PD from 1994–96; therefore, a sensitive REP-PCR test is needed before vine, bacteria, vector, and host management strategies can be developed.

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## **Postharvest/Biotechnology**

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### **Postharvest Behavior of Watermelon Fruit Blotch**

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Transmission of watermelon fruit blotch was not observed during the first week of postharvest storage at either 11 °C or 20 °C when the diseased surface of an affected watermelon was placed in direct contact with the surface of a healthy fruit. Abrasion of either the diseased fruit, the healthy fruit, or both fruit did not facilitate transmission of the disease compared to unabraded controls. After 3 weeks’ storage, disease transmission was significantly greater at 20 °C than at 11 °C, illustrating the importance of appropriate temperature management during postharvest handling. Harvesting appears to arrest the development of watermelon fruit blotch if the disease symptoms cover less than approximately 5% of the fruit surface at harvest.

## Modelling Moisture Loss of Onions in Storage Using Moisture Loss Information Obtained from Individually Measured Onions

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Vidalia onions were grown following recommended cultural practices in 1994–1996 and they were harvested at early, optimum, or late maturity. After onions were cured for various lengths of time, a random sample of onions was marked for individual measurement. All onions were placed into either low or high humidity A/C controlled storage for up to 30 weeks. Onions were removed as they showed signs of being rotten. Initially, and every 2 weeks thereafter, weight and grade data were collected from individual onions and in bulk from other onions. There were up to 96 treatment combinations each year. Using individual onion data, simulation of the weight loss of the bulked onions was done. Although over 5,000 onions were involved, individual measurements were taken on only 1,920 onions over the 3 years. Five simulations were conducted using parameters derived from individual onion data. Results of the simulations resembled the actual weight loss trends within the specified 90% confidence range.

## Quantifying Loss of Firmness in Blackberries

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Measurement of firmness of blackberries is challenging because of their nonspherical shape, large pyrenes, and mixture of receptacle and epidermal tissues. Firmness at harvest is important to minimize damage from finger compression and after harvest, as fruit that soften during storage often have more decay and leakiness than firmer fruit. We have done subjective ratings over the last 4 years using a scale of 1 (firm) to 5 (mush) and find that discerning between ratings of 2 and 3 is the most difficult subjective decision. We have used a hand-held penetrometer adapted with an insect pin to measure epidermal thickness and receptacle firmness after storage, but correlation with subjective ratings has been unsatisfactory. We have also measured whole fruit compression using a Texture Technologies® TA2 texture analyzer that collects 500 data points per second. While this works well with fruit subjectively rated 1 to 3, it cannot measure soft fruit rated 4 and 5. However, both puncture and compression tests have successfully quantified firmness loss with ripening.

## Storage Life of a Midseason Peach Held at 5 °C

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Growers in north and central Texas produce peaches of exceptional size and quality yet have no information on the best maturity stage/storage regime for maximum shelf life. 'Majestic' peaches were harvested at five maturity stages, corresponding to hard green through full red, soft ripeness. Intermittent warming and/or delayed warming reduces chilling injury in peaches and these treatments were used on hard green through firm red stages. Fruit were held 4 weeks at 5 °C, 85% RH continuously (control); 1 day at 20 °C followed by 4 weeks at 5 °C (DS); 4 weeks at 5 °C with 1 day warming at 20 °C every 2 weeks (IW). Chilling injury symptoms (internal browning) were noted on control and IW peaches after 2 weeks storage. We concluded that hard green peaches are too immature and red peaches at velvet and full soft stages are too soft (<20N flesh resistance) to ship. Chilling injury appeared in peaches after 2 weeks storage at 5 °C but could be avoided by delaying storage for 24 hours after harvest.

## Vegetable Crops

### Many Fresh-market Tomato Growers in the Southeastern U.S. Use IPM

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IPM teams from Alabama, North Florida, Georgia, Kentucky, North Carolina, South Carolina, and Tennessee composed of growers, private consultants, and faculty defined IPM on fresh-market tomatoes and created a survey from this definition to evaluate the level of IPM used by growers in the southeastern U.S. The survey included three sections: cultural practices, pesticide application techniques, and specific pest management practices, and was distributed to tomato growers in the region by mail, at county meetings, and through other relevant venues. Additionally, growers were asked to identify problems (insect, disease, and nonpest, i.e., cultural) and beneficial technology or research developments. Results of the survey revealed that in North Florida, Georgia, Kentucky, North Carolina, and South Carolina more than 75% of the tomato acreage is in the medium or high IPM category. These states have met or exceeded the State IPM teams' criteria for practicing IPM and have met the Federal mandate of IPM implementation on 75% of the fresh-market tomato cropland. Tomato producers listed early blight, late blight and bacterial spot as their main disease problems; tomato fruit worm, thrips, and aphids as their primary insect problems; and poor weather conditions, government regulation, and labor issues as their primary nonpest problems. Producers throughout the region felt that the development of resistant varieties would help them increase production the most. The State IPM teams outlined a clear definition of IPM in fresh-market tomato production and the survey results established a baseline that can be used to measure the success of programs to increase IPM adoption. The results will aid in focusing the Extension/research agenda in the universities in the Southeast.

### The Effect of Colored Plastic Mulches on Whitefly Populations in Watermelon Production

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The squash leaf curl virus (SLCV), transmitted by the sweet potato whitefly (*Bemisia tabaci* biotype B), is widespread on fall-planted watermelon in the Rio Grande Valley and Coastal Bend areas of south Texas. The objective of the study was to evaluate colored mulches for their effects on whitefly populations, virus incidence, and watermelon yield. Eleven polyethylene films were included as treatments in both a spring and fall study and were replicated five times in a randomized block design. Plastic mulches caused substantial improvement in melon yields (40%) in the spring crop, similar to responses obtained in other studies on cantaloupes. Fall yield increases due to the use of mulches did not occur. Whitefly populations were much lower in 1996 than they have been in previous years, therefore this was not an adequate test of its effects on whitefly behavior. Even so, there were indications in the fall crop that the use of plastic mulch tended to result in lower whitefly numbers. No evidence was found of any difference between the various mulch materials regarding whitefly counts.

### Analysis of Muskmelon Yields From the Tri-State Cooperative Project Involving Seven Locations, Three Years, and Four Cultivars

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The Tri-State Cooperative Project involved North Carolina, South Carolina, and Georgia. Muskmelons were grown following recommended cultural practices at seven locations in 1985–1987. Two plantings in the spring and again in the fall were made. Cultivars were

HILINE, MAGNUM, MAINST, and SUMMET. Locations were for North Carolina: Fletcher (FLT) and Lewiston (LEW); for South Carolina: Clemson (CLM), Charleston (CHL), and Florence (PD); and for Georgia: Attapulgus (ATT) and Plains-Tifton (PLA). Not all locations planted muskmelons during the 12 planting times available except the two spring plantings in 1987. Analysis of each location revealed that years were significant except for ATT; seasons except for ATT; plantings except for FLT; and cultivars except for CHL and LEW. Season  $\times$  cultivar was significant only for FLT and PLA. LEW and ATT had the highest yields, while FLT had the highest variance. Spring plantings had higher yields. MAINST had the highest yield among the cultivars. Analysis of the location by cultivar means revealed that locations were significant ( $P = 0.01$ ) and cultivars were significant ( $P = 0.05$ ).

