
Abstracts of the ASHS Southern Region 56th Annual Meeting

Greensboro, N.C.

3–5 Feb. 1996

Extension

COOPERATIVE EXTENSION IN THE AGE OF ACCOUNTABILITY

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This presentation focuses on driving forces and philosophies in the current Age of Accountability and explores ideas of how to respond. The increased scrutiny faced by all public agencies is requiring that Cooperative Extension approach the issue of accountability a bit differently. We must articulate our objectives and values to specific clientele groups, the general public, and government officials. Hard questions are being asked about past and anticipated return on tax dollars invested in state and federal agencies. The Government Performance and Results Act of 1993 requires "performance based budgeting" for all federal agencies, including the USDA. Each federal agency must develop an action plan with well-defined objectives and anticipated impacts to justify the allocation of federal funds. The overriding theme is not how busy we are and how many activities we can report, but what has been the impact of our efforts.

BUILDING THE LAND-GRANT CONCEPT INTO THE WORLD WIDE WEB

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The land-grant system was founded on the principle that education and information make a critical difference in people's lives, and that the government plays an important role in providing education and information by funding teaching, research, and extension programs. This mission was interpreted previously as a charge to establish great educational institutions to provide a low-cost, quality education to everyone who applied, to place extension professionals within every county in the nation, and to build massive research centers to provide a continuous flow of new, science-based information to all at no charge. My thesis is that the World Wide Web and other emerging information technologies represent the only solution to the dilemma faced by the land-grant system for providing research-based, high-quality education and information to a growing clientele at a reasonable cost. *Aggie Horticulture* (<http://aggie-horticulture.tamu.edu>), a Web server that is modeled on the land-grant principle, will be used as an example of one approach to land-grant programs of the 21st century.

INFO-UFAXBACK: DELIVERING CONSUMER INFORMATION WITH FAX-ON-DEMAND TECHNOLOGY

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Consumers applaud the Minnesota Extension Service, INFO-U FAXBACK system that delivers consumer horticulture publications 24 hours a day, 7 days a week. Consumers call the fax-on-demand

system and, following voice instructions, use the phone key pad to enter their fax number and select a publication or a catalog of over 300 yard care and gardening titles. Documents selected are transmitted immediately to the fax number entered. Delivery cost runs \$0.18 per document in the metro toll-free calling area, and \$1.64 for long-distance calls. Compared to \$2.75 for printing, postage, and handling per fact sheet sent by mail, the system saved \$7000 in 1995 transmitting 2722 publications. Investment in system hardware and software runs \$6000 to \$8000. Documents can be stored as DOS text, which eliminates artwork and formatting, or scanned as graphic files that require 40 times more hard drive storage space. A document requires a one-time investment in staff time of 10–60 minutes to reformat for the fax-on-demand protocol.

HORTBASE: AN EXAMPLE OF PROFESSIONAL SOCIETIES' ROLES IN ELECTRONIC INFORMATION SYSTEMS

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HortBase, a global electronic information system for classroom, distance education, lifelong learning and Extension, incorporates three innovative concepts: 1) Three-dimensional team-creation of the electronic information files (subject, communications, and information science authors working together from start to finish to create the file). Team-creation respects, uses, and develops the professional strengths of each of the three team members. 2) National peer review by each file creator's professional society (ASHS, ACE, and ASIS, respectively) not only enhances information quality and continued professional development of the authors, but also creates wider acceptance and use of the information. 3) Nationwide, or even worldwide, distribution of the workload and costs of creation, review, revision, and distribution of the electronic information, rather than individual efforts-expenditures within each state, will minimize redundancy and will enable us to do more as a group and to specialize individually. Capabilities of electronic information systems facilitate, indeed require, this new approach to information development and delivery.

ASSESSING THE NORTH CAROLINA MASTER GARDENER PROGRAM

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A total of 51 Extension agents were surveyed in the North Carolina Master Gardener program. Thirty-five (68%) agents returned the survey. The highest benefits from participation in the Master Gardener program were expanded outreach of the county office and increased community support. The top three program barriers are limited time, financial resources, and the recruiting/supporting of volunteers. The majority (60% agreed) of agents felt the Master Gardener program was a cutting-edge program and the Master Gardener Association (67.7% agreed) should continue to be supported. The three significant programming thrusts at the county level were new clientele, increased number of volunteers, and volunteer input into the local program.

Significant features from the state level were the production of support materials, administrative support, and the N.C. Master Gardener Manual. Future changes/improvements to the Master Gardener program should be done through in-service training, completion of the teaching modules project, and more agent sharing sessions. Most agents (58.8%) have been in the Master Gardener program for 5 years or less, with 42.9% possessing horticulture undergraduate degrees. At least 100 median hours per agent were freed up by Master Gardeners answering phone calls and conducting workshops. The estimated savings to homeowners per county was a \$20,000 median.

THE FUTURE OF EXTENSION

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Extension gained strength from its inception in the early 1900s until the early 1980s. Then things changed—trends led to the notion that extension should get out of social programs and let producers pay their own way. These were the Reagan/Thatcher years. England, New Zealand, Australia, and Canada largely dismantled their extension services. This was supposedly due to financial reasons. They let the private sector take up whatever was released. In the U.S. during the 1980s the Extension Service came under similar attacks and some erosion of the services took place in various states. This has led to a reorganization of the extension service at the federal level, bringing the ARS and Extension Service closer together. I believe that this is the future for Extension—to bind and to build with research to improve and promote continued transfer of new technology. I see this as very difficult for the private sector to do. The ARS and university researchers have to be intimately involved with extension personnel. Program development must be two-fold and must begin to cross state lines both at the state and county levels. Extension workers are doing many of the research jobs of the 1960s and 1970s. For example, our Florida county agents are now doing demonstration and applied research studies that the experiment station personnel did up until 1980. For survival, county operations will need further combining and refining. The basis of the future lies in accountability of extension programs to the public and continued public relationships to express the good job that extension does for all Americans.

Education

EDUCATING VIA THE AIRWAYS...THE TIME IS NOW

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Advancements in telecommunications technology have impacted society in many ways. Much discussion exists about redefining the role of colleges and universities. The progress being made in educational methods is changing conventional classroom teaching. While change may be necessary for institutions of learning to compete in a global marketplace, colleges and universities remain highly focused on what their role will be in improving educational quality. A review of available literature reveals that many factors have created alternative ways for educators to be effective in providing course material to students. The effects of modern technology will present new challenges and innovations in the way horticultural education will be presented.

CHARACTER EDUCATION—ITS PLACE IN THE CLASSROOM

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In *The Seven Habits of Highly Effective People*, Stephen Covey presents a convincing appeal to replace what he calls the "Personality Ethic" with focus on the "Character Ethic" as a foundation of success. Rutgers' professor Donald McCabe's 1991 survey reporting that 67% of 6000 college students responding to a survey say they have cheated

at least once verifies the need to address basic foundations of character, including honesty and integrity in the college classroom. The question is no longer "Do we need character education?" but rather "How can we implement a process that inspires people to action?" A process involving students in the development of both personal and class codes of ethics has been well received in a sophomore-level landscape appreciation course. Incorporating such codes into all classes would be a logical response to McCabe's study, which revealed that dishonesty is less prevalent at schools with explicit honor codes. Encouraging students to write ethics statements that address high standards of behavior and concern for a greater society and world is a first step toward developing concerned professionals who will serve the public with integrity and understanding after they leave the classroom.

ENHANCING HORTICULTURAL EDUCATION THROUGH WORLD WIDE WEB TECHNOLOGY

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The World Wide Web and other emerging information technologies are bringing about a quiet revolution in higher education. Networked computers deliver high-quality educational enhancements to students at little per unit cost to the teacher. Slide presentations, course handouts, on-line color photographs, and interactive modules are accessible from the computer desktop via high-speed Ethernet or modem connections. *Aggie Horticulture*, the Web server of the Texas Horticulture Program, will be used as a model to demonstrate the impact of Web technology on delivery of enhancements to "traditional" lecture-format courses and its potential for delivery of "nontraditional" courses to large audiences independent of space and time constraints.

DISTANCE LEARNING—IT'S NOT FOR EVERYONE

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One of many forms of Distance Learning is "Interactive Video Teleconferencing" (IVT). I was an early user of interactive video for both course teaching and delivery of extension programs in small fruit production. But after 3 years of trying interactive video for delivery of an extension program, "Preplant Considerations for Strawberry Plasticulture Producers," agents and growers have indicated a strong desire to discontinue the use of this medium in favor of truly "live" regional meetings for the 1996 season. Growers and many agents may have some anxiety about appearing "on TV," and this leads to fewer questions and reduced audience participation levels when this extension meeting format is used. There is also the additional problem of finding funds to defray the costs associated with IVT programs. An evening broadcast of 2 hours to six university sites on the MCNC network in July 1994 led to charges of more than \$700 to the program sponsor, the North Carolina Strawberry Association. Quality interactive video programs require considerable advance planning and program preparation. In cases where this medium is being used only infrequently by the specialist (one or two meetings each year), the audience is basically uncomfortable with the idea of "being on TV" and network costs are high. The advantages of a more traditional extension meeting format will likely outweigh the benefits of distance education via interactive video.

USING TEACHING PORTFOLIOS EFFECTIVELY

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The Teaching Portfolio is a factual description of a professor's strengths and accomplishments. It includes documents and materials that collectively suggest the scope and quality of a professor's teaching performance. The Teaching Portfolio is a living, breathing document that changes over time. Items in a Teaching Portfolio include a statement of teaching responsibilities, description of steps to improve teaching, instructional innovations, student and teaching evaluations, awards and honors, and a record of students who have succeeded. I will discuss the steps taken at Clemson University to use the Teaching Portfolio.

J.B. Edmond Undergraduate Competition

INFLUENCE OF LIGNITE-ACTIVATED WATER ON SEED GERMINATION, CUTTING PROPAGATION, AND PLANT PERFORMANCE

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This project tested rates of lignite-activated water (LAW) for its influence on seed germination, cutting propagation, and plant performance. LAW is a product of CAW Industries, Rapid City, S.D. LAW is water-activated by lignite in a process that includes the addition of sulfated castor oil, calcium chloride, magnesium sulfate, sodium meta silicate, and fossilized organics from refined lignite. LAW is reported to improve many plant performance traits. Four rates were used in this study. Seed germination trials indicated no significant differences in germination percentage with LAW applications with the two species tested, *Echinacea purpurea* and *Hibiscus dasycalyx*. In a "closed" system, LAW enhanced cutting propagation success of *Aster caroliniana*, *Cuphea micropetala*, and *Verbena* 'Homestead Purple', as measured by percent rooting and dry weight of roots produced. Cutting propagation of two woody species, *Illicium henryi* and *Rosa banksiae*, was not improved with LAW additions. In the SFASU Arboretum, pansy performance, as measured by plant dry weight, was improved one month after establishment.

NEW PEST CONTROL STRATEGIES AND EFFECTS ON POLLINATION OF CUCUMBERS

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Cucumbers are susceptible to the bacterial wilt organism that overwinters in the gut of Diabroticite (cucumber) beetles. This disease is transmitted in feces via open feeding wounds and plugs xylem vessels of water conductive tissues. Insecticides can be applied to control Diabroticite beetles. Adios, a semiochemical bait impregnated with cucurbitacin is combined with the insecticide carbaryl, which can be applied after plant emergence to control Diabroticite beetles. However, the method of application for giving the maximum control was unknown. This study evaluates the rate of application, number of applications, methods of application using pressure and airblast sprays, and compares two Adios formulations. Also studied were the effects of Adios on bee fertilization and the quality of the fruit, since carbaryl is toxic to bees and thus affects pollination. Adios was also compared to a foliar insecticide, Asana XL.

BIOSTIMULANTS CAN INCREASE GROWTH OF GREENHOUSE-GROWN ORNAMENTAL ANNUALS

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Three biostimulants, Grow-plex (Menefee Mining Corp., Dallas), Roots 2 (LISA Product Corp., Independence, Mo.), and Root n' Shoot (Natural Organic Products International, Mount Dora, Fla.) were applied to transplanted plugs of *Salvia splendens* 'Empire Red' and *Begonia semperflorens* 'Varsity Pink' and 'Varsity Brite Scarlet'. Root n' Shoot drench (0.78%) solutions at transplant increased root weight, but a 1.56% solution decreased root weight of *Salvia*, although shoot growth was unaffected. Root n' Shoot decreased shoot growth of *Begonia*, but did not affect root growth. Roots 2 treatments (0.25% or 2.00%) increased shoot weight of *Salvia*, but did not affect the root growth of *Salvia* or the root or shoot growth of *Begonia*. Spraying Grow-plex (0.78% or 1.56%) to runoff at transplanting and 2 weeks after transplanting did not affect root or shoot growth of *Salvia* or *Begonia*.

Norman F. Childers Graduate Competition

OZONE SENSITIVITY OF BUDDLEIA CULTIVARS

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Five cultivars of buddleia, *Buddleia davidii*, were exposed to subambient, ambient, and twice-ambient levels of ozone in open-top chambers for 8 weeks during 1995. Plants were evaluated for foliar injury, growth index, and inflorescence characteristics during and following the exposure period. Destructive harvests were conducted at the end of the exposure period to determine the dry weight of both above- and below-ground plant components. All cultivars showed signs of visible injury in the twice-ambient treatment at both 3 and 8 weeks after treatment initiation (WAT). At 3 WAT, 'Pink Delight' was the most severely injured, followed by 'Opera'. The other three cultivars had similar lower levels of foliar injury. Reductions in growth index as well as dry weight were found for all cultivars in the twice-ambient treatment. The number of developing floral buds and inflorescences was reduced in the twice-ambient treatment for all cultivars. Differences among the cultivars was due to normal differences in growth habit and not due to elevated ozone levels. These data indicate that *Buddleia* cultivars are sensitive to levels of ozone similar to those found in urban areas of the southeastern United States.

BA-INDUCED OFFSET FORMATION IN HOSTA DEPENDENT ON CULTIVAR

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A foliar spray of 0, 1250, 2500, or 3750 mg benzyladenine (BA)/liter was applied to 10 hosta cultivars. Response to BA treatment was cultivar dependent, with BA promoting offset formation in half of the cultivars tested. Increase in offsets compared to the control ranged from 116% in 'Francee' to 3500% in 'Francis Williams' at 30 days after treatment (DAT) and from 150% in 'Royal Standard' to 2250% in 'Francis Williams' at 60 DAT with 3750 mg BA/liter. Stage of development, as indicated by the number of unfurled leaves on offsets, was also cultivar and BA dependent. All cultivars treated with 3750 mg BA/liter had an average of three or more unfurled leaves at 60 DAT, while among control plants, 40% of cultivars averaged less than three unfurled leaves. No phytotoxic symptoms were noted in any cultivar, and growth index was either increased or not affected by BA treatment. Chemical name used: *N*-(phenylmethyl)-1*H*-purin-6-amine (benzyladenine, BA).

EVALUATION OF HERBICIDE ABSORPTION AND RELEASE PROPERTIES OF FIVE HERBICIDE-COATED FERTILIZERS

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Several experiments were conducted to determine release rates of five oxadiazon-coated fertilizers. Five fertilizers and 4-mm glass beads (nonabsorbent control) were coated with ¹⁴C-oxadiazon + formulated oxadiazon, then placed in a separatory funnel and leached with 20 ml of water for 14 days. ¹⁴C-oxadiazon was quantified by use of liquid scintillation spectrometry. For glass beads, Nutricote, Meister, and Osmocote, 70% to 80% of the ¹⁴C-oxadiazon was recovered in the first two leaching events. Oxadiazon leached from Polyon was 47% during the first two events and remaining oxadiazon was slowly released over the next 12 leaching events. ¹⁴C-oxadiazon from the other fertilizers over the last 12 days of leaching was less than that recovered from Polyon. Evaluation of the total surface area of a 50-g sample revealed Polyon had the greatest total surface area of the five fertilizers. Scanning electron micrographs before and after leaching

indicated potential erosion of the Polyon surface compared to little or no change in the surfaces of the other fertilizers.

CONTAINER HOLE POSITION AFFECTS GROWTH OF WETLAND SPECIES

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Four wetland species, *Canna flaccida* (canna), *Iris versicolor* (iris), *Spartina alterniflora* (smooth cord grass), and *Juncus effusus* (rush), were planted into five different trade gallon container types. The container types used were no hole pots, four holes at the bottom of the pot, four holes half way up the side wall of the pot, four holes three-quarters of the way up the side wall of the pot, and pot-in-pot which consisted of trade gallon growing pots with four holes at the bottom of the pot placed inside a full gallon socket pot with no holes. Canna visual shoot and root rating were highest for the pot-in-pot treatment. Rush pot-in-pot plants had the highest growth indices, visual shoot, and root ratings compared to the remaining four pot types. Shoot count for iris was highest for the pot-in-pot containers. Container hole position did influence growth of smooth cord grass.

RED MAPLE CULTIVARS DIFFER IN FOLIAGE CHARACTERISTICS

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Average leaf area (LA) and petiole length (PL) was determined for 13 red maple selections May–Sept. 1993. Bloom types were determined based on the predominate flower structures present in Spring 1993 and 1994. Leaves were collected from an existing field study installed in Mar. 1990. Trees were drip-irrigated throughout the study, thereby eliminating moisture stress concerns. *Acer xfreemanii* ‘Scarsen’ (LA = 131.5 cm²), ‘Morgan’ (LA = 93.6 cm²), and ‘Autumn Blaze’ (LA = 83.9 cm²) had the largest leaves. *Acer rubrum* ‘Autumn Flame’ (LA = 40.0 cm²) had the smallest leaves. *Acer rubrum* ‘October Glory’ (PL = 17.1 cm) had the longest petioles followed by ‘Fairview Flame’ (PL = 15.4 cm). Shortest cultivar petioles were on *A. rubrum* ‘Franksred’ (PL = 9.3 cm) and ‘Tilford’ (PL = 9.3 cm). Flowers were predominately pistillate on ‘Autumn Flame’, ‘Franksred’, ‘Morgan’, ‘October Glory’, ‘Redskin’, ‘Scarsen’, and ‘Schlesingeri’. Flowers were predominately staminate on ‘Fairview Flame’, ‘Karpick’, ‘Northwood’, and ‘Tilford’. ‘Autumn Blaze’ did not exhibit flowers in 1993 or 1994. Some seedlings in the study were pistillate, and others were staminate.

RECYCLED NEWSPAPER AS A LANDSCAPE MULCH

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Two studies were conducted to evaluate recycled newspaper mulch for landscape plantings. In the first study, two paper products (pellets and crumble) were tested at three depths. Application of either 25 or 50 mm provided excellent control of prostrate spurge. Of the four annuals grown, ageratum exhibited severe stunting of roots and shoots. In the second study, three annual species were mulched with the two recycled paper products applied at 25 mm each and adjusted with P at 0, 3.75, or 7.5 ppm to bind excess Al. When no P was added, ageratum growth was about half that of the control plants. Addition of P at either rate resulted in similar growth compared to control plants. Marigold and geranium were less affected by recycled paper mulch; however, when P was added growth was always similar to nonmulched control plants.

CARBOHYDRATE STATUS OF CuSO₄ SPECTRAL FILTER-GROWN CHRYSANTHEMUM PLANTS

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The response of ‘Bright Golden Anne’ chrysanthemum plants grown under CuSO₄ spectral filters to exogenous GA₃ application was evaluated to determine the relationship between gibberellins (GAs) and carbohydrate levels. The CuSO₄ filters removed far red (FR) wavelengths of light and increased red : far red (R:FR), blue : far red (B:FR), blue : red (B:R) ratios, and phytochrome

photoequilibrium (Ø) values of transmitted light compared to water (control) filter. Plant height, internode length, and leaf and stem dry weights were significantly reduced by light passing through CuSO₄ filters in spring and summer seasons. Weekly applications of exogenous GA₃ reversed the reduction in height and internode length induced by CuSO₄ filters. Plants grown under CuSO₄ filters responded more to exogenous GA₃ application with respect to height and internode length, suggesting that the sensitivity to GA was not lowered. Light passing through CuSO₄ filters reduced the carbohydrate levels, but the response varied with the season. Weekly GA₃ application increased the carbohydrate levels, but did not totally reverse the reduction in carbohydrate levels under the CuSO₄ filters. Although GA₃ application increased the carbohydrate levels partially in CuSO₄ filter-grown plants, the inhibition of GAs may not be solely responsible for reduction of carbohydrate levels under CuSO₄ filters, showing that exogenous GAs and carbohydrate levels are not well correlated under CuSO₄ spectral filters.

Vegetable Crops

FIELD EVALUATION OF NEW BELL PEPPER CULTIVARS FOR BACTERIAL LEAF SPOT RESISTANCE

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Kentucky growers currently produce about 1300 acres of bell peppers worth \$2 million for both fresh market and processing. Bacterial leaf spot (BLS) caused by *Xanthomonas campestris* pv. *vesicatoria* has been the scourge which continues to limit expansion of pepper production in the state. Fourteen new BLS-resistant varieties and experimental lines were evaluated together with two standard (susceptible) varieties in 1995 at two locations. All entries were exposed to an induced BLS epidemic at one location but were kept disease-free at the second location. Field resistance to four races of BLS was high for all but one of the lines tested, which claimed resistance to races 1, 2, and 3. Cultivars with resistance to only race 2 or races 1 and 2 of the pathogen were no different from susceptible checks in terms of yields and disease resistance. Six entries performed well at both locations; these will be included in further trials in 1996.

CONTROL OF PHYTOPHTHORA BLIGHT IN BELL PEPPER

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Field studies were conducted in 1993, 1994, and 1995 to evaluate chemical and biological agents for control of phytophthora blight in bell peppers grown on polyethylene-mulched raised beds. Treatments included Kocide 606 (foliar applied), Ridomil 2E (soil applied), Ridomil 2E (directed spray), Ridomil/Copper 70W (foliar), Ridomil 2E (soil) + Ridomil/Copper 70W (foliar), fluazinam (soil/foliar), and Actinovate bioconcentrate (seedling media applied). The experimental area was inoculated with *Phytophthora* 2 weeks after transplanting. All plants were rated for disease incidence (number of plants exhibiting visual symptoms) beginning at inoculation and continuing every week for 5–6 weeks. Disease incidence was severe in 1993 and 1995. None of the chemical or biological agents had an effect on total marketable yields or fruit weights during the three years. Disease ratings were highest in the control, Ridomil 2E (soil), and Actinovate plots. Yields did not reflect the severe disease infestation that occurred in some plots, possibly because greatest disease incidence occurred late in the season. Best *Phytophthora* control was obtained from chemical treatments containing copper compounds (Kocide and Ridomil/Copper 70W).

ENZYME ACTIVITY IN TABASCO FRUIT SEPARATION ZONES
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Red-mature Tabasco (*Capsicum frutescens*) fruit ('McIlhenny Select') normally separate easily at the junction of the fruit and receptacle or calyx. Differences in fruit detachment force (FDF) between two lines, one that separates readily ('McIlhenny Select') and one that does not ('Hard Pick'), have been reported previously (Motsenbocker et al., 1995). In this study, enzyme activity from the detachment area was analyzed by viscosity reduction. The reaction mixture was 0.3% pectin in 20 mM NaAc, pH 5.5, for polygalacturonase (PG) and 0.6% carboxymethyl cellulose (CMC) in 20 mM NaPO₄, pH 6.0, for cellulase. Preliminary data indicated that PG and cellulase enzyme activity increased during fruit ripening in both lines. Only cellulase activity, however, correlated with FDF. In addition, the activity of both enzymes was higher in the 'McIlhenny Select' line than the 'Hard Pick' line at the orange and red-mature stages.

BUMBLEBEES: AN ALTERNATIVE POLLINATOR FOR CUCUMBER

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The effectiveness of bumblebees, *Bombus impatiens*, and honeybees, *Apis mellifera*, on the pollination of cucumber, *Cucumis sativus*, was compared at the individual bee level. A correlation between the number of bee visits a flower received and the resultant seed set was established. In both cucumber varieties, 'Calypso' and 'Dasher II', *B. impatiens*-visited flowers consistently had higher seed sets than *A. mellifera* when compared at equal visit numbers. This difference between bee types was found to be highly significant.

EFFECT OF PLANTING DATES AND VARIETIES ON YIELD OF SOUTHERNPEA [*VIGNA UNGUICULATA* (L.) WALP.]

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Southernpea varieties have shown the ability to yield differently when planting dates are altered. Identification of yield potential based on planting date would allow producers to select varieties based on time of planting. Ten varieties of peas with three different maturities were selected. The ten varieties were planted on five dates over a 2-year period. Results indicate that relative days to maturity can be shortened or lengthened by time of planting. Varieties planted in early June or early August took longer to mature than when they were planted in late June or early July. Southernpeas planted between 15 June and 15 July will normally produce the highest yields. Some long-season, upright varieties can be planted as early as 1 June with no loss in yield. Indeterminate and short-season varieties in this experiment showed the ability to produce high yields when planted as late as 1 Aug. These results suggest that some southernpea varieties will respond dramatically to different environmental conditions created by altered planting dates.