### Effects of Crop Rotations, Winter and Summer Cover Crops, and Minimum-till on Pepper and Sweet Corn Production

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Pepper and sweet corn were tested in a rotation with crimson clover and velvet bean (*Mucuna pruriens*) cover crops at different locations in Georgia, North Carolina, and South Carolina from 1995 to 1996. Vegetable production with minimum-till following the cover crops was compared with two different conventional methods (following rye cover or fallow). All minimum-till/cover crop treatments caused reduction of total number of pepper fruit, compared to the conventional methods. Effects on premium grade (Fancy + U.S. #1) were similar to the effects on total fruit. The highest percentage of premium grade was produced by both conventional methods in 1996. Sweet corn responded similarly to these treatments in 1995. However, in 1996, clover plots had corn yields nearly as good as the conventional plots. As in bell pepper, plots with velvet bean cover produced lower yield in 1996. Treatment effects on number of marketable corn were the same as the effects on total ears produced.

### Comparison of Ten Plant Source Origins on Field Performance of 'Sweet Charlie' Strawberry in Florida

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The objective of this study was to compare plant health and growth in Florida fruiting fields of 'Sweet Charlie' plants from 10 different plant sources. Bare-root plants from Ontario, Nova Scotia, Massachusetts, Oregon, North Carolina, Alabama, and Florida and plug plants from North Carolina and Florida were compared in a RCBD of four replicates. Plants were rated for vigor, production, diseases, and pests throughout the 1995–96 season. Crown size of transplants ranged from 7 to 12 mm. Plants from northern sources exhibited angular leaf spot (*Xanthomonas fragariae*) and gnomonia (*Gnomonia* spp.) while southern-raised plants were infected with phomopsis (*Phomopsis obscurans*) and anthracnose (*Colletotrichum* spp.). Initial ratings confirm the potential for aphids and two-spotted spider mites (*Tetranychus urticae*) to be introduced on transplants. Plants from northern origins flowered 10–14 days earlier than plants produced in southern regions. Total season marketable fruit production was not statistically different among the eight bare-root treatments. Monthly fruit production was significantly different among treatments for all months except February. Performance of plug plants compared to bare-root plants of the same geographic origin were inconsistent. Initial crown size, average berry size, and cull fruit production were significantly different among the plant sources. In summary, clear differences in foliar diseases and monthly fruit production were strongly associated with transplant source. A strawberry farmer may maintain more stable production throughout the year by using transplants from several geographic origins.

### Effect of Three Different Planting Patterns on the Yield of Four Sweetpotato [*Ipomoea batatas* (L.) Lam] Cultivars

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In 1995 a study was conducted in split-split-plot design to determine the effect of single, double, and equilateral planting configurations with a single and double recommended rate of fertilizer (NPK), would have on the yield of four sweetpotato cultivars. TU-1892, Jewel, TU-82-155, and Georgia Jet were planted on a raised shaped bed 2 ft wide. Fertilizer was banded in the center of the bed and plants were then placed 6 inches away on both sides of this band for the double and equilateral configurations and on one side for the single configuration. Plants were spaced 12 inches apart within rows and the rate of fertilizer used for both single and double rows was the recommended rate for single rows. All plots were side dressed with an additional 80 lbs/acre of K at the time of flowering. Marketable yield data showed that by doubling the recommended rate of fertilizer yield increased for all cultivars which ranged from 26%–41% for single, 35%–88% for double, and 64%–104% for equilateral configurations, respectively. The results also indicated that net returns for TU-1892 was 217%, Jewel 136%, TU-82-155 203%, and Georgia-Jet 171%, for double and equilateral configurations, respectively, when the rate of fertilizer was doubled.

### Broadcast vs. Band Applications of Fertilizer for Vegetable Crops

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A study was conducted to evaluate the effect of banding or broadcasting fertilizer on yield and quality of turnip (*Brassica rapa* L. Rapifera group), sweetcorn (*Zea mays* var. *rugosa* Bonaf.), and cabbage (*Brassica oleracea* L. Capitata group). Preplant fertilizer was applied broadcast prior to bedding, broadcast after bedding, or banded after bedding. Sidedress applications were broadcast or banded on the beds. Strong visual differences were noticed early in the season in the spring turnip crop with the growth in the broadcast-then-bed treatment appearing superior. The yield at first harvest and total yield were lower for turnip growth with the bed-and-broadcast treatments. No differences in yield of cabbage and sweetcorn resulted from the treatments. Few differences in turnip stem to leaf ratio were noted due to fertilizer treatment. Few differences in yield due to sidedress method were noted with any of the crops. Since broadcasting can be done with a faster, wider applicator, growers could reduce costs by broadcasting fertilizer and obtain yields that are at least equivalent to the yields from banding.

### Evaluation of Presswheels and Seed Coverers for Direct Seeding of Brassica

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Improved stand establishment of direct-seeded crops has usually involved seed treatment and/or seed covers. Planters have been evaluated for seed/plant spacing uniformity, singulation, furrow openers, and presswheel design; however, effects of presswheels and seed coverers on plant establishment have not been widely investigated. Five experiments were conducted in a fine sandy loam soil to determine effect of presswheels and seed coverers on emergence of direct-seeded cabbage and mustard. Seed were planted with Stanhay 870 seeder equipped with one of four presswheels and seed coverers. Presswheels included smooth, mesh, concave split, and flat split types. Seed coverers included standard drag, light drag, paired knives, and no coverer. Soil moisture at planting ranged from 8% to 19% in the top 5 cm of bed. Differences in plant counts taken 2 weeks after planting

were minimal with any presswheel or seed coverer. Visual observation indicated the seed furrow was more completely closed with the knife coverer in high soil moisture conditions. All tests received at least 14 mm of precipitation within 6 days from planting, which may account for lack of differences in plant emergence.

### Field Performance of Lettuce Grown in Alabama

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While lettuce is one of the most widely consumed vegetables in the United States, production is mainly concentrated in the western states. This research investigated the feasibility of lettuce production in the Southeast (SE), where downy mildew, tip burn, bitterness, bolting, and postharvest handling are potential production problems. Lettuce varieties were evaluated on plastic mulch and drip irrigation under several growing conditions. Cultivar and location significantly ( $P < 0.01$ ) affected yield and transplant survival rate. Following these tests, 'Salinas 88 Supreme', 'Legacy', 'Bullseye', 'Epic' (crisphead); 'Nancy', 'Nevada', 'Ostinata' (butterhead); 'Parris Islands', 'Augustus' (Romaine); and 'Red Salad Bowl', 'Red Prize', and 'Slobolt' (loose leaf) are considered best-performing lettuce varieties for Alabama. These results, along with bitterness evaluation, support the potential for lettuce production in the SE.

### Sensory Evaluation of Bitterness in Lettuce Varieties Grown in the Southeastern United States

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The main limiting factor to lettuce production in the Southeast is bitterness. Bitterness in lettuce is associated with sesquiterpene lactones, a bitter principles of the latex of wild lettuce species *Lactuca virosa* or *L. sativa*. These wild species are used as parents in the development of virus-resistant cultivars. This study evaluated bitterness of 18 commercial cultivars of lettuce grown following recommended production practices at two locations. Lettuce was hand harvested, refrigerated, washed, and cut into bite-size pieces. Samples were served one by one to a group of 15 panelists, trained with caffeine solutions of increasing bitterness scores (BS; 0% = 0, 0.05% = 2, 0.08% = 5, 0.15% = 10, and 0.20% = 15). A BS of less than seven was acceptable. BS was significantly ( $P < 0.02$ ) different among varieties. Varieties with lowest BS were 'Epic', 'Salinas 88 Supreme', 'Nevada', 'Red Prize', and 'Legacy'. For these varieties, mean, most frequent, and highest BS were less than seven. This study suggests that it is possible to grow nonbitter lettuce in the Southeast.