VEGETABLE FARMING IN ROMANIA

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I received an Eisenhower Exchange Fellowship (the fellowship's office is based in Philadelphia). The purpose of my fellowship was to work as a horticulture consultant on a 12-acre community development vegetable farm located in Curtea de Arges, Romania. The farm was designed to produce vegetables for market in the town or community of Curtea de Arges. Romania, a former part of the communist regime, is considered a poor country. Money was siphoned away from the people through corrupt government practices and mismanagement. The result of a political upheaval has the people now living in primitive conditions and they need help to feed themselves. Vegetable farming in Romania is still reliant on manual labor and manure fertilizer. Romania is at least 50 years behind other Western European countries or the United States in knowledge and farming technologies.

Crops on the 12-acre farm were manually seeded, transplanted, watered, hoed, weeded, sprayed, and harvested. My concerns, along with those of the director of the community development project, were to advise and set up demonstrations on modern farm techniques to assist the farm manager in doing a better job. Some of the tasks that I was successful at were 1) setting up demonstrations of clear plastic and rowcovers on cabbage and potatoes to increase earliness of crops, 2) setting up drip irrigation systems in low tunnel greenhouses, and 3) determining the feasibility and profitability of crops grown at the farm.

PERFORMANCE OF TROPICAL PUMPKIN (*CUCURBITA MOSCHATA*) INBREDS AND HYBRIDS

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Traditional varieties and selections of tropical pumpkins have long trailing vines that produce two to five fruit weighing from 2 to 20 kg each. Bush inbreds have been developed from crosses between 'La Primera', 'La Segunda', and 'Seminole' with 'Bush Butternut'. These inbred plants produce four to 10 early-maturing fruit weighing 1 to 2 kg each at the crown of the plant. Hybrids made with the vining types produce plants that have short or intermediate-length vines. Fruit are produced at the crown and on short laterals on the short-vine hybrids and on laterals on the intermediate-vine hybrids. Some short-vined and intermediate-vined hybrids produce higher yields than the traditional type, but fruit size is smaller and the fruit wall is generally thinner. C42-1-9-1 x Linea C. Pinta, an intermediate-vine type, produced the highest yield in spring (66.5 t·ha⁻¹) and fall (39.9 t·ha⁻¹) at Bradenton, Fla. About three fruit weighing 4 to 5 kg each were produced per plant.

WATERMELON FRUIT BLOTCH: HOST PLANT RESISTANCE AND SEED STERILIZATION EFFORTS

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A selection of Congo produced fruit that were not infected by blotch (pathogen *Acidovorax avenae* subsp. *citrulli*) in a replicated trial interplanted with infected seedlings. Ninety percent of Congo fruit not infected with the bacterial pathogen had a darker green background than those infected. PI 295843 and PI 299318 selections were also not infected. Infection rates in susceptible checks ranged from 22.5% to 47.6% and from 0 to 13.9% among triploids. Both ploidy level and genotype significantly affected infection rates. Infestation rates in triploid seeds were reduced but not eliminated by dry heat up to 75C. Heat treatment necessary to kill the pathogen was detrimental to germination.

PATHOGENICITY AND VIRULENCE OF *COLLETOTRICHUM* SPECIES ON CUCURBIT FRUIT

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Three taxa, *Colletotrichum orbiculare*, the unconfirmed teleomorph of *C. orbiculare* (*Glomerella cingulata* var. *orbiculare*), and *C. magna*, have been reported to cause anthracnose of cucurbits. In a previous study, virulence, vegetative compatibility, and mtDNA RFLPs have been used to examine these taxa. The three taxa can be distinguished based on mtDNA RFLPs. Under controlled greenhouse inoculation tests, only isolates of *C. orbiculare* (CO) from cucurbit hosts were highly virulent on cucurbit foliage; isolates of *G. cingulata* (GC) and *C. magna* (CM), and CO from cocklebur hosts were weakly virulent or avirulent. The majority of CM and GC isolates were recovered from fruit, whereas most CO isolates were recovered from foliage. A study was conducted to evaluate the pathogenicity and virulence of anthracnose isolates on cucurbit fruit. Twenty-seven isolates of the three taxa were selected based on the host and geographic origin, mtDNA RFLP haplotype, vegetative compatibility group, and race. Mature fruit from cucumber cultivars Marketer (susceptible) and H19 (resistant) and watermelon cultivars Black Diamond (susceptible) and Charleston Gray (resistant) were used. Fruit were inoculated by placing Torula yeast agar inoculum plugs (8

mm in diameter) into wounds. Following inoculation, the wounds were covered with Parafilm and incubated for 8 days at 25°C at 100% RH. On the third day the Parafilm was removed from the wound. Disease symptoms were evaluated by measuring lesion diameter and depth and evaluating the presence or absence of sporulation. All three anthracnose taxa are capable of infecting cucurbit fruit. CM and GC isolates were more virulent than CO isolates on cucumber. In contrast, on 'Black Diamond', CO isolates were more virulent than CM and GC isolates. No significant differences in virulence were observed on 'Charleston Gray'. There were no significant differences in virulence between the races of CO except on 'Charleston Gray', where race 2 isolates were significantly more virulent than race 1. CO isolates from cocklebur were only weakly virulent on cucurbit fruit.

RECURRENT SELECTION FOR SPECIFIC COMBINING ABILITY FOR YIELD IN FOUR SLICING CUCUMBER POPULATIONS

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Plant breeders often measure selection progress for yield by measuring the hybrid performance (combining ability) of a breeding line. This information is used to develop breeding lines with higher combining ability. The objectives of this study were to measure the specific combining ability for yield traits over three selection cycles from four slicing cucumber populations with 'Poinsett 76', a popular slicing cucumber cultivar; and to determine the change in specific combining ability for yield traits in four populations improved through recurrent selection. Four slicing cucumber populations, North Carolina wide base slicer (NCWBS), medium base slicer (NCMBS), elite slicer 1 (NCES 1), and Beit Alpha 1 (NCBA1), were developed and improved through modified half-sib selection from 1983 to 1992 to improve yield *per se* and fruit quality in each population. Eleven families were randomly selected from each of three selection cycles (early, intermediate, advanced) from each population and were hybridized to 'Poinsett 76'. Twenty-three seeds from each cross were planted in 1.2-m plots in Spring and Summer 1995. When 10% of fruit were oversized (>50 mm in diameter), plants were sprayed with paraquat to defoliate them and to simulate once-over harvest. The experimental design was a randomized complete block with 22 replications per population arranged in a split plot with the four populations as whole plots and the three cycles as subplots. The combining ability for early and marketable yield of NCWBS and NCBA1 increased as the number of selection cycles increased. Conversely, selection for higher yield *per se* decreased the combining ability of the NCES 1 population for early and marketable yield. The NCBA1 population exhibited the largest gain (131.2%) from cycle 0 to 8 averaged over all traits. Early yield exhibited the largest gain (60.8%) averaged over all populations.

A TISSUE CULTURE APPROACH FOR DEVELOPING TETRAPLOID WATERMELONS

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Tetraploids are needed to synthesize triploid watermelons, which produce "seedless" fruit with improved quality. Traditionally, the tetraploids are induced by applying colchicine to the growing apex of seedlings or soaking the seeds with colchicine solution. This method often produces low frequency of tetraploids and high frequency of chimeras. Breeding tetraploids takes much longer time than breeding diploids because of the low female fertility. We developed a tissue culture approach that allows breeders to develop desirable tetraploids with commercially acceptable volume of seed in 2 years. This tissue culture approach includes: 1) regenerate plants via shoot organogenesis from cotyledon tissue; 2) screen tetraploids based on leaf morphology (more serrated leaf margin and wider leaf shape) before transplanting, and confirm tetraploids based on pollen morphology (larger pollen with four copii) and/or seed characteristics; 3) self-pollinate tetraploids or cross the tetraploids with diploids to accurately estimate the female fertility; 4) micropropagate the best tetraploid(s) using axillary buds during the off-season; and 5) produce tetraploid

seed from the cloned tetraploids in an isolation plot and evaluate the triploids derived from the tetraploid(s) in the following season. This approach has been practiced on more than 20 genotypes over the past 4 years.

FIELD PERFORMANCE, EAR CHARACTERISTICS, AND SENSORY EVALUATION OF WHITE SWEET CORN VARIETIES

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Field performance, ear characteristics and sensory ratings were determined for 'Even Sweeter', 'Fantasia', 'Silver Queen', 'Silverado', 'Snow Belle', 'Snow White', 'Starshine', and 'Treasure' sweet corn varieties. Yield ($P = 0.60$), ears per hectare ($P = 0.77$), and ear fill ($P = 0.22$) were not significantly affected by variety, whereas ear set height ($P < 0.01$), ear length ($P < 0.01$) and diameter ($P < 0.01$), tip cover ($P < 0.01$), eye appeal ($P < 0.01$), as well as sensory ratings of appearance ($P < 0.01$), sweetness ($P < 0.01$), and flavor ($P < 0.01$) after cooking were. None of the selected varieties was rated unacceptable. However, because mean separation tests at the 5% and 10% levels did not provide clear groupings and because all attributes have to be considered together in variety evaluation, a global performance index (GPI) was developed by adding the ranks of each variety for each attribute. GPI ranged between 28 for 'Treasure' and 59 for 'Snow White' on a 10 (best) to 80 (worst) scale. 'Treasure', 'Silver Queen', and 'Even Sweeter' were above average. These varieties may be considered best performers for white sweet corn production in central Alabama.

IDENTIFICATION OF A RAPD MARKER LINKED TO THE ROOT KNOT NEMATODE-RESISTANT GENE IN SWEETPOTATO

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The inheritance of root-knot nematode race 3 [*Meloidogyne incognita* (Kofoid & White) Chitwood] resistance was studied in 71 progenies of the F_1 backcross population produced from the resistant parent 'Regal' and the susceptible parent 'Vardaman'. The distribution frequency of the progenies measured on total nematode number (eggs + juveniles) indicated a bimodal distribution with a ratio of 4 resistant : 1 susceptible. Based on this phenotypic ratio, the proposed genetic model was duplex polysomic inheritance (RRrrrr = resistant). Bulk segregant analysis in conjunction with the RAPD technique was employed to identify RAPD marker linked to the root knot nematode-resistant gene. Nine of 760 random decamer primers screened showed polymorphic bands. Primer OPI5₁₅₀₀ produced a band in the resistant bulk, but not in the susceptible bulk. Estimated recombination frequency of 0.24 between the OPI5₁₅₀₀ marker and the root-knot nematode-resistant gene indicated linkage.

EFFECT OF WATER DEFICIT ON YIELD COMPONENTS OF SOUTHERNPEA [*VIGNA UNGUICULATA* (L.) WALP.]

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Southernpea [*Vigna unguiculata* (L.) Walp.] is the main source of protein in humid and subhumid tropics, but production is limited by low and erratic rainfalls. This potential calls for greater management of water deficit stress through timely irrigation and greater understanding of crop response to adverse environmental conditions. The objectives of this study were to: identify growth stages of southernpea sensitive to water deficit, estimate critical length of water deficit detrimental to southernpea during each stage, and describe physiological and morphological responses of southernpea to water deficit stress. In this study, two southernpea cultivars, 'AR.91-285' and 'Coronet', were used to examine the effect of water deficit stress on seed yield, number of pods per plant, number of seeds per pod, pod length, and hundred seed weight during three stages of growth. The greenhouse and field results for these parameters indicated that the vegetative stage was the least sensitive to water deficit stress, followed by pod

filling and flowering stages. However, pod filling stage was found to be less sensitive than vegetative stage beyond 21 days of stress. The critical length of water deficit causing yield reduction appeared to be 7 days for flowering and pod filling stages and 14 days for vegetative stage. 'Coronet' was less sensitive to water deficit stress than 'AR.91-285'. Reduced plant size, change in leaf color, and wilting were plant responses during the vegetative stage. Leaf senescence, flower abscission, fewer and shorter pods, and early pod maturity were observed plant responses during the reproductive stages. We observed a general decline in stomatal conductance and net CO₂ assimilation with increasing days of stress. After 7 and 14 days of water-deficit-stress vegetative growth, stomatal conductance and net CO₂ assimilation returned to the levels of control.