### Development of Bell Peppers with Resistance to the Southern Root-knot Nematode

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The southern root-knot nematode (*Meloidogyne incognita*) is a major pest of bell peppers (*Capsicum annuum*) in the United States. Since none of the leading bell pepper cultivars grown in the U.S. exhibit adequate levels of resistance, a breeding program was initiated to incorporate the *N* root-knot nematode resistance gene into commercial bell pepper germplasm. A backcross breeding procedure was used. The donor parent of the *N* gene was the open-pollinated, pimiento pepper cultivar Mississippi Nemaheart, and the recurrent parents were the open-pollinated bell pepper cultivars Keystone Resistant Giant and Yolo Wonder. A large number of homozygous resistant BC<sub>6</sub> populations were evaluated in field tests in 1995, and two lines (PA-440, an isoline of 'Keystone Resistant Giant', and PA-453, an isoline of 'Yolo Wonder') were selected for further field evaluation and seed multiplication in 1996. Results of replicated field and greenhouse tests conducted in 1996 indicate that root-knot nematode resistance has been incorporated successfully in 'Keystone Resistant Giant' and 'Yolo Wonder' backgrounds.

## Posters

### Influence of Various Polyethylene Mulch Colors on Growth and Development of 'Vates' Collards

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The effect of various mulch colors (black, yellow, red, blue, white, and aluminum) on growth and development of 'Vates' collards was evaluated in Fall 1996 at the E.V. Smith Research Center in Shorter, Ala. Black polyethylene mulch was installed onto raised, fumigated beds, then sprayed with a 1 : 2 (v/v) mixture of exterior oil-based enamel paint to paint thinner with one of the five mulch colors listed. Five-week-old plants were transplanted into beds. Beginning two weeks after transplanting and continuing every other week thereafter, heads were harvested to determine head fresh weight and dry weight. Hourly soil temperatures at 10 cm soil depth were recorded and growing degree days (GDDs) with a base temperature of 4.4 °C were calculated. At two weeks after transplanting, average head fresh and dry weight were highest for the aluminum-colored treatment with head fresh (24.7 and 12.3 g, respectively) and dry weights (2.7 and 1.3 g, respectively) twice that of the yellow treatment ( $P \leq 0.05$ ). By four weeks after transplanting and up through the final harvest, marketable yield and average head fresh weights did not differ among the treatments (17,900 kg/ha, 1.4 kg per head, respectively). The red and black mulch treatments accumulated more GDDs than the other treatments, but total marketable yields did not differ among any treatments.

### Influence of Cold Water Priming on Spinach Seed Performance

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Six experiments were conducted to determine the effect of priming on spinach seed performance. Performance was determined by percent, uniformity, and speed of germination after 10 days. In Expt. 1, performance at 22 °C was improved for primed seeds compared to unprimed seeds and germination was >90% for both primed and unprimed seeds. In Expt. 2 (incubator @ 40 °C for 16 h/30 °C for 8 h), germination was reduced for both seed treatments and primed seeds had more germination, but less uniformity than unprimed seeds. In Expt. 3 (incubator @ 40 °C for 16 h/30 °C for 8 h), initial temperatures were 40 °C for 16 h, 40 °C for 8 h, or 30 °C for 8 h. There was an interaction between priming and initial temperature for percent germination, indicating that only primed seeds varied in response to initial temperature. Priming improved percent germination but reduced uniformity and did not influence speed of germination. In Expt. 4 (growth chamber @ 40 °C for 16 h/30 °C for 8 h), priming significantly improved percent seedling emergence and speed compared to unprimed seeds but did not influence uniformity. In Expt. 5 (growth chamber @ 40 °C for 16 h/30 °C for 8 h) initial temperatures were 40 °C for 16 h, 40 °C for 8 h, or 30 °C for 8 h. Priming significantly improved seedling emergence and speed and did not affect uniformity of emergence. Seedling emergence was significantly improved for seeds planted at an initial temperature of 40 °C compared to 30 °C.

### Reduction of Tomato Early Blight by Combining Soil Solarization and Biological Control Strategies

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Combinations of solarized soil (SBS), bare soil control (BS), black plastic mulched soil (BM), row cover (RC), fungicide (chlorothalonil)

and biological treatments (*Bacillus cereus*) were evaluated. SBS vs. BS treatments were main plots, mulch and row covers splitplots and foliage treatments split-splitplots. Application of either foliar treatment was superior to BS. Using a 1/2 rate of fungicide on plants from solarized soil treatments showed equal or comparable reduction of the disease when compared to tomatoes grown in BS with high rates of the fungicide. Combined treatments of solarized + BM, BM with or without RC and low rate of fungicide or biological agent, were the most effective when compared to BS + fungicide, indicating that integration of plasticulture and biological strategies can reduce early blight below the levels of commercial fungicide applied to tomatoes grown on BS.

### Thrips Resistance Studies of Onions (*Allium cepa* L.) in South Texas

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Thrips are the major insect pest of onions grown in South Texas. Four cultivars, 'IPA-3', 'TG1015Y', '1664' (glossy control), and '1900B' (waxy control), were grown in a split-plot design with insecticide sprayed or nonsprayed treatments as the main plots and cultivar as the subplots. The experiment was conducted at the Texas Agricultural Experiment Station, Weslaco, Texas, in the 1995-96 season. The objectives of the study were to compare 'IPA-3' and 'TG1015Y' for thrips resistance and evaluate possible resistance mechanisms that may be present in 'IPA-3'. The average number of thrips per plant and leaf damage rating were significantly higher for 'TG1015Y', indicating that some resistance is present in 'IPA-3'. However, there were no significant differences in yield between the two cultivars. A comparison of leaf wax characteristics indicated no significant difference between 'TG1015Y' and 'IPA-3' using gravimetric or gas chromatography techniques. However, scanning electron micrographs of 'TG1015Y' leaves appeared more similar to '1900B' and 'IPA-3' appeared more similar to '1664'. The insecticide spray treatment had significantly fewer thrips, less damage, and higher yield than the nonsprayed treatment.

### Practical Application of PCR-based Technology to Screen Texas Onion Breeding Lines for Cytoplasmic Male Sterility

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Identification and production of onion male-sterile and maintainer lines by conventional breeding takes between 4 to 8 years, due in part to the biennial nature of onion. In addition, male sterile plants and maintainer genotypes occur at a very low frequency in onion populations (Pike, 1986). A significantly shorter and more efficient alternative involves the screening of breeding lines for cytoplasmic male sterility using PCR-based technology. Thirty short-day onion breeding lines from the Texas A&M onion program were screened for type of cytoplasm (normal or sterile). Specific amplification of a fragment of chloroplast genome was achieved using the polymerase chain reaction according to Havey (1991). Forty-eight individual onion plants were screened per line. Out of thirty lines evaluated, 13 showed 100% sterile cytoplasm, 6 showed 100% normal cytoplasm, and 11 showed both types of cytoplasm. Lines showing normal cytoplasm or both cytoplasmic types were kept and reanalyzed. Only plants presenting normal cytoplasm were grown to maturity to help in the identification of maintainer lines as part of the Texas A&M onion breeding program.