HOODED SPRAY APPLICATION OF POSTEMERGENCE HERBICIDES FOR SOUTHERN PEA PRODUCTION

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Concerns over ground water, nonpoint pollution, and soil erosion have indicated a need for reduced use of preemergent herbicides and reduced tillage. This study was initiated to determine the feasibility of using postemergent, burndown herbicides under hooded sprayers in the production of southern peas. Two rates of paraquat, glufosinate, and glyphosate were applied at two application timings. All herbicides controlled rice flatsedge but not goosegrass. Since an untreated strip was left surrounding the drill, complete weed control did not occur in this system. In most cases, delaying application of the herbicides by 2 weeks tended to result in lower yields. However, no differences from a delay in cleaning the hoed check were noted. Plots treated with paraquat at 1.0 pt/A – timing 1 and glufosinate at 7.0 lb a.i./A – timing 2 had yields lower than the hoed check. Based on this study, southern peas can be grown successfully without the use of a preemergent herbicide by proper timing of a hooded application of a burndown herbicide with proper timing.

ONIONS FOR WINDOWS

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A market window for onion occurs when f.o.b. prices are above grower break-even price for a period of 4 to 6 weeks. Market windows were calculated to occur from late June to early August and from early October through December for northwest Texas onions. Five-year average prices ranged from \$6.25 to \$7.40 (1990–94), and a breakeven price of \$5.38/50-lb sack was calculated from an analysis of total costs of production and marketing and historic yields. Ongoing research and grower demonstrations with advanced breeding lines, commercial cultivars, and selections from yellow, white, and red cultivars have defined certain cultivars that display superior attributes and mature within the market window. Superior cultivars adapted to the first market window include XPH-87N60, 'Sunre 1445', 'Sunre 1462', 'Yula', 'Spano', 'Cimarron', 'Riviera', 'Utopia', and 'Alabaster'. Superior cultivars adapted to the second market window include 'Sweet Perfection', 'Sterling', 'Vega', 'Bravo', 'Capri', 'Vaquero', 'El Charro', 'Quest', 'Shasta', and 'Vision'. 'Vaquero', 'Sunre 1462', 'Sunre 1445', 'El Charro', and 'Viceroy' have potential for short-term storage for October to December markets.

HIGH-SPEED CULTIVATION OF VEGETABLE CROPS WITH FINGER-WHEEL CULTIVATORS

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The Precision Cultural System (PCS) developed by the Louisiana Agricultural Experiment Station allows simple and precise cultivation of vegetable crops; however, speed of the cultivators in small vegetable crops has been limited. The standard PCS sweep cultivator was limited to about 1.6–2.4 km·h⁻¹ in small crops because it would throw

soil over the crop plants at higher speed. The standard PCS rotary tiller cultivator could operate at 3.2–4.8 km·h⁻¹ in small crops but could not be operated faster in larger crops, due to its tendency to "walk" out of the soil at higher speeds. The standard PCS sweep cultivator was modified by replacing the sweeps between the twin drills with two pairs of straight finger-wheel ("rolling cultivator") spiders non-angled and in tandem. The finger-wheel gangs on the bed sides were also inactivated by raising them above the soil. The resulting PCS cultivator was successfully operated in very small crop plants (≤ 25 mm high) at speeds of 8–10 km·h⁻¹ with no crop damage. The cultivator could then be easily refitted for standard sweep cultivation on subsequent passes. No reductions in weed control or yield of mustard, kale, turnip, or spinach were noted when using the high-speed system.

YIELD RESPONSE OF TOMATOES AND BEANS TO COVER CROPS OVER TIME

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Tomatoes and beans were grown in rotation for 4 years with three cover crop treatments (bareground, wheat, and crimson clover) and three nitrogen rates (0, 60, and 120 kg N/ha). Over the course of the study, when no additional N was provided, lowest yields of tomatoes and beans were obtained with the wheat cover crop. With the highest N rate, however, there was little difference in yields of beans or tomatoes with any of the cover crop treatments. Considering the benefits associated with the use of cover crops, it is encouraging to see that with proper N amendment, yields obtained with cover crop systems can be comparable to conventional bareground systems.

SOIL NITROGEN RESPONSE TO COVER CROPS IN A TOMATO-BEAN ROTATION

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A 5-year study using winter cover crops (wheat or rye, crimson clover, and fallow) in a tomato and bean rotation indicated several soil responses to the cover crops. Advantages of crimson clover winter cover crop to the soil in a tomato-bean rotation included adding organic matter to the soil, which resulted in an increase in the amount of inorganic nitrogen in the upper levels of the soil profile and an increase in the soil's water-holding capacity. An additional benefit of winter cover crops to the soil was the potential of reduced nitrogen leaching.

CROP YIELD AND BIOMASS AS CORRELATED WITH N LEVELS AND COVER CROPS

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Cucumber and potato crops were tested in a rotation with winter cover crops at different locations in Georgia, North Carolina, and South Carolina from 1991 to 1994. Biomass DM of vegetable crops was greatest when grown after crimson clover. Clover plantings resulted in a greater biomass than wheat when preceded spring cucumber crop. Vegetable biomass produced on clover plots or with

N rates of 60 to 120 kg-ha⁻¹ was equivalent. Nitrogen recovery by cover and vegetable crops was enhanced by clover plantings. Clover biomass (tops only) provided an average of 138 kg N/ha for the cucumber crop, compared to an average of 64 kg N/ha provided by wheat. Nitrogen recovery by vegetable crops was also enhanced with 60–120 kg N/ha rates. Yields were highest when high N rates were used and when crops were produced on clover plots. Vegetable yield, cover crop biomass, and N recovery were positively correlated with vegetable biomass and applied N.

SUMMER AND WINTER COVER CROPS IN A VEGETABLE ROTATION SYSTEM

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A 3-year study of cover crops (rye + crimson clover or sudex) and vegetable rotation systems was conducted using a Norfolk sandy loam soil. Cash crops were planted on all plots each spring, and in the fall, crops were snap beans/squash, sudex, or fallow. Late incorporation of cover crops depleted soil water content, resulting in a need for irrigation before spring plantings. Sudex residue had a high C : N ratio, delaying the total mineralization of N. Potato yields were not affected by rotation treatments. Cover crops improved snap bean emergence and yield. Snap beans had a differential uptake of Fe, Al, and B with cover crops. Tomato growth and yield were reduced with winter cover crops. Fall squash yield was not influenced by rotations.

EVALUATION OF SUMMER COVER CROPS FOR USE IN VEGETABLE PRODUCTION SYSTEMS

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Five grasses, six broadleaf species, and five legume/grass mixtures were evaluated for their production of aboveground biomass (AGB), nitrogen contribution, C : N ratio, ability to compete with weeds, and susceptibility to three methods of mechanical kill. Of the legume species, sesbania, cowpea, and soybean produced the most biomass, which totaled 5542, 4227, and 3934 kg-ha⁻¹, respectively. Nitrogen in the AGB of these species was 109, 95, and 83 kg-ha⁻¹, respectively. AGB production of the grass species ranged from 8677 kg-ha⁻¹ for sorghum-sudangrass to 5247 kg-ha⁻¹ for pearl millet. Nitrogen in the AGB for the grass species ranged from 68 to 38 kg-ha⁻¹. In general, the cover crops most competitive with weeds were those that had an excess of 3900 kg AGB/ha. The broadleaf species were effectively controlled by mowing, while undercutting controlled five of the species, and rolling provided little control. Undercutting provided the best control of the grasses, while rolling was effective on the most mature species, and mowing provided little control.

THE USE OF WINTER CROPS TO REDUCE NITROGEN LEACHING

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The cost-effectiveness of using winter cover crops to reduce nitrogen leaching was estimated. Costs were based on cucumber and sweetpotato grown in rotation, three fertilizer application levels (0, 60, and 120 kg N/ha), and three winter covers (weeds/bare, wheat, and clover). Soil N was measured in 15-cm intervals to a depth of 90 cm at the 1993 harvest and 1994 planting. The cover crop biomass was also analyzed. Nitrogen trapping by wheat and clover was compared to bare ground with adjustment for N fixing by clover. Four scenarios—sweetpotato/both covers/high N and cucumber/wheat cover/low and medium N—yielded increased leaching compared to their bare ground counterparts. Leaching prevented from the other scenarios ranged from 1.07 to 20.11 kg-ha⁻¹. Costs, yields, and vegetable

prices were used to calculate profit changes from the bare ground method on a dollar/kg basis. Profit changes ranged from negative \$2372.74/kg for cucumber/wheat cover/high fertilizer to the only positive change of \$16.53 for sweetpotato/clover/medium fertilizer. Negative costs resulted from yield increases when nonwinter weed covers were used.

Fruit Crops

HIGH-DENSITY APPLE ORCHARD MANAGEMENT TECHNIQUES EVALUATED FOR THE SOUTHEAST—YEAR 5

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Managing vegetative growth in higher density apple systems in the Southeast can be difficult due to the longer growing season. This study was initiated in 1990 to evaluate leader management techniques that have commercial potential for high-density systems in the Southeast. ‘Spur Galagored’, ‘Jonagored’, and ‘Red Fuji’ apples on Mark rootstock were planted in the four major apple production regions of western North Carolina. The three leader management techniques evaluated were weak leader renewal, banding of the leader during the growing season (snaked leader), and leader heading with partial terminal leaf removal (H + PTLR) every 25 cm of leader growth. In the third year, branching was greatest for the snaked leader. In the fifth year, no differences in trunk cross-sectional area were detected between the leader management techniques. However, yields were significantly greater for trees managed with the snaked leader. Trees with the snaked leader yielded 44 kg/tree compared to 35 and 34 kg/tree for the H + PTLR and weak leader renewal, respectively. This illustrates that leader management techniques that use pruning or vegetation removal reduce the early production required of profitable high-density systems.

EARLY PERFORMANCE OF THE NC-140 APPLE CULTIVAR/ROOTSTOCK TRIAL: GROWTH AND YIELD, 1990–1995

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‘Empire’, ‘Smoothee’, ‘Jonagold’, and ‘Rome Beauty’ apple cultivars (CV) on five size-controlling rootstocks, Bud.9, M.9 EMLA, M.26 EMLA, Mark, and Ott.3, were planted in Fayetteville, Ark., in 1990 as a complete block design with six replications. Although interactions for several growth variables were observed in 1990–93, there were no cultivar–rootstock interactions in 1994, 1995, or for cumulative yield. After six seasons’ growth, CV did not significantly affect any growth variable. Trees on M.26 and M.9 were the largest, while trees on Mark were significantly smaller for both tree height and TCA; trees on Ott.3 and Bud.9 were intermediate. ‘Smoothee’ had the greatest cumulative yield, while both ‘Jonagold’ and ‘Rome Beauty’ had significantly less; ‘Empire’ yield was intermediate. Trees on Ott.3 and M.26 had larger cumulative yields than other stocks, which were all similar. Trees on Mark had the greatest yield/TCA, while M.9 and M.26 had the least yield/TCA; Ott.3 and B.9 were intermediate. Trees on Mark had very high levels of foliar Mn and exhibited symptoms of Mn-induced internal bark necrosis.

PERFORMANCE OF OWN-ROOTED ‘PREMIER’ RABBITEYE BLUEBERRY VS. ‘PREMIER’ GRAFTED ON *V. ARBOREUM* THROUGH THREE HARVEST SEASONS ON A FUQUAY SOIL

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Own-rooted ‘Premier’ blueberry (*V. ashei* Reade) was compared to ‘Premier’ grafted on *V. arboresum* Marsh. (sparkleberry) for yield and fruit characteristics in a five-rep RCB design with three plants/rep. With grafted plants, three reps were on rootstock #17 and two on rootstock #10, and results were combined for statistical analyses. Production of suckers by rootstocks was also recorded. Plants were

established on an upland doughty mineral Fuquay soil, modified with sawdust, at Jackson Springs, N.C. Supplemental irrigation was applied only in the establishment year and the following year, and landscape fabric was installed in the rows for weed control also in the year following establishment. 'Premier' grafted on *V. arboreum* yielded significantly higher than own-rooted 'Premier' in all three harvest seasons. Fruit size on grafted plants was also significantly larger than on own-rooted plants in harvest years 2 and 3. There were no differences in fruit color, picking scar, firmness, or flavor in years 2 and 3, and only small differences in harvest year 1. The data for years 2 and 3 indicated that there were differences among stocks in yield; however, both graft combinations were higher-yielding than own-rooted plants. There were also differences among stock clones for the number of suckers produced in harvest years 2 and 3. The highest-yielding graft combination also had the lowest number of rootstock suckers.