### Quality and Marketable Yield of Baby-style Carrots as Affected by Root Size, Population Density and Lines of Seed/Bed

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Baby-style carrot *Daucus carota* Mill. cv. Caropak was studied under four population densities, three different numbers of lines per bed, and harvested under three root size harvest parameters in the Rio Grande Valley of Texas. Four phases in the baby-style carrot process were evaluated. Length of the roots at harvest and projected values for total waste and marketable yield were estimated. Length was affected by root size at harvest, the most desirable root length occurred when harvested at 25%-35% roots diameter >2 cm. The longer roots (16.55 cm) were in the treatments with 6 seed lines per bed and 197 plants/m<sup>2</sup>. Population density affected the fresh and cut weight in the baby-style carrots process with the highest weight at 321 plants/m<sup>2</sup>. Percent of cut waste was the same at the three-root size at harvest with 21.65% of crowns and tips cut. The percent of graded waste was lowest when harvested at the biggest root size, 14.23% and four seed lines per bed produced the highest waste with 18.14. Seed lines per bed affected the quality of the roots in the graded step. Based on a 40% peeling waste projection the lowest total waste was estimated at 59.69% and the highest projected marketable yield of 19.4 t/ha of final product when roots were harvested using the 25%-35% root diameter parameter. Root size at harvest is the main factor affecting projected marketable yield of baby-style carrots in South Texas.

### Effects of Different Cover Crops on Sweet Corn and Bell Pepper Production

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Rye and crimson clover as winter cover crops and red clover as a companion crop were evaluated in sweet corn and bell pepper production systems in South Carolina. Winter cover crops were planted in fall and incorporated into the soil 3 weeks prior to planting vegetable crops. Red clover was overseeded with the vegetable crops. There were no significant differences among treatments for corn yield. Marketable number and weight of bell peppers were significantly higher in both winter cover crops compared to red clover and fallow (control) treatments. Number of cull peppers (smaller peppers than USDA grades) were lower in both cover crops compared to other treatments. Lack of response in red clover compared to the fallow treatment may be due to the lower emergence of red clover when used as a companion crop with bell pepper. Marketable bell pepper yield was higher in the late harvest compared to the early harvest in all the treatments.

### End-of-Day Light Quality Effects on Growth and Development of Watermelon Plants

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End-of-day (EOD) red (R) or far-red (FR) light treatments were used to study phytochrome-regulated growth and dry matter distribution in 2-week-old watermelon plants. Plants were exposed to low-intensity R or FR light for 15 min at the end of photoperiod for 9 consecutive days. End-of-day FR increased the petiole elongation in the first two leaves, which was accompanied by higher dry matter partitioning to the petioles after 3 days of treatments. However, total plant dry mass (above ground) in FR-treated plants increased significantly after 6 days of treatments. This indicates EOD FR regulated dry matter compensation among plant parts at the early stages of EOD light treatments, allowing plants to better adapt to the environment. Net CO<sub>2</sub> assimilation rate in the second leaf of FR-treated plants also increased. Phytochrome involvement in these processes is suggested, since growth and dry matter distribution patterns were reversible when plants were treated with FR immediately followed by R.

## Effect of Temperature Preconditioning on Free Radical Scavenging Enzymes in Chilling-tolerant and Chilling-sensitive Tomato Fruit

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The ability of two tomato cultivars, *Lycopersicon esculentum* cv. VFNT Cherry (chill sensitive) and *L. esculentum* x *L. pimpinellifolium* cv. New York 280 (chill tolerant) to acclimate to low temperature storage at 2 °C were compared following prior temperature preconditioning. The activities of catalase, peroxidase, and superoxide dismutase and electrolyte leakage were monitored during a 15-day preconditioning period. Low temperature preconditioning reduced membrane damage in both fruit. In contrast, high temperature preconditioning accelerated the rate of leakage in VFNT, while fruit of NY 280 remained relatively undamaged. Low temperature preconditioning stimulated a 4-fold increase in catalase and peroxidase activities in fruit of NY280. High-temperature preconditioning appeared only to benefit fruit of NY280. Regardless of pretreatment, no significant change in superoxide dismutase activities were observed for either cultivar. These findings suggest that the ability to acclimate to low temperature stress may correlate with increased levels of catalase and peroxidase.

## Bell Pepper and Lettuce Response to Garlic Sprays

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The efficacy of garlic spray (GS; Garlic Barrier™) as an alternative to conventional chemical control of disease and insect pests was evaluated on bell pepper and lettuce. Treatments consisted of a recommended chemical spray as needed (Treat. 1), GS applied once (Treat. 2) or twice (Treat. 3) a week, and water spray applied twice a week (Treat. 4). Because of no pest pressure during the test, no chemical sprays were used in Treat. 1. Differences among bell pepper yields were not significant ( $P > 0.50$ ). For lettuce, Treat. 2 resulted in significantly ( $P = 0.02$ ) higher head yield. Differences among treatments were not visually detectable in the field. These results suggested that GB applied at the manufacturer's rate (Treat. 2) did not adversely affect bell pepper and lettuce growth and yield. Garlic smell was not detectable on either vegetables, even after Treat. 3. Due to a low pest pressure, this study failed to identify beneficial effects of the GS. Without more scientific reports, relying only on GS to control pests of bell pepper and lettuce may involve uncontrolled risks.

## Cultivar and Maturity Effects on Color and Chemical Composition of Strawberry Fruit

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The color and chemical composition of three strawberry (*Fragaria × ananassa* Duchesne) cultivars, 'Arking', 'Cardinal', and 'Earliglow' and one advanced selection, A-7383, were examined at four maturity stages in a 2-year study. Cultivar- and maturity-related differences were observed in CIELAB color space coordinates, L\*, a\*, b\*, anthocyanin concentration, percent soluble solids; pH, titratable acidity, sugar/acid ratio, and total solids, insoluble solids, fructose, and sucrose content. No cultivar effect was detected for glucose concentration. 'Arking' and 'Cardinal' had the most intense red color and were similar in L\*, a\*, b\* values, titratable acidity, and the concentration of anthocyanin, soluble solids, total solids, and fructose. They differed significantly in pH, sugar/acid ratio, and insoluble solids. A-7383 and 'Earliglow' exhibited differences in all measured characteristics except total solids. A-7383 fruits contained the lowest anthocyanin concentration and were the darkest and least red of the genotypes.

## Propagation of Erect Blackberries by Floricane Stem Cuttings

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An experiment was carried out to investigate whether detached segments of floricanes during winter pruning of erect blackberries could be used as a source of propagating material. Portions of lateral branches from 'Arapaho', 'Navaho', 'Choctaw', and 'Shawnee' field-grown plants, subdivided according to their position on the cane (tip, middle, and base), and treated with or without 0.3% IBA in talc were stuck in peat-perlite mix under intermittent mist in greenhouse conditions. Differences in percentage of cuttings rooted occurred only for cultivars; 'Arapaho' rooting the highest (99%) and 'Shawnee' the lowest (83%). IBA improved volume of roots formed. Cultivar by position interaction effect was evident for volume of roots, percentage survival of cuttings after potting, percentage shoot formation, and dry weight of shoots and roots, with highest values for stem cuttings taken from the middle of canes of 'Arapaho' and lowest for basal cuttings of 'Shawnee'. 'Choctaw' stem cuttings produced the largest shoots regardless of their position or treatment with IBA. These findings suggest that propagation of erect blackberries by floricane stem cuttings is feasible. This work might be useful to plant breeding, either for early collection of pollen or in controlled pollinations.

## Al, Mn, and Ca Fertilization on Two Rabbiteye Blueberry Cultivars

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The effects of varying Al, Mn, and Ca fertilization levels on 'Tifblue' and 'Brightwell' rabbiteye blueberry (*Vaccinium ashei* Reade) plant growth, chlorosis symptoms, and leaf elemental content were studied in a sand culture experiment. Increased Al fertilization linearly decreased Ca, Mg, and Mn leaf concentrations and plant vigor. Calcium fertilization did not affect plant growth or leaf concentration of the two cultivars. Increased Mn fertilization increased Al and Mn leaf concentrations and resulted in more chlorosis symptoms. Plants fertilized with the highest rates of Al and Mn had the least amount of growth.