GALL MIDGES, *CONTARINIA AGRIMONIAE* FELT AND *DASINEURA* SPP. (DIPTERA: CECIDOMYIIDAE), ASSOCIATED WITH BLACKBERRY FLOWER INJURIES AND NUBBINS
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Larvae of *Contarinia agrimoniae* Felt, a gall midge, were discovered during 1986 in blossoms of blackberry cultivars and wild-growing plants that had a history of poor fruit set and 'nubbin' formation (Stiles, Semtner, and Reed, 1996). Other species damage blackberries in Europe, but the only North American recognition of *Rubus* flower bud infestation was with *Dasineura rubiflorae* Felt during 1886 (Gagne, 1989). During 1995 we found larvae of a *Dasineura* spp. in damaged buds at two, widely separated, commercial, North Carolina, blackberry sites. It is not known if the latter insects are different from the species that was collected during 1886. Midge larvae probably overwinter in soil under affected plants so we sprayed diazinon on the soil surface before bloom to kill larvae or interfere with pupation and reduce crop injuries. Infested 'Shawnee' and 'Cheyenne' buds were $\approx 100\%$ more numerous among controls than diazinon-treated plots. Numbers of larvae varied among infested buds; 83 were observed in one bud from a nontreated 'Cheyenne' plot.

'KIOWA' BLACKBERRY

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'Kiowa' is the eighth in a series of erect-growing, high-quality, productive blackberry cultivars developed in the breeding program of the Arkansas Agricultural Experiment Station. Large fruit size is the most outstanding characteristic of 'Kiowa', with fruit size usually 30% heavier than 'Shawnee'. 'Kiowa' has generally been less productive than 'Shawnee' but similar in productivity to 'Choctaw'. First picking of 'Kiowa' is usually 3 days later than that of 'Shawnee'. The harvest season for 'Kiowa' is long, with fruit commonly ripening over a 6-week period. Fruits of 'Kiowa' are firmer than 'Shawnee' and 'Choctaw'. Plants of 'Kiowa' are not as vigorous or erect as are plants of 'Shawnee', although row establishment has been good using either plants or root cuttings.

SCREENING PLANTS AS SUPPLEMENTAL FORAGES FOR POLLINATING BUMBLEBEES (*BOMBUS* SPP.)

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Bumblebees (*Bombus* spp.) are important pollinators of mostly self-sterile rabbiteye blueberry (*Vaccinium ashei* Reade). Annual bee colonies start from solitary overwintered queens who emerge in near-synchrony with rabbiteye blueberry bloom. Although colony populations may reach several hundred individuals by midsummer, in early spring most *Bombus* visiting rabbiteye blueberry are queens reared the

previous season. Thus, practices that encourage production of queens in summer may increase populations of blueberry pollinators the next spring. In south Georgia, midsummer shortages of nectar-yielding plants may nutritionally limit queen production, and cultured bee forages may help overcome this deficiency. Candidate plants must not compete with the crop for pollinators, and they must be attractive to bees, easy to grow, vigorous, and non-invasive. In 3 years of trials, the following plants have shown promise as supplemental bumblebee forages in south Georgia: *Althea* (*Hibiscus syriacus*), *Abelia* (*Abelia grandifolia*), *Vitex* (*Vitex agnuscastus*), red clover (*Trifolium pratense perenne*), Mexican heather (*Cuphea hyssopifolia*), monkey grass (*Liriope muscari*), summer sweet (*Clethra alnifolia*), and giant sunflower (*Helianthus giganteus*).

EVALUATION OF THE GENETIC DIVERSITY OF THE AMERICAN CHESTNUT

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The genetic diversity within and between geographic populations of the American chestnut tree was evaluated with allozyme and RAPD markers. Winter dormant or mature shoot buds from American chestnut trees collected in Alabama, Georgia, North Carolina, Virginia, Pennsylvania, Ohio, Michigan, and Connecticut were used for isozyme assays. Genetic diversity statistics calculated for 20 isozyme loci indicated that the highest level of heterozygosity was detected in the Alabama and Connecticut populations, the lowest level in the Great Smoky Mountain populations. RAPD analyses were conducted on American chestnut plant material. The best results were obtained with seed tissue. Seed from New York, Virginia, and Pennsylvania populations and buds from Alabama and Georgia populations were evaluated for RAPD markers scattered throughout the chestnut genome.

HARDINESS OF PRIMARY BUDS OF MUSCADINE GRAPE CULTIVARS

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Eleven muscadine grape (*Vitis rotundifolia* Michx.) cultivars were evaluated in Nov. and Dec. 1994 and Jan. and Feb. 1995 for primary bud hardiness using differential thermal analysis. Vines sampled were located at the University of Arkansas Fruit Substation, Clarkeville. Data analysis indicated a significant date $\times$ cultivar interaction for mean low temperature exotherm (LTE). Mean LTE decreased for all cultivars during the sampling period. Hardier cultivars for November and December were 'Sterling' and 'Summit'; for January, 'Nesbitt', 'Summit', 'Carlos', and 'Sterling'; and for February, 'Sugargate', 'Carlos', and 'Summit'. The minimum LTE for any cultivar was -23.8°C for 'Sugargate' during February.

GROWTH REGULATORS: FRUIT SET EXPERIMENTS ON BLUEBERRIES IN SOUTHERN GEORGIA

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Five experiments were run using surfactants and gibberellic acid (ProGibb). Fruit set is a problem with rabbiteye blueberry plants. Gibberellic acid sprayed on plants when they are in bloom does enhance fruit set. Currently, it costs \$247/ha to achieve this enhanced fruit set. 'Tifblue', 'Climax', and 'Woodard' cultivars were used in on-farm experiments. Usually, applications of 80 + 80 are used. With use of X-77 and L-77 surfactants, rates were reduced to 40 + 40. Other rates examined were 32 + 32, 24 + 24, 16 + 16 + 16. Fruit was enhanced significantly over no spraying. Airblast I sprayer performed better PropTec, whether used for day or night applications. Spraying slanting downward produced greater fruit set than from the side. E1: Trt = 15 - 20, C = 11 lb/lo. E2: 32 + 32 = 12, 16 + 16 = 7 lb/lo. E3: AB = 64, PT = 48 %FS; Trt = 56, C = 35 %FS; 'C' = 73, 'T' = 39 %FS. E4: 5% FS with Trt; 'T' = 53, 'W' = 57 %FS. E5: 30 + 30 = 87, - 40 + 40 = 80 %FS.

PEACH TREE SHORT LIFE NOT INFLUENCED BY PREPLANT HYDRATED LIME TREATMENTS

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'Redhaven' peach trees were planted on a nonfumigated peach tree short life (PTSL) site in Pontiac, S.C. The experimental design was a split plot with 12 replicates. Preplant subplot treatments were 0, 3, and 6 kg of hydrated lime mixed with 1.9 cubic meters of native soil (Lakeland sand) per planting hole. Main plot treatments consisted of mixing in the planting holes 0 or 5 liters of soil taken from a nearby orchard site that had shown "suppressive" tendencies towards ring nematode reproduction. Hydrated lime treatments increased soil pH by 0.6 to 1.4 units. Boron deficiency occurred in the 6-kg plots. Hydrated lime did not significantly reduce PTSL as 88%, 79%, and 92% of the trees in the 0-, 3-, and 6-kg plots, respectively, died from PTSL by the fifth year. No differences in survival were found between the nonsuppressive and suppressive soil treatments, as both had 86% tree death from PTSL. No trends in ring nematode populations were found among treatments.

FURTHER RESEARCH ON NITROGEN FERTIGATION OF PEACANS

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After 10 years, application of 112 kg N/ha, divided into four annual applications and applied through the drip irrigation system (fertigated), provided nut yield and quality as good as 224 kg·ha⁻¹ all broadcast or 1/2 fertigated and 1/2 broadcast. Leaf N was well above the 2.50% deficiency threshold. Treatment rates were halved for six additional years with no detrimental effects on yield and quality from fertigation. All treatments still provided leaf N well above the deficiency threshold. After 16 years of N fertigation there appears to be no serious reduction of pH or flushing of other nutrients from the wetted zone of the emitter. Leaf and soil analysis indicate a loss of Ca and Mg in the area away from the emitter when N was broadcast. Soil pH and nutrients were lower in the wetted zone of the emitter than in the area not wet by the emitter, and soil pH, K, and Mg were reduced in the 15- to 30-cm layer with fertigation. Leaf nutrient concentrations reflected the cation concentrations in the nonwetted area. Broadcast N was from NH₄NO₃ and fertigated N was from URAN (16% N from NH₄NO₃ and 16% N from urea).

FERTILIZING MATTED ROW STRAWBERRIES: AN OVERVIEW

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Generalized recommendations for the southeastern U.S. would typically include soil testing well in advance of establishment. Lime, P, and K should be applied at least 2 weeks before planting. Nitrogen is either broadcast and incorporated before planting or sidedressed 2 to 4 weeks after planting at 30 to 70 kg·ha⁻¹. Additional N at 30 to 65 kg·ha⁻¹ is applied late August to mid-September. A late winter N application at 20 to 30 kg·ha⁻¹ is suggested for sandy soils. On established plantings fertilization takes place at renovation, with P and K being applied based on soil test or foliar analysis results. Nitrogen rates are typically in the range of 35 to 60 kg·ha⁻¹. Later season fertilization generally follows the rates and timings of fall and winter recommendations of the establishment year. Minor nutrients can be limiting on sandy soils and B may be required in a wider range of soil types.

FERTILIZING BLACKBERRIES: AN OVERVIEW

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Fertility and soil preparation practices for blackberries from numerous states were reviewed to determine common recommendations. Soil pH was uniformly suggested to be 6.0–6.5, with the use of dolomitic lime commonly preferred for pH adjustment. Organic matter additions were often recommended, using cover crops or animal manures the year before planting. Additionally, the incorpora-

tion of P and K the fall before planting was commonly suggested, with rates of application dependent on soil test levels. Nitrogen applications were recommended each year, with rates increasing to the maximum suggested in years 2 or 3. Ammonium nitrate was always the preferred N source. Rates ranged from 28 to 56 kg N/ha for the first year to 67 to 90 kg N/ha for mature plantings, with rates largely dependent on soil type, with sandy soils receiving the higher rates. Application of K was usually recommended for every other year, based on soil test levels.

EFFECTS OF A LONG-TERM BLUEBERRY FERTIGATION PROGRAM ON SOIL PH, CONDUCTIVITY, AND NUTRIENT LEVELS

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Mill Creek Farms, a 52-acre rabbiteye blueberry field 6 miles west of Nacogdoches, Texas, represents a unique case history in terms of plant response to a nutrition and irrigation strategy. Since establishment in 1988, the field has received daily drip irrigation during the growing season (April through September) with nutrients delivered at each watering. Soil conductivity, pH, and nutrient values have been useful in determining fertilizer sources (ammonium sulfate, urea, and 25N–9P–17K + micronutrients) and rates (5 to 10 lb of fertilizer per week depending on source). A 1986–88 survey of East Texas rabbiteye blueberry fields is used as the basis for comparison of soil, leaf tissue, and irrigation water nutrient values. A study in Summer 1995 determined soil pH, conductivity, and nutrient values at 0–6, 12–18, and 18–24 inches below the drip line at distances 0, 12, 24, and 48 inches away from the drip line. Results indicate a narrow 2- to 3-foot band of irrigation influence on soil nutrient values. In general, soil nutrient values have been lower in the root zone than recommended by "sufficiency" guidelines, yet there has been no decline in plant vigor or productivity.

NUTRITION MANAGEMENT OF APPLES: AN OVERVIEW

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Current practices of fertilizer management, potential problems, and paths for fertilizer management research were discussed. Apple nutrition management in the humid southern regions of the U.S. is typically challenged by several factors such as inherently low soil pH, variable soil chemistry, and irregular precipitation. Some literature and personal experiences with orchard replant conditions and fumigation, fertigation, fertilizer delivery system, and time of fertilizer application were reviewed. On replant sites, fumigation and liming significantly improved tree survival and growth in the first 5 years. Fertigation with ammonium nitrate significantly lowered soil pH in the root zone compared to top dress applications. Using calcium nitrate resulted in less pH reduction. Results of studies of autumn application of N fertilizers have been mixed, with reports of no, decreased, or increased effects on fruit set, yield, and growth. Studies with size-controlling rootstocks indicate additional need to study the uptake of Mn and related Mn toxicity. Precocious rootstocks with high early yields have resulted in foliar K levels approaching deficiency within the first 10 years of production. Indications are that high-density orchards may have additional requirements for K fertilizers.

Floriculture/Ornamentals

PANSIES: AN ALTERNATIVE CROP FOR THE TOBACCO FLOAT BED SYSTEM

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A study was conducted with pansies (*Viola wittrockiana*) on a tobacco float bed system to determine if plugs could successfully be grown into transplants and to determine nutrient levels that would

provide the best transplants. Transplants were grown in a soilless media in 72-cell polystyrene float trays, floating on four different nutrient concentrations: 25, 50, 100, or 200 ppm. Length of time needed to produce regular-size transplants is reduced by half. Only 3 weeks are needed using the floating bed system, while 6 to 9 weeks are needed for the conventional method. Transplants displayed vigorous growth with normal morphology. Plant height and weight are significantly enhanced by increasing the nutrient concentration.

SCREENING HERBICIDES FOR INJURY TO THREE CONTAINER-GROWN PANSY CULTIVARS

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Little information is available on phytotoxic effects to annual bedding plant species from herbicides commonly used on container-grown woody plant species. *Viola ×wittrockiana* 'Crystal Bowl True Blue', 'Imperial Antique Shades', and 'Maxim Orange' were grown in 2.54-liter (#1) containers using an amended 6 pine bark : 1 sand medium. Five days after containerizing, each cultivar was either hand-weeded or treated with one of 13 granular or spray, pre- or post-emergence herbicides, within recommended rates in two separate studies. Herbicide phytotoxicity ratings were made 15, 30, 60, 90, and 120 d after treatment. Shoot dry weights were taken 120 d after treatment. Most injurious and persistently injurious herbicides were Rout 3G (oxyfluorfen + oryzalin), Pendulum 60 WDG (pendimethalin), and Ronstar 2G (oxadiazon). Low shoot dry weights closely correlated to injury rating. Least injurious herbicides included Pennant 7.8E (metolachlor), Surflan 4AS (oryzalin), Stakeout (dithiopyr), Pennant SG (metolachlor), and Derby SG (metolachlor + simazine). Southern Weedgrass Control, a granular formulation of pendimethalin, was among the least injurious, while Pendulum 60 WDG, a liquid formulation of pendimethalin, was most injurious. Evidence suggests that phytotoxic injury was greater on small, newly transplanted plants, though in some cases they were able to outgrow the injury.

GIBBERELLIN PHYSIOLOGY OF SPECTRAL FILTER-GROWN CHRYSANTHEMUM PLANTS

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Endogenous gibberellins of chrysanthemum [*Dendratema ×grandiflorum* (Ramat) cv. Bright Golden Anne] were characterized in preparation for quantification of endogenous gibberellins in apices under control and CuSO₄ spectral filters. Expanding shoots were separated into young expanding leaves and apices. Methanolic extracts of young expanding leaves were purified by solvent partitioning, PVPP column chromatography, and reversed-phase high performance liquid chromatography. Two bioactive regions corresponding to the HPLC retention times of GA and GA₁₉ standards were detected in fractions using the recently developed non-dwarf rice bioassay. Di-deuterated internal standards of GA₁₂, GA₅₃, GA₁₉, GA₂₀, and GA₁ were added to similar extracts of shoot apices. The presence of endogenous GA₅₃, GA₁₉, GA₂₀, and GA₁ in chrysanthemum apices was confirmed by isotope dilution using gas chromatography-mass spectrometry-selected ion monitoring and Kovats retention indices. Ions for the deuterated internal standard of GA₁₂ were detected, but not for endogenous GA₁₂. The above results demonstrate that the early 13-hydroxylation pathway operates in chrysanthemum.

FORM OF NITROGEN AFFECTS GROWTH OF CATHARANTHUS ROSEUS

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Annual vinca [*Catharanthus roseus* (L.) G. Don] is intolerant of high fertility, cool temperatures, and wet soil conditions, making vinca difficult for growers to produce alongside other, more tolerant bedding plants. Our objective was to develop better recommendations for producers. Growth of 'Grape Cooler' vinca was compared using different production inputs, including type of media (with or without bark), form of micronutrient source, and form of N. Optimal root and shoot dry weights occurred in peat-lite media with either sulfated or

chelated micronutrients adjusted to pH 5.5. Root and shoot dry weights were greatest when high nitrate-N to ammonium-N ratio fertilizers were used. Root and shoot dry weights were negatively affected by high levels of ammonium-N in the fertilizer solution. Root development is the critical factor in the production of high-quality vinca. Our data suggest that root development may be optimized by using fertilizer products that have a high nitrate to ammoniacal nitrogen ratio. Micronutrients in the sulfate form also seem to enhance growth when medium pH is maintained near 5.5. Use of high-porosity, peat-based mixes appears to provide an optimal root growth environment.

APPLICATION TECHNIQUE INFLUENCES IMIDACLOPRID EFFICACY ON POINSETTIA

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Rooted 'Freedom' poinsettia cuttings were treated with imidacloprid by surface application (0.005 g a.i./16.5-cm container) and the following alternative application techniques: foliar spray, 10 s dip, and 1 h dip (0.028 g a.i./liter). Topdressed plants were either overhead- or bottom-watered to investigate effects of leaching on imidacloprid residual activity. Number of silverleaf whitefly nymphs/cm² leaf were counted weekly, then biweekly, from 14 to 112 days after treatment. Spray and dip applications delayed establishment of heavy whitefly populations compared to the untreated control but did not prevent infestation. Single foliar and dip applications of imidacloprid proved not to be viable control alternatives. The two irrigation treatments using surface-applied imidacloprid provided whitefly control through 84 days after treatment. Beyond 84 days after treatment, topdressed, subirrigated plants had more whiteflies than topdressed, overhead-irrigated plants.

DEVELOPMENT AND ASSESSMENT OF AN ACIDIFICATION CALCULATOR FOR IRRIGATION WATER ALKALINITY REGULATION

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Excessive alkalinity in greenhouse irrigation water can increase substrate solution pH, resulting in reduced micronutrient availability for plants. A spreadsheet was designed to offer a quick and practical method for calculating: 1) amount of nitric, phosphoric, and sulfuric acid required to achieve an endpoint alkalinity or pH in irrigation water; 2) the amount of nutrients added by the acid addition; and 3) acid costs. It calculates both pH and alkalinity of irrigation water after acidification, regardless of the endpoint selected. The spreadsheet accounts for the pH-dependent reaction that determines the relative percentage of each of the carbonate species—carbonates (CO₃²⁻), bicarbonates (HCO₃⁻), and carbonic acid (H₂CO₃)—present in the solution. In addition, the acidification calculations account for the dissociation characteristics of the acid selected to neutralize the alkalinity. The spreadsheet was validated with six water sources from Indiana and North Carolina. Alkalinity neutralization was achieved within an acceptable range (greatest deviation from predicted pH was 0.16 units; greatest deviation from predicted residual alkalinity was 0.21 meq-liter⁻¹) for both target endpoint pHs and endpoint alkalinity concentrations. The mathematical model used in the spreadsheet development provides a chemical basis for acidification and provides results useful for making grower recommendations for acid additions to irrigation water for alkalinity neutralization.

DENITRIFICATION OF IRRIGATION RUNOFF USING A PACKED COLUMN BIOREACTOR

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Denitrification of irrigation runoff was achieved using a fixed

colony of facultative, heterotrophic bacteria in an anaerobic environment. Ammonium nitrate was used to create three influent nitrate concentrations of 50, 150, and 200 ppm NO_3^- , which were passed through two 17.5-gallon upflow bioreactors at 1.0 gallon/minute and yielded effluent concentrations of 1.9, 5.2, and 15.9 ppm NO_3^- , respectively. The fate of nitrate, nitrite, and ammonium as they passed up the columns was analyzed at an influent of 100 ppm NO_3^- , 29 ppm NH_4^+ , 0 ppm NO_2^- , and 1.0 gpm at five sample regions along the columns. The majority of the nitrates (76.5%) were removed in the first region of the columns with subsequent regions reducing 4.8% to 7.6%. Nitrite was produced (1.0 ppm) within the first region of the columns, with the majority (21.12%) being removed in the final region. Intermediate regions reduced 5.2% to 16.5% of the nitrites. Ammonium concentrations remained mostly steady, with slight reductions (6.3% to 11.1%) occurring primarily in the first two regions of the columns. Colony equilibration (Transient Response Time) was also recorded at 1.0 gpm with NO_3^- concentration steps from 150 to 100 ppm NO_3^- and 100 to 50 ppm NO_3^- . About 2 days passed before the colony adjusted to the change.

DAIRY COW COMPOST AS A POTTING SUBSTRATE FOR GROWING HYBRID RHODODENDRONS

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With the rising cost of sphagnum peat, nurserymen are looking at alternatives for growing substrates. Daddy Pete's plant pleaser is a product of composted cow manure. This study was conducted to see if composted cow manure could be used to grow containerized plants and replace sphagnum peat. Research was conducted using two *Rhododendron* cultivars, 'English Roseum' and 'Scintillation'. Plants of each cultivar were potted into 3-gallon containers. Test substrates were tested against the grower's standard mix, 80 pine bark : 20 sphagnum peat (% by volume), amended with 20 lbs Scotts Prokoke, 8 lbs dolomitic limestone, and 1.5 lbs step minor element package/1.7 yard³. Test substrates were treated equally. Daddy Pete's plant pleaser can work as a substitute for peatmoss in a growing mix. The Daddy Pete compost grew just as good a plant as the Buds & Bloom standard. Watering management turns out to be a factor because the compost generally held more water, therefore not needing irrigation as frequently.

MONITORING AND CONTROLLING DENITRIFICATION OF IRRIGATION RUNOFF USING A PACKED COLUMN BIOREACTOR

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Denitrifying bioreactors are systems that need close monitoring and control. Data concerning several system parameters is updated secondly on a computer, using LabView software and a Lab-PC+ I/O card from National Instruments. The flow rate through a denitrifying bioreactor is possibly the most important variable to monitor and control. The flow sensor used is a low inertia paddle wheel type that generates a digital pulse output whose frequency is proportional to the flow rate. This digital pulse wave is read by the computer, which converts the frequency directly to the flow rate. The computer is capable of operating in either open loop or closed loop settings. The second most important variable in a denitrifying bioreactor is the concentration of dissolved oxygen in the influent water stream. Using standard on/off controls, nitrogen gas, and a turbulator, the oxygen concentration can be maintained at levels below 1.8 mg O_2 /liter. The dissolved oxygen concentration is monitored with a probe that generates a millivolt signal proportional to the amount of oxygen present in the water. The millivolt signal is read by the computer 1000 times per second, generating a graph of the dissolved oxygen over time. Another signal the computer could use to decide the flow rate is the influent nitrate concentration. The lower concentrations do not require as much residence time to remove all the nitrates. The influent nitrate concen-

tration would also allow the computer to control the flow of substrate into the system.

GREENHOUSE SOLARIZATION OF RECYCLABLE MEDIA FOR GROWING MARIGOLDS

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An experiment was conducted to determine the influence of manure and fertilizer, with and without solarization, on the growth of marigolds. Average plant height was significantly greater in media that was solarized and covered with a plastic film to retain heat. Leaf length was significantly greater in amended media with fertilizer application. Plants grown in covered media produced significantly more flower buds than those grown in noncovered media, while flower numbers were significantly greater for fertilized plants. Plant fresh and dry weights were significantly affected by covering the media during solarization and the application of fertilizer. Media amended with manure significantly affected plant fresh weight only. Flower size showed significant interactions between all factors evaluated in this study.

WETTING AGENTS USED IN CONTAINER SUBSTRATES—ARE THEY BMP'S?

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Packaged commercial grower mixes routinely contain wetting agents. Studies report that dry components such as pine bark can be more thoroughly moistened if wetting agents are used. Under frequent leaching irrigations, wetting agents have been reported to enhance nutrient loss. Effective longevity is expected to be only 3 to 4 weeks. New products claim greater longevity and advertise that less water volume is required for optimum plant growth. One such product is Saturaid (Debco Pty, Victoria, Australia). The objective of this study was to evaluate the effect of Saturaid on physical properties, nutrient levels, and growth under decreasing irrigation volume. The granular wetting agent was incorporated at 0, 1.0, and 2.0 g-liter⁻¹ substrate volume. *Cotoneaster dammeri* 'Skogholm' plants were potted into 2.8-liter pots and irrigated with 500 ml of water for 22 days, after which one-third of the containers received 425 ml (–15%) and one-third were irrigated with 350 ml (–30%) daily. Saturaid had little effect on moisture and air characteristics, and no effect on foliar nutrients or on leachates collected at 43, 64, or 84 days. When irrigation volume was decreased 15%, top dry weight was greatest at 2 g, followed by 1 g of Saturaid. When irrigation volume was decreased 30%, the same results occurred for top and root growth.