## Effect of Selected Growth Retardants on 'Arabe' Grapevines

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The effect of three plant growth retardants, bitertanol, tradimefon, and hexaconazole, on short-term vine regrowth of pruned 'Arabe' grape (*Vitis vinifera*) was studied in field experiments conducted in the Dominican Republic. Individual soil drench treatments of the three retardants were applied to adult pruned 'Arabe' grape plants at rates 0, 0.25, 0.50, 0.75 and 1.00 g active ingredient per plant. Three weeks after treatment, bitertanol did not have a significant effect on vegetative growth, whereas triadimefon and hexaconazole caused significant reductions on vine regrowth. The effect of triadimefon as a growth retardant was stronger than that of hexaconazole, as described by regression equations  $Y = 30.88 - 25.68X$  for triadimefon, and  $Y = 32.9 - 15.2X$  for hexaconazole.

## Effect of Gibberellic Acid 3 and Nitrogen on the Seedlings of the Tropical Fruits *Malpighia puniceifolia*, *Spondias dulcis*, and *Melicoccus bijugatus*

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Container experiments were conducted in the Dominican Republic to determine the effects of gibberellic acid (GA<sub>3</sub>) and nitrogen (N) treatments on the seedling growth of Spanish lime (*Melicoccus bijugatus*), golden apple (*Spondias dulcis*), and acerola (*Malpighia puniceifolia*). The three species responded with linearly increased

height and dry weight to increasing GA<sub>3</sub> levels. Each species responded differently to N rates. Spanish lime did not respond to N supply, whereas golden apple was highly responsive and the growth of acerola was reduced at high N rates.

### Salinity Tolerance of Tamarind, Barbados Cherry, and Zapote Seedlings

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Nursery experiments were conducted in the Dominican Republic to determine the tolerance of tamarind (*Tamarindus indica*), acerola or Barbados cherry (*Malpighia puniceifolia*), and zapote (*Calocarpum sapota*) irrigation with saline water (0, 2, 4, 6, and 8 dS/m) at different frequencies (every 24, 48, and 72 hours) during 60 days. Results indicate that tamarind was the less salt-sensitive and zapote the less salt-tolerant of the three species. Linear relationships were found between salt concentration and growth, with biomass accumulation decreasing as salinity and irrigation frequency increased.

### Effect of Exogenous Gibberellic Acid on Papaya Ringspot Virus (PRSV)-Infected Papaya

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Field and container experiments were conducted in the Dominican Republic to determine the effect of gibberellic acid 3 (GA<sub>3</sub>) rates on papaya ringspot virus (PRSV)-infected seedlings and adult plants of 'Cartagena Ombigua' papaya. The apical region of PRSV-infected and PRSV-uninfected plants was sprayed with GA<sub>3</sub> aqueous solutions at rates 0, 25, 50, 75, and 100 ppm. PRSV-uninfected adult plants and seedlings produced longer internodes as GA<sub>3</sub> rates increased. Adult PRSV-uninfected plants flowered normally at any GA<sub>3</sub> rate. PRSV-infected seedlings and adult plants also responded to GA<sub>3</sub> sprays, but to a lower extent. Typical symptoms of the disease were present in all the infected plants regardless of the GA<sub>3</sub> rate applied, and adult plants did not flower at any rate. Results indicate that PRSV-infected 'Cartagena Ombigua' papaya plants are responsive to exogenous GA<sub>3</sub>, although in a lesser degree than PRSV-uninfected plants. Linear regression equations described the effect of GA<sub>3</sub> on the stem elongation of PRSV-infected and uninfected 'Cartagena Ombigua' seedlings and adult plants.

### Response of Young 'Keitt' Mango Trees to Nitrogen and Gibberellic Acid Supply

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Field experiments were conducted in the Dominican Republic to determine the effect of gibberellic acid (GA) and nitrogen (N) treatments on the growth of lateral branches in young 'Keitt' mango plants. Two-year-old 'Keitt' mango plants were pruned and treated with combinations of gibberellic acid (0, 20, 40, 60, 80, and 100 ppm) foliar sprays and soil nitrogen fertilization (18.75, 37.50, and 56.25 g). There were no N by GA interactions. Treatments did not significantly influence days to sprouting, number of sprouts, or number of leaves per sprout. N rates did not affect sprout length, whereas increasing GA rates enhanced sprout elongation. The effect of GA was described by the linear equation  $Y = 14.59 + 0.27X$ . Results indicate that GA sprays can be used to enhance sprout elongation to promote the desired round shape in canopies of 'Keitt' mango plants.

### Effect of Soil Applications of Iron, Copper, Zinc, and Manganese on the Growth of Young Papaya Plants

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The response of young 'Cartagena Ombigua' papaya (*Carica papaya*) plants to soil-applied copper (Cu), zinc (Zn), iron (Fe), and

manganese (Mn) was determined. Nursery experiments were conducted in the Dominican Republic, where Cu (0, 0.023, 0.046, 0.069, and 0.092 g), Mn (0, 0.27, 0.54, 0.81, and 1.08 g), Fe (0, 0.49, 0.98, 1.47, and 1.96 g) and Zn (0, 0.2, 0.4, 0.6, and 0.8 g per plant) were individually applied 20 days after transplanting. There were significant responses to the four elements. Maximum growth was obtained with 0.092 g Cu, 0.4 g Zn, 0.54 g Mn, or 0.98 g Fe per plant.

### Response of Young Papaya Plants to Nitrogen, Phosphorus, and Potassium Supply

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Studies were conducted in the Dominican Republic to determine the short-term response of young 'Cartagena Ombigua' papaya (*Carica papaya*) plants to nitrogen (N), phosphorus (P), and potassium (K) fertilization. N, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O were individually applied 20 days after transplanting at rates 0, 6, 12, 18, and 24 g per plant. Plant height, stem diameter, leaf area, and root and shoot dry weight responded to N and K in a quadratic fashion ( $N: Y = 30.79 + 1.35X - 0.07X^2$ ;  $K_2O: Y = 30.02 + 1.6X - 0.06X^2$ ). Maximum growth was obtained with 6 and 18 g of N and K<sub>2</sub>O, respectively. P fertilization did not significantly affect shoot growth, but it stimulated root growth ( $Y = 2.02 + 0.41X - 0.013X^2$ ).

### Influence of Calcium, Magnesium, Boron, and Molybdenum Fertilization Rates on the Growth of Young Papaya Plants

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The effect of varying calcium (Ca), magnesium (Mg), boron (B), and molybdenum (Mo) rates on the growth of young 'Cartagena Ombigua' papaya (*Carica papaya*) plants was studied in experiments conducted in the Dominican Republic. Rates of 0, 3, 6, 9, and 12 g Ca; 0, 0.85, 1.7, 2.55, and 3.4 g Mg; 0, 20, 40, 60, and 80 mg B; and 0, 0.05, 0.1, 0.15 and 0.2 mg Mo per plant were applied to the soil 20 days after transplanting. Ca did not stimulate plant growth, but instead was toxic at rates of 9–12 g per plant. Mg fertilization significantly stimulated root growth ( $Y = 2.35 + 0.48X$ ,  $r^2 = 0.95$ ), but not shoot growth. Mo applications decreased plant growth, whereas B enhanced overall plant growth ( $Y = 10.64 + 70.5X$ ,  $r^2 = 0.96$ ).

### Effect of Exogenous Gibberellic Acid on the Growth of Young 'Hall' and 'Semil-34' Avocado Trees

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Field experiments were conducted in the Dominican Republic to determine the effect of gibberellic acid treatments on the elongation of the leading and lateral branches of 'Hall' and 'Semil-34' avocado (*Persea americana*) plants. The plant growth regulator was applied as a foliar spray to the leading branch at rates 0, 20, 40, 60, and 80 ppm. 'Hall' avocado was not responsive to gibberellic acid treatment, whereas 'Semil-34' was responsive, with higher rates inducing a more pronounced stem elongation. As an undesirable side effect, gibberellic acid treatment also stimulated the elongation of lateral branches in 'Semil-34', making it unsuitable to enhance apical dominance on the leading branch.

### Heat Tolerance of Annual Cultivars in Zone 8

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In the summer of 1995 and 1996, 245 and 400 annual plant cultivars were evaluated for heat tolerance and landscape performance. Nine transplants of each cultivar were installed in raised beds amended with controlled-release fertilizer as per soil analysis recommendations, under full-sun and overhead irrigation, at the E.V. Smith Research Center in Shorter, Ala. (lat. 32° 30' N, long. 85° 40' W). No mainte-

nance, with the exception of one midseason pruning of petunia, was performed on any of the cultivars. *Catharanthus roseus* 'Blush Cooler' was the best performer in 1995 with a mean rating of 4.1 (of 5.0). *Salvia farinacea* 'Victoria Blue' and *Petunia ×milliflora* 'Fantasy Pink' performed well, with a mean rating of 3.5. In 1996, the cultivar with the highest mean rating was *Gomphrena globosa* 'Lavender Lady' (4.1). Second highest was *G. globosa* 'Strawberry Fields' (4.0). Other cultivars that performed well in 1996 and had high mean ratings were *Verbena ×speciosa* 'Imagination' (3.6) and *Melampodium paludosium* 'Derby' and 'Medallion' (3.5 and 3.5).

### Growth Differences in Hydroponic and Container-grown Geraniums

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Seeds of Dynamo white geraniums were started in a soilless media in the germination chamber. After germination, one-third of the plants were placed under an intermittent mist system, and two-thirds were placed in rockwool cubes (7.62 cm × 7.62 cm × 6.35 cm) and placed into the hydroponics system. Plants that were placed under the mist system were transplanted into 16 cm × 16 cm (width × depth) plastic pots containing a soilless media of 1 peat moss : 1 perlite (v/v). After 45 days, half of the hydroponically grown plants were transplanted into 16 cm × 16 cm plastic pots containing peat moss and perlite. Observations included final plant height, top fresh weight, and top dry weight. The hydroponically-grown geraniums were significantly taller than the pot-grown geraniums and the hydroponic/pot-grown geraniums, 58.17 cm, 36.42 cm, and the 41.75 cm, respectively. The hydroponically grown plants were also significantly higher in top fresh weight and top dry weight.

### A Comparison of Recycled Paper as a Growth Substrate in Container Production of Azaleas

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Wet Earth (WE) is a recycled paper product that may substitute for peat moss as a growth substrate. WE is available at various pH levels and may be formulated using: 1) paper production byproducts (WES), or 2) recycled corrugated cardboard (WEC). Use of WE by commercial growers would reduce demand for both landfill space and for slowly renewable resources such as peat and pine bark. Experiment objectives included: analyzing plant performance of azaleas (*Rhododendron obtusum* 'Hino Crimson') in WE-based growth substrates at pH 3.4 and pH 6.6 and in peat-based growth substrates (Trial pH), 2) analyzing plant performance of WES, WEC, and peat moss-based growth substrates (Trial SC), and 3) determining changes, if any, in substrate physical properties from planting to harvest. Shadehouse experiments were conducted in summer of 1996. Ratios of pine bark to WE tested were 100% pine bark, 1 : 3, 1 : 1, 3 : 1, and 100% WE by volume. Plant heights, widths, and visual quality ratings were obtained monthly throughout the 16-week experiment. Leaf, shoot, and root dry weights and leaf nitrogen concentration were determined at harvest. Changes in volume, bulk density, porosity, and air space were also measured. Plants performed poorly in WES, pH 3.4, with mortality exceeding 90%. Peat and WEC yielded similar (and best) results. Optimum plant performance for all substrates occurred in 1 : 3 and 1 : 1 (WE : pine bark) mixes. At concentrations over 50%, increases in bulk density and reductions in volume and percent air space in WE substrates were severe enough to negatively impact root growth and plant quality.

### The Effect of Mulch Type and Fertilizer Placement on Marigold (*Tagetes erecta* 'Hybrid Gold') Growth in Landscape Plantings

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The objective of this study was to examine the influence of mulch material and fertilizer application method on nutrient availability in a landscape situation. Beds containing four mulch materials (pine bark,

cypress pulp, pine straw, and cottonseed hulls) and three fertilizer application methods (granule, liquid, and time release) were established. Fertilizer placement included application either above or below the mulch horizon. Beds with and without mulch cover and no fertilization were established as controls. Marigolds, *Tagetes erecta* 'Hybrid Gold', were planted within the beds. Plants in unmulched or fertilized control beds had greater dry weights than plants in beds with mulch alone. Only plants grown in the cottonseed hull control demonstrated a slight improvement and cottonseed hulls demonstrated the best plant performance overall. The greater nitrogen content of cottonseed hulls may influence less immobilization of nitrogen in the soil solution during decomposition and reduce competition for nutrients between microorganisms and plants. Fertilization improved plant growth in all treatments except pine bark. Beds using pine bark showed significant reduction in plant dry matter accumulation. Potential toxicity or changes in soil chemistry by pine bark may have influenced these results and will be examined in further experiments. Fertilizer placement had no effect on plant growth.

### Seed Storage Media Effects on Persimmon Germination

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Common persimmon, *Diospyros virginiana*, a medium to large, attractive native tree of narrow habit, is potentially a valuable landscape tree due to its tolerance of diverse environmental conditions. Previous work by the authors demonstrated that seed stored in perlite or peat moss had a higher percent germination following cold storage than seed stored without media. Seeds were prepared for cold storage by two methods: 1) moist seed—cleaned (cap, skin, and the easily removed pulp discarded), and (2) dry seed—cleaned, dried for three days, and the remaining pulp removed. The media were either dried or moistened, but not saturated. The treatments were: 1) moist seeds; 2) dry seeds; 3) moist seeds in dry perlite; 4) moist seeds in moist perlite; 5) dry seeds in dry perlite; 6) dry seeds in moist perlite; 7) moist seeds in dry peat moss; 8) moist seeds in moist peat moss; 9) dry seeds in dry peat moss; 10) dry seeds in moist peat moss. Seed was stored at 4.4° for 142 days. Germination of seed stored in dry perlite was not significantly different from that stored in moist perlite or peat moss, but dry peat moss significantly limited germination regardless of seed preparation.

### Influence of Seed Treatments on Germination and Initial Growth of Ornamental Palms

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Experiments were conducted in the Dominican Republic to determine the effect of physical and chemical treatments on the germination of the ornamental palms *Roystonea hispaniolana* Bailey (Royal palm), *Acrocomia quisqueyana* Bailey (Corozo palm), *Sabal umbraculifera* Mart (Cana palm), *Phoenix canariensis* (Canary Islands date palm), *Veitchia merrillii* (Becc) Bailey (Manila palm), *Chrysalidocarpus lutescens* Wendl (Areca palm), and *Caryota urens* (Fish tail palm). Treatments were seed immersion in water or gibberellic acid 3 (GA<sub>3</sub>) solution for 72 hours, immersion in concentrated nitric acid for 5 minutes, or cracking of the seed coat. Rate and percentage of emergence 90 days after treatment were measured. The best results for *Roystonea*, *Phoenix*, *Veitchia*, *Caryota*, and *Chrysalidocarpus* were obtained soaking the seeds in water or a 200-ppm gibberellic acid solution. Nitric acid and seed coat cracking significantly reduced the germination percentage in all the species, except *Acrocomia quisqueyana* and *Sabal umbraculifera*. Seeds of *Acrocomia* did not germinate as a response to any of the treatments tested. *Sabal* seeds germinated only after coat cracking or nitric acid treatment.