CONTAINER PRODUCTION OF UNDERUTILIZED URBAN TREES USING KENAF AND COCONUT COIR PITH

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Growth responses during nursery production in 2.2- and 11.4-liter plastic containers to conventional and alternative media of four species of small trees of limited availability for potential use in urban sites in the southwest United States (*Acacia wrightii*, *Chilopsis linearis*, *Chitalpa tashkentensis*, and *Rhus lanceolata*) were compared to that of a commercially available small tree (*Fraxinus velutina*). Four media combinations, at 3:1 (v/v) of bark : sand (conventional), bark : coconut coir pith, kenaf stalk core : peatmoss, and kenaf : coir, with three fertilizer concentrations (3.6, 7.2, and 10.7 kg-m⁻³ of 18N–2.6P–10K Osmocote) were tested with each species. All species exhibited commercially acceptable growth (80 to 167 cm mean heights in 11.4-liter containers in 240 days) with near 100% survival in most media and fertilizer combinations with the following exceptions: shoot extension of *Rhus lanceolata* was reduced by 20 to 30 cm and survival by 20% to 50% in kenaf media with high fertility rates; and *Acacia wrightii* had acceptable shoot extension but exhibited poor trunk diameter growth across media relative to the other species. Slight

reductions in growth of some species were noted with kenaf media and slight increases with coconut coir, but differences were not likely of commercial significance. Kenaf media was significantly lighter (20% to 80%) than bark media, but had elevated initial electrical conductivity (EC) and shrank to 60% to 70% of its initial volume after 240 days. Kenaf : peatmoss media had a slightly lower mean pH (6.34) compared to the other media (pH 6.41–6.49).

AN EVALUATION OF TREATED WASTE WATER FOR THE PRODUCTION OF NURSERY AND FLORAL CROPS

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A survey of five different waste water treatment plants was conducted to identify potential variability in water quality factors. Salinity, pH, and alkalinity varied widely between sites. Mineral content did not differ significantly between sites. *Syngonium* spp. were subirrigated with four different combinations of treated waste water (TWW) and reverse osmosis (RO) water. Weekly measurements of EC and pH were taken and final height, width, and quality ratings were recorded. Based on these results, a 1 TWW : 1 RO water combination was then used to evaluate four different soluble fertility regimes. Salinity was the most limiting factor in the use of TWW on *Syngonium* spp. Growth and quality decreased as the percentage of treated waste water increased in each treatment combination. Salable plants were produced using a 1 TWW : 1 RO water combination and 100 ppm (N) fertilizer.

SHRUB ROSES: LOW MAINTENANCE?

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Twelve shrub rose cultivars were evaluated for pest resistance in the southern Blue Ridge mountains under high humidity and rainfall (1.34 inches per week average during the 1994 and 1995 growing seasons). ‘Albo plena’, ‘Blanc Double de Coubert’, ‘Fru Dagmar Hastrup’, ‘Roseaie de l’Hay’, *R. rugosa* ‘Alba’, ‘Sarah van Fleet’, and ‘Topaz Jewel’ were highly resistant to black spot and *Cercospora* sp. leaf spot. ‘Alba Meidiland’, ‘Linda Campbell’, ‘Pink Meidiland’, and ‘Scarlet Meidiland’ were susceptible, while ‘Bonica’ displayed intermediate resistance to both diseases. ‘Sarah van Fleet’ foliage and the flowers of ‘Albo plena’, ‘Blanc Double de Coubert’, and *R. rugosa* ‘Alba’ were damaged by Japanese beetle feeding. No other cultivars were damaged by Japanese beetles.

PROFILING THE TEXAS A&M HORTICULTURE JOB OPPORTUNITIES NEWSLETTER: CONTENT, READERSHIP, AND PERCEIVED VALUE

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A sample of individual and institutional recipients of a monthly horticultural job opportunities newsletter and firms/organizations listing positions in the newsletter were surveyed to determine the perceived value of the newsletter as a job search tool and recruitment tool, respectively. Survey information was also used to develop a profile of the individuals and organizations using the newsletter. Original position descriptions on which the briefer newsletter listings were based were used to develop a profile of the industry segment, degree/experience requirements, geographic location, and starting salaries/benefits of positions listed between Jan. 1993 and Dec. 1994. While the newsletter generated contact between prospective employees and employers, only 20% of the prospective employees received job offers by responding to newsletter listings. Individual recipients valued the newsletter as a job search tool more than institutional recipients, or private industry as a recruitment tool. Starting salaries of listed positions were comparable to those previously reported in industry and academic surveys. Foreign language skills and previous work experience were more frequently requested than above minimum grade point averages or completion of government/industry certification pro-

grams. Landscape-related disciplines constituted the majority of BS/BA positions listed, where advanced degree positions were more evenly distributed over horticulture-related disciplines.

Postharvest/Biotechnology

IMPACTS OF NORTH CAROLINA’S EXTENSION POSTHARVEST TECHNOLOGY PROGRAMS AND PUBLICATIONS

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Extension postharvest quality maintenance programs in North Carolina were significantly enhanced by engineering inputs and Exxon violation escrow funds. Equipment and storage designs and recommendations have provided tangible results for North Carolina horticultural crops producers and shippers, including “Cool and Ship,” a portable, pallet-size forced-air cooling system, thermal storage immersion hydrocooling systems, and the horizontal air flow sweetpotato curing and storage system. Impacts include: 30% to 50% blueberry and strawberry loss reductions using forced-air cooling; and 20% to 30% sweetpotato packout rate increases when cured and stored with the new system. Useful materials include a video on cooling options, a computer decision aid for precooling, a storage poster, and more than two dozen publications on Maintaining the Quality of North Carolina Fresh Produce.

YEASTS INHIBIT DEVELOPMENT OF LESIONS IN ‘GOLDEN DELICIOUS’ APPLES INOCULATED WITH *BOTRYTIS CINEREA*

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Strategies to reduce postharvest losses of fruit to pathogens include low-temperature storage, fungicides, and use of organisms with biological control capabilities. Our objective was to determine the effectiveness of two yeast isolates in inhibiting lesion development caused by *Botrytis cinerea* (Bc) on freshly harvested apples of different maturity. ‘Golden Delicious’ apples were harvested on 29 Aug., 23 Sept., and 10 Oct. 1995. Apples comprising the seven treatments [control, wound, *Cryptococcus humicola* (Ch), *Sporobolomyces roseus* (Sr), Bc, Bc + Ch, Bc + Sr] were placed in plastic boxes with damp paper towels. Each day for 7 days, ethylene and CO₂ production and lesion diameter at the wound were recorded. Ethylene and CO₂ production were not affected by treatment. Lesion diameter on apples treated with Bc was smaller on the first harvest, compared with the second and third harvests. Sr provided partial control on the second and third harvests, and Ch completely inhibited lesion development on all harvests.

CHANGES IN CARBOHYDRATE LEVELS AND SUCROSE-METABOLIZING ENZYMES DURING DEVELOPING AND RIPENING IN WATERMELON

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Changes in the activities of sucrose-metabolizing enzymes as related to ontogeny and ripening were studied in fruit mesocarp tissues of watermelon [*Citrullus lanatus* (Thunb.) Matsum & Nakai, cvs. A.U. Producer and Sweet Scarlet]. The levels of soluble sugars and the activities of sucrose synthase (SS; EC 2.4.1.13), sucrose-phosphate synthase (SPS; EC 2.4.1.14), and invertase (INV; EC 3.2.1.26) were measured. The temporal pattern of these enzymes relative to the levels of soluble sugars were similar for both cultivars. ‘Sweet Scarlet’ was characterized by having higher INV and SPS activities, while SS activities tended to be similar in both cultivars during fruit development. During later stages of ripening, ‘Sweet Scarlet’ tended to

accumulate reducing sugars, while 'AU Producer' tended to accumulate sucrose and therefore had lower sucrose-cleaving enzyme activity. Results indicate that SPS and INV appear to play a prominent role in carbohydrate metabolism in developing and ripening tissues of watermelon.

MOISTURE LOSS (%) DURING STORAGE OF INDIVIDUAL ONIONS AS AFFECTED BY HARVEST MATURITY, VARYING LENGTH OF CURING (HR), GRADE SIZE, AND LEVEL OF HUMIDITY

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Onions were harvested early, optimum, late (0%, 7%, 100% tops down). Onions were placed at random into one of twenty-four 30 × 30 × 30-cm boxes, which were stacked four high. Heated air was forced from bottom to top of each stack (curing). Curing lasted 24, 48, or 72 hours. Onions from each box were graded as to size and placed at random into one of four mesh bags for storage. Two bags each were put into either low- or high-humidity conditions. One of two bags were used for the individual onion study. Initially and every 2 weeks for 30 weeks, each onion was weighed and resized for effects of moisture loss. Moisture loss was correlated with harvest maturity: early 25%; optimum 28%; late 31%. Moisture loss rates were similar regardless of grade size. Lasting 30 weeks by size: J 1%; L 13%; M 25%; S 40%. Size reduction: J→L 10%; L→M 18%; M→S 25%. Individual onions' moisture loss rate were highly variable.

PERCENT ONIONS LOST DURING STORAGE AS AFFECTED BY HARVEST MATURITY, VARYING LENGTH OF CURING (HR), GRADE SIZE, AND LEVEL OF HUMIDITY

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Onions were harvested early (0% tops down), optimum (7% tops down), or late (100% tops down) and placed at random into one of twenty-four 30 × 30 × 30-cm boxes. Four boxes were stacked, resulting in six stacks. Onions in a stack were cured 24, 48, or 72 hours by forcing heated air from bottom to top of stack. Cured onions at each depth were then graded as to size and randomly placed into one of four mesh bags for storage. Two bags were placed in low humidity, the other two in high humidity. A bag of onions were inspected for any visible rots, which were removed. Good and bad onions were weighed separately and counted by size. This was repeated every 2 weeks for 30 weeks. Ninety percent of all early harvested onions lasted 10 weeks, while 50% of small early harvested onions lasted 30 weeks. Smaller grades lasted longer. More hours of initial curing helped smaller than larger grades.

Posters

IN VITRO CALLUS INITIATION AND DEVELOPMENT OF *MEDICAGO*

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The success of genetic transformation depends on the efficiency and reliability of in vitro shoot regeneration. This research was pursued to investigate how different plant growth regulators influence alfalfa callus initiation and development, thus to establish a foundation for further development of an efficient shoot organogenesis protocol for the genetic transformation system. BA, zeatin, and 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) were evaluated for callus initiation and development. BA at 1 or 5 mg-liter⁻¹, or zeatin at 5

mg-liter⁻¹ promoted callus regeneration and further development toward shoot organogenesis. However, 2,4,5-T at 1 mg-liter⁻¹ enhanced only callus production. These results can and will be used for further development of a shoot regeneration protocol to assist alfalfa genetic transformation.

RAPID PREDICTION OF ALUMINUM TOLERANCE IN ALFALFA

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Alfalfa (*Medicago sativa* L.), one of the most important forage legumes in the United States, has been recognized as an aluminum-sensitive species (Kemp-Glass et al., 1993). Hematoxylin staining has been used to evaluate differences in root growth and stain uptake between sensitive and resistant individuals in wheat (Ruiz-Torres et al., 1992). Attention in this study is focused on the hematoxylin staining pattern because the procedure is simple and rapid. Ten alfalfa cultivars were used: 'Apollo', 'ARC', 'Foundation Vemal', 'Shenandoah', 'Spreador 2', 'WL 311', 'Saranac', 'Saranac AR', 'Cimarron', and 'Cimarron VR'. Twenty seeds of each were stained in a solution of hematoxylin for 2 days. After staining, the seedlings were transferred to a potting medium for 14 days. After 14 days, plantlets were transferred to Porters soil (pH 4.5, 80% aluminum saturation) and grown in the greenhouse for 60 days. After 60 days, fresh and dry root and shoot weights were taken. Root length densities were determined and these parameters were compared to the tolerance level predicted by hematoxylin stain. Results of stain correlate with biomass at highly significant levels and will be of great use in the development of an acid/aluminum-tolerant alfalfa.

HEAT TOLERANCE OF SELECTED ANNUAL CULTIVARS IN ZONE 8

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Our objective was to determine heat tolerance and performance of 245 summer-flowering annual plant cultivars installed 16 Mar. 1995 in beds receiving full sun located at the E.V. Smith Research Center in Shorter, Ala. (lat. 32°30' N, long. 85°40' W). No maintenance, with the exception of one midseason pruning of petunias, was performed. *Catharanthus roseus* L. 'Blush Cooler' had the highest mean rating (4.1 of 5.0). *Salvia farinacea* Benth. 'Victoria Blue' and *Petunia ×hybrida* 'Fantasy Pink' both performed well with 3.5 mean ratings. 'Purple Wave', a compact spreading cultivar of *P. ×hybrida*, had a 3.1 mean rating, but had a 5.0 rating before pruning. We do not recommend pruning 'Purple Wave'. Of the 34 marigold cultivars evaluated, *Tagetes erecta* L. 'Antigua Mixed' had the highest mean rating. *Tagetes erecta* 'Inca Yellow' and 'Perfection Gold' tied with the second highest mean rating.