### Effect of Cropping System on Residual Soil P from Poultry Litter Application

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When poultry litter (PL) is applied to meet the nitrogen (N) needed for plant growth, phosphorus (P) can accumulate, leading to non-point



source pollution of surface water. This study was conducted at Overton, Texas on a Bowie fine sandy loam (fine-loamy, siliceous, thermic, Plinthic Paleudults) to investigate the use of warm- and cool-season forage legumes in rotational cropping systems to remove excess P. Cropping systems were: spring legume–fall vegetable (SL-FV), spring vegetable–fall legume (SV-FL), and spring vegetable–fall vegetable (SV-FV). Warm- and cool-season legumes were Iron and Clay cowpea and crimson clover, respectively. Poultry litter rates were 0, 1X, 2X, 4X, and commercial blend (CB) as subplots. Fertility treatments were applied to vegetable plots only. The crop, 1X PL and CB rate for each season were: spring 1995—watermelon, 2.2 t·ha<sup>-1</sup>, 48.8N–12.2P–28K kg·ha<sup>-1</sup>; fall 1995—turnip, 8.3 t·ha<sup>-1</sup>, 89.6N–24.4P–28K kg·ha<sup>-1</sup>; spring 1996—tomato, 6.7 t·ha<sup>-1</sup>, 100.9N–17.1P–78.5K kg·ha<sup>-1</sup>. Soil P increased at all depths sampled (0–15, 15–30, and 30–45 cm) as PL rate increased. Residual P from CB was equal to the control. Through spring 1996, soil P concentration in the surface 0–15 cm was increased by all systems. System SV-FL reduced P accumulation by 35.6 mg·kg<sup>-1</sup> when compared to SL-FV and 44.7 mg·kg<sup>-1</sup> when compared to SV-FV. Residual P continued to increase as PL rate increased. Rate of increase was reduced by a system of SV-FL.

### Potential of Cool-Season Legumes for Removing Excess P From Poultry Litter Application

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Phosphorus (P) concentration in surface waters from non-point agricultural sources is an increasing resource management concern. This study was conducted at Overton, Texas, on a Bowie fine sandy loam (fine-loamy, siliceous, thermic, Plinthic Paleudults) to evaluate cool-season legumes for P uptake following poultry litter (PL) application rates on spring vegetables. Treatments were PL rate (0, 1X, 2X, 4X) and a commercial blend (CB) for comparison. Cool-season legumes, consisting of crimson clover, berseem clover, hairy vetch, and red clover, were the subplots. The vegetable crop in Spring 1995 was watermelon. The 1X PL rate was 2.2 t·ha<sup>-1</sup> and the CB was 44.8N–0P–32.5K kg·ha<sup>-1</sup>. Dry matter yield was decreased by the 4X PL rate. Plant P concentration increased linearly as PL rate was increased. The greatest P uptake (4.1 kg·ha<sup>-1</sup>) was at the 2X rate. Hairy vetch had the greatest yield (1,875 kg·ha<sup>-1</sup>), plant P concentration (0.53%), and P uptake (9.6 kg·ha<sup>-1</sup>). PL rate increased soil P concentration at all depths. The least amount of P accumulation was from CB and was equal to the control. Hairy vetch appears to have the capability of removing a greater amount of P and reducing soil concentration when compared to the other legume species tested.

### Initial Observations on Cassava (*Manihot esculenta* Crantz) Establishment and Adaptability in the Rio Grand Valley

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Four cassava (*Manihot esculenta* Crantz) accessions were received from the USDA, ARS Plant Introduction Station in Mayaguez, PR on 16 Jan. 1996. The next day the 15- to 20-cm-long cuttings were propagated individually in 1-gal. pots containing Metro Mix No. 4 for 10 weeks before field setting into a transition Hidalgo-McAllen fine sandy loam soil on a USDA, APHIS site near McCook, Texas. Three plant establishment methods, control (no soil amendment), addition of 15 Mt bagasse/ha, or 50 kg cross-linked polyacrylamide/ha into the planting trench were evaluated. The 2 × 1.2 m spacings on 15-cm-high beds provided 4036 plants/ha. Plants received a total of 35.8 cm of water between field planting and harvest (230 days). Mid- and late-season soil moisture (kg/m<sup>3</sup>) at 38 cm depth only was lowest in soil containing bagasse. Establishment method had little or no effect on plant size, leaf nutrients, leaf pigment concentrations, root dry matter, or root yield. Accessions differed in many of these attributes except root yield, the means of which ranged from 5 to 9 Mt/ha. Only roots survived an air temperature of –5.4 °C on 19 Dec.

### Using Phenomenological Interviewing: A Qualitative Research Method for People–Plant Studies

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Phenomenological interviewing is a research approach used extensively and successfully in the social sciences and has implications for

those working with people–plant interactions. Although many research methods are available for horticulturists to use in obtaining information about a target audience, most methods used (e.g., surveys and questionnaires) are quantitative in nature in that they provide numerical data on statistical generalizable patterns. Phenomenological interviewing allows investigators, through open-ended interview questions, to obtain more in-depth data than traditional quantitative techniques. Transcribed interview tapes become the data from which analysis and interpretation follows. “Coding” the data by searching for words, phrases, patterns of behavior, subjects’ ways of thinking, and events which are repeated and stand out classify and categorize the data helping with its interpretation and write up. Writing up such data must develop how you interpret what you found by carefully integrating themes that support a thesis and create or augment theoretical explanations. This research method allows investigators to understand and capture the points of view of the participants without predetermining those points of view through prior selection of questionnaire or survey categories.

### Breedlove Dehydrated Foods Feeding Hungry People Worldwide in Partnership with Fruit and Vegetable Growers

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Breedlove Dehydrated Foods (BDF), the largest charitable dehydration plant in the world, is capable of dehydrating 6,000 lb. raw product/hr. BDF dehydrates and distributes nutritious fruits, vegetables, and legumes to charitable organizations which feed hungry people. At least 35,617 people die from hunger in our world every day! Thousands of tons of nutritious but slightly imperfect horticultural products are wasted yearly in the United States. Donations totaling \$7.8 million funded construction of BDF. Texas A&M and Texas Tech Universities provided expertise to plan and operate BDF. BDF dehydrated over 30 million lb. of fruits and vegetables in the initial two years of operation. BDF is a model of people focused on an unusually high goal and working together.

### Components of Resistance to *Colletotrichum acutatum* in Strawberry (*Fragaria × ananassa* Duch.)

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Two experiments were designed to study components of resistance to *Colletotrichum acutatum* on runners of three strawberry cultivars: incubation period, latent period, length of the lesion and spore production, and infection frequency with three levels of inoculum density (10<sup>4</sup>, 10<sup>5</sup>, 10<sup>6</sup> spores/cc) were considered. Rate of disease development was also determined. There were significant differences in all the components among the resistant and susceptible cultivars. Both ‘Chandler’ and ‘Sweet Charlie’ expressed susceptible reactions. The length of the lesion, number of spores/cm of the lesion, incubation period, latent period, and rate of anthracnose development were statistically similar in ‘Chandler’ and ‘Sweet Charlie’. The only significant difference among them was found in infection frequency. ‘Chandler’ had a greater number of infection sites with all three concentrations of spores included. The cultivar Pelican showed a high level of partial resistance associated with longer incubation and latent periods, lower number of spores/cm of lesion, shorter lesion, smaller number of infection sites, and lower rate of disease development.

### Conservation Tillage of Sweetpotato

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A cultural practice that can modify and conserve the soil environment is needed in sweetpotato [*Ipomoea batatas* (L.) Lam.] production. The objective of this research was to evaluate conventional and conservation tillage of sweetpotato with four cover crop species (fallow, ryegrass, rye, and wheat). The cover crops were seeded in late Oct. 1995, and the sweetpotato transplants (‘Beauregard’) were transplanted at two dates the following spring (May and June). Conservation tillage significantly lowered soil temperature (10 cm depth)

during storage root initiation and development. Moreover, each cover crop significantly reduced weed emergence and soil erosion. The ryegrass conservation tillage treatment significantly increased marketable yield of sweetpotato in the first planting date, while rye and wheat performed equally well in the second planting date. In the second planting date, white grub (*Phyllophaga ephialda* Say) injury to storage roots was significantly higher in the conservation tillage treatments. However, conservation tillage seems to be a viable alternative to the conventional method of sweetpotato production.

### Tolerance of 'Sunrise' Papaya to Postemergence Herbicides

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Trials were conducted under controlled conditions to determine the tolerance of young papaya plants (15 cm tall) to postemergence herbicides. Herbicides used were paraquat (1.68 Kg ai/Ha), MSMA (2.24 Kg ai/Ha), 2,4-D (4.26 Kg ai/Ha), bromoxynil (0.28 Kg ai/Ha), cyanazine (1.12 Kg ai/Ha), dimethenamid (1.12 Kg ai/Ha), endothal (0.56 Kg ai/Ha), imazameth (0.067 Kg ai/Ha), imazethapyr (0.028 Kg ai/Ha) lactofen (0.12 Kg ai/Ha), oxyfluorfen (0.03 Kg ai/Ha), acifluorfen (0.28 Kg ai/Ha), atrazine (2.24 Kg ai/Ha), and bentazon (1.12 Kg ai/Ha) as well as the untreated control. Atrazine, bentazon, cyanazine, imazameth, imazethapyr, and dimethenamid did not cause phytotoxicity at the rates used and were equal to the untreated control. Other herbicides caused severe injuries followed by total death at 10 days after treatment.

## National Sweetpotato Collaborators

### Progress in Breeding for Sweetpotato Weevil Resistance

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A breeding program to develop improved sweetpotato genotypes with increased sweetpotato weevil resistance was started in 1990. Germplasm, including plant introductions, cultivars, and breeding lines with reported insect resistance, was field tested for injury levels by applying low numbers of weevils. Low levels of resistance were found and 'Regal' was among the highest. Top performing lines were selected and intermated. After 2 selection cycles the most highly resistant selection produced 89% uninjured roots compared to 28% in 'Regal'. Severity of injury score was 16 times lower in the most resistant selection (0.15) compared to 'Regal' (2.40).

### Sweetpotato Plant Bed Fertilization

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Seventeen plant bed fertilizer treatments including different rates of N, P, and K were evaluated for the effect on plant production and sweetpotato yield. 'Beauregard' storage roots were bedded. Treatments were 0, 40, 80 lb N/ac; 0, 80, 160 lb P/ac; or 0, 75, 150, and 300 lb K/ac. Each nutrient was evaluated in a separate trial. After the first cutting, half of the N treatments and all P and K treatments had 40 lb N/ac top-dressed on the beds. For the first cutting the high rate of N (80 lb/ac) had a higher green weight than the low rate of 0 lb/ac. There were no other differences found in the first or second cuttings for plant production or yield. Plant bed fertilization also had no effect on transplant survival.

### Multiple Defense Functions of Sweetpotato Resin Glycosides

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Sweetpotato resin glycosides were purified by HPLC methods. Most allelopathic potential could be explained by these compounds. Fifty percent inhibition ( $I_{50}$ ) of seed germination was obtained for redroot pigweed at 160 ppm, for velvetleaf at 13 ppm and for proso-millet at 11 ppm. Seed of the congeneric species *I. purpurea* was not

sensitive. Growth of yellow nutsedge was drastically reduced, the  $I_{50}$  for shoot growth was 30 ppm, for number of roots 36 ppm, and for total root length 19 ppm. The glycosides accounted for approximately half of the total fungicidal activity of all extract fractions when tested on *Fusarium oxysporum* pv. *batatae*. At 2 mg per ml, the glycosides inhibited hyphal growth by 31%. This concentration is less than 10% of the glycoside concentration in dry periderm tissue of 'Regal'. The purified glycosides were incorporated into a mericid diet for diamond-back moth larvae. All observed antibiosis was caused by the glycosides; the  $LD_{50}$  was 7.2 mg per ml diet. At that concentration the surviving larvae showed a weight decrease of 46%.

## National Cowpea Improvement Association

### Development of a Pinkeye-type Southernpea Cultivar with Green Cotyledons: A Progress Report

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The development of southernpea (*Vigna unguiculata*) cultivars with a persistent green seed color has been the subject of much interest for more than two decades because seeds of such cultivars can potentially be harvested at the near-dry seed stage of maturity without loss of their fresh green color. The success of the cream-type cultivar Bettergreen, which is homozygous for the *gc* gene conditioning green cotyledons, demonstrated that the development of cultivars with persistent green seed color is feasible. In 1990, an effort was initiated to develop a pinkeye-type southern pea cultivar homozygous for the *gc* gene. The pinkeye is the major cultivar class of southernpea utilized for processing in the United States. Seeds containing embryos homozygous for the *gc* gene are easily identified, and this ability to select in the seed stage greatly facilitated the rapid development of advanced breeding lines. More than two dozen advanced generation pinkeye lines with green cotyledons were ready for preliminary field testing in 1995, and seven were selected for detailed evaluation in 1996. Results of the 1996 tests indicate that the *gc* gene has been successfully incorporated into elite pinkeye germplasm.

### Reaction of Cowpea Cultivars, Breeding Lines, and PIs to Bacterial Blight

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Bacterial blight, incited by *Xanthomonas axonopodis* pv. *vignicola*, is a major disease of cowpea. Strong resistance has not been reported in commercial cultivars. Many cultivars released within the last ten years have not been previously screened. Thirty-eight cowpea cultivars, 60 breeding lines, and 25 PIs were screened for reaction to bacterial blight in tests conducted in a greenhouse. Inoculum was adjusted turbidimetrically ( $OD_{620nm} = 0.1$ ) to approximately  $10^8$  cfu/ml. Seedling plants were inoculated by either leaf infiltration or stem puncture methods. Ratings were on a 1-6 scale in which 1 = no symptoms, 2 = localized lesions at site of inoculation, 3 = lesions spreading slightly near site of inoculation, 4 = any symptoms on systemically infected leaves or stems, 5 = extensive wilting and/or stem collapse, 6 = dead plant. All cultivars were susceptible to the pathogen. Cream-type cultivars Bettergreen, Tender Cream, Zipper Cream, Carolina Cream, and Mississippi Cream were among the most susceptible. Breeding lines MN13, MN150, TX57069-11, TX 58048-2000, and TX 59069-11 produced hypersensitive reactions in response to leaf infiltration inoculation. However, the three TX lines were rated susceptible when inoculated by stem puncture. Eighteen PIs (including PI293467, PI293521, PI293525, PI293567, and PI293571) were highly resistant to bacterial blight.