USING A "STUDENT-ORIENTED LEARNING OUTLINE" (SOLO) TO IMPROVE PERFORMANCE IN WRITING IN AGRICULTURAL SCIENCE DISCIPLINES

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AGRI 1203 "Introduction to Plant Sciences" is a college core requirement for students in the College of Agricultural, Food, and Life Sciences. One of the objectives is accomplished in part by writing a scientific research-review paper (term paper) on a subject of the student's interest. After several semesters of assigning the term paper, it was apparent that students had extensive variation in experience and skills in writing and documenting references. A SOLO was created so that students could develop and practice techniques in reading, understanding, summarizing, and documenting references in a research paper. The SOLO is a self-instructional exercise consisting of three parts: 1) a statement of learning objectives, 2) activities on how to achieve the objectives; and 3) exercises to measure mastery level of the exercise's objectives. The SOLO and student and instructor evaluations of the SOLO will be presented and discussed in the poster.

IRRIGATION NOZZLE HEIGHT INFLUENCES WATER CAPTURED BY CONTAINERS

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Rain drop momentum, based on the height from which it falls, is an important factor in drop penetration of plant canopy. This may explain why nursery operators report that substrates appear wetter from rain than from an equivalent amount of water applied with overhead irrigation. We investigated the influence of irrigation nozzle height on amount of water captured by *Rhododendron* sp. 'Formosa' grown in 10-liter containers. A Wobblers® (#8, 7.6 liters·min⁻¹) irrigation nozzle was positioned 1.2, 2.4, 3.6, 4.8, or 6.0 m above grade. Plants were placed in a circle 3.6 m from the riser base for the 1.2-m-high nozzle, 4.5 m from riser base for the 2.4-m-high nozzle, and 5.4 m from riser base for all other heights and irrigated for 3 hours. Prewashed disposable diapers were placed on substrate surface of each container with and without (control) plants. Diapers were weighed after irrigation and water captured was calculated and expressed as percentage of control containers. Capture increased from 144% at 1.2 m to 178% at 3.6 m then declined with increasing height. The decline was likely due to small drops with low momentum striking plants because plants remained 5.4 m from the riser base.

HANK KEMBLE DOESN'T WORK HERE ANYMORE

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Hank Kemble is the only county agent role ever cast in a network television series. On *Green Acres*, Mr. Kemble always had advice for novice farmer Oliver Douglas. Unfortunately, Mr. Kemble's advice was usually vague and uncertain. More unfortunate is that this is the only image many people have regarding Cooperative Extension. As the last segment of the land-grant system established, Extension personnel were the last recognized as equals among faculty. The mistaken image of the county agent as a book-trained farm boy with no common sense and a government job has been reinforced by declining respect for the farming community. In reality, county agents today deal with social and agricultural issues in urban and rural communities. Agents work with reduced staffs while being educators, scientists, and administrators in addition to routine duties. Extension specialists routinely teach and conduct research. National and international recognition and peer-reviewed publications are necessary for promotion while conducting traditional duties, too. As educational requirements of agents and specialists increased, numbers of undergraduates entering Extension dropped (<1% of Univ. of Georgia horticulture graduates in the last 5 years). Georgia specialists with a PhD increased from 60% (1979) to 89% (1996). Agents with MS degrees increased from 36% (1987) to 45% (1996). Image, salary, and job security determine if Extension can attract qualified personnel. Extension was never a Hank Kemble organization and graduates must be convinced that Extension is a viable and respectable career and Hank Kemble doesn't work here anymore.

CROPPING SYSTEM AND POULTRY LITTER EFFECTS ON RESIDUAL SOIL NO₃-N AND P

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Primary environmental concerns regarding application of poultry litter (PL) for crop production are nitrate leaching into ground water and increased levels of P in the soil that can erode into surface water. This study was initiated to investigate use of warm- and cool-season annual forage crops to remove excess nutrients supplied by PL in rotational-cropping systems on a Bowie fine sandy loam (fine-loamy, siliceous, thermic, Plinthic Paleudults). PL was applied at one (1×) or two (2×) times the recommended rate in the spring, fall, or spring and fall. Rates were based on N requirement of the crop and percent N in the litter. Comparisons were made to fertilizer blends (FB) and control treatments with no PL or FB. After 3 years of treatments, NO₃-N

increased at the 122-cm depth by 30 and 50 mg·kg⁻¹ from the 1× and 2× rate, respectively. The greatest accumulation was from FB (72 mg·kg⁻¹). With PL applied in spring only, spring vegetables followed by a fall cover showed a significant reduction in NO₃-N leaching and accumulation. Regardless of cropping system, rate, or time of application, P concentration increased by 40 mg·kg⁻¹ in the surface 15 cm of soil when compared to FB. If applied in an environmentally sound manner, PL will be less of a threat to pollution of ground water than similar rates of FB. Applying PL rates sufficient to meet crop needs for N results in P accumulation that can lead to nonpoint source pollution of surface waters.

A PHOTOCATALYTIC REACTOR FOR THE REMOVAL OF ETHYLENE IN AIR: PERFORMANCE UNDER CONDITIONS RELEVANT TO HORTICULTURE

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A reactor designed to catalyze ethylene to carbon dioxide and water in the presence of UV radiation was tested under a wide range of conditions applicable to horticulture. The reactor was constructed of a hollow stainless steel housing into which a 4-W UV lamp was inserted. Fourteen grams of zirconia-titania catalyst crystals, particle size 0.50 to 0.75 mm, filled the space between lamp and housing. Polysulfone end caps sealed the unit on each end and provided fitting by which air was directed in one end and out the other. Increasing dewpoint temperature (5, 11, 17, and 22°C) resulted in decreasing ethylene removal. Increasing reactor temperature (20, 30, 40, 60, and 80°C) resulted in increasing ethylene removal. Increasing air flow (106, 255, 385, 665, 1000, and 2000 ml·min⁻¹) resulted in a decreasing proportion of ethylene removed from the air stream but an increasing total amount of ethylene catalyzed per unit time (μl·day⁻¹). Increasing ethylene concentration (65, 147, 260, and 1131 ppb) resulted in increasing ethylene removal. The reactor performed well under all these conditions, and these data will be used to design ethylene removal systems for a wide variety of horticultural applications.

EFFECT OF HARVESTING METHOD AND DRYING TREATMENT ON THE ANTIOXIDANT ACTIVITY OF SAGE

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Sage contains the antioxidant thujone, which can be used to preserve foods in place of synthetic antioxidants. This study was conducted to determine if different harvesting methods would affect greater retention of antioxidant activity (AOA) of sage. The harvesting methods evaluated included sickle harvest, hand harvest, and flail harvest. Harvested samples were air-dried (temperature range 15 to 49°C) and oven-dried (continuous 49°C). Leaf area analysis indicated that flail harvesting induced substantial chopping and size reduction of the harvested material. AOA of sample extracts was measured using a carotenoid bleaching process against a standard BHT solution. Our results show a definite difference in retention of AOA between the harvesting methods (sickle 65%, hand 55%, flail 50% of BHT). This difference between harvesting methods was the same over the two drying treatments, although oven drying resulted in a decrease in AOA for all harvesting methods. Supported by USDA grant 93-34150-8409 and the Oklahoma Agricultural Experiment Station.

THE EFFECTS OF LIGHT QUALITY ON ENDOGENOUS CYTOKININ LEVELS IN IPT-TRANSGENIC TOBACCO

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Similarities exist between the effects of phytochrome and cytokinins on plant growth and development (e.g., chloroplast development, amaranthin synthesis, seed germination). It is unclear, however, if and how these two systems interact. The coaction between phytochrome and cytokinins was investigated by using *Nicotiana plumbaginifolia*

plants transformed with the *isopentenyl transferase (ipt)* cytokinin gene and treated with end-of-day (EOD) red (R) and far-red (FR) light. The *ipt* gene was under control of either a constitutive cauliflower mosaic virus promoter (35S-plants) or an inducible, heat shock promoter (HS-plants). When treated with EOD FR light, whole plants were characterized by decreased chlorophyll concentrations and increased fresh weights. When treated with EOD R light, 35S-plants contained high concentrations of zeatin riboside (ZR) compared to plants treated with EOD FR light. When treated with EOD FR light, HS-plants contained high concentrations of ZR compared to plants treated with EOD R light. Both cytokinin responses were photoreversible. The reasons for the differences between the 35S- and HS-plant responses are not known. Results appear to implicate interactions between phytochrome and cytokinins in plant growth and development.

TRIFLURALIN FOR WEED CONTROL IN CORIANDER, DILL, AND DANDELION

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Field studies were conducted to determine the efficiency and crop safety of trifluralin [2,6-dinitro-*N*, *N*-dipropyl-4(trifluoromethyl)benzenamine] in coriander (*Coriandrum sativum* L.), dill (*Anethum graveolens* L.), and dandelion greens (*Taraxacum officinale* Weber) when applied preplant-incorporated at 0.56 and 0.84 kg a.i./ha. Visual injury evaluations, crop fresh and dry weight at maturity, and leaf area were used to determine adverse effects of trifluralin on each crop when compared to an untreated control. Dandelion greens had a 47% and 49% reduction in leaf area when treated with trifluralin at 0.56 and 0.84 kg a.i./ha when compared to the untreated weed-free dandelion treatment. Coriander and dill showed no visual crop phytotoxicity and no adverse effects on crop growth, fresh and dry weight yield, or leaf area when treated with trifluralin. Trifluralin, when used in combination with early season mechanical cultivation, can provide selective weed control of many of the most common winter annual weeds in south Texas while exhibiting a high level of crop tolerance for coriander and dill.

SOURCES OF ADEQUACY OF INFORMATION ABOUT PESTICIDE APPLICATION IN THE ATLANTA LANDSCAPE MAINTENANCE AND LAWN CARE INDUSTRY

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Managers and employees of landscape maintenance and lawn care industry (LM/LC) applying pesticides can prevent pollution. Adequate information about application of herbicides, insecticides, fungicides, and nematicides is a prerequisite for proper application. A survey, prepared by an interdisciplinary research team "Ornamentals Working Group," was implemented in 1994 to Atlanta metro area firms. The gross return rate was 25.4%. The majority of respondents had 10 or fewer years of experience in providing landscape services; had at least 13 years of schooling; and were in their thirties or forties. The categorical nature of dependent variables suggested ordered probit procedure as the statistical estimation method. Independent variables included characteristics of the respondent, firm characteristics, and information sources about the application of a specific pesticide. Extension and research personnel and commercial representatives were important information sources about insecticide and fungicide application. The use of all three sources of information by the LM/LC industry seems to depend on pesticide type, with commercial representatives, and extension and research personnel often acting as complementary information sources.

QUALITY EVALUATION OF THREE NEWLY RELEASED SOUTHERN Highbush BLUEBERRY CULTIVARS

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The southern highbush (*Vaccinium* mostly *corymbosum*) blueberry cultivars Jubilee, Magnolia, and Pearl River, released by the

USDA in 1994, were compared with 'Premier' and 'Climax', two widely planted rabbiteye (*V. ashei*) cultivars, on the basis of flowering and harvest dates, yield, and physical and chemical quality parameters. The southern highbush cultivars flowered later and ripened at least 1 week before 'Climax', one of the earliest rabbiteyes. 'Pearl River' berries had less waxy "bloom" and appeared almost black when fully ripe; they had significantly less anthocyanins than the other cultivars compared. 'Premier' was lower in titratable acidity and higher in sugars than the southern highbush cultivars. Although data analysis indicated statistical differences in glucose and fructose concentrations among the other four cultivars, these differences were not pronounced. Based on the quality factors used in this study, the southern highbush cultivars compared acceptably to the rabbiteye cultivars.

THE EFFECT OF FUNGICIDE ON THE GROWTH OF APPLE BITTER ROT PATHOGENS

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Bitter rot, an economically important disease of apples in the southeastern U.S., is caused by a complex of plant pathogenic fungi. Fruit infection can result in large yield losses. Control of this disease is contingent upon the effectiveness of several commonly used fungicides. Two fungal species, *Colletotrichum gloeosporioides* (C.g.) and *C. acutatum* (C.a.), cause bitter rot. Isolates of both species also show a large degree of genotypic variation. The objective of this study was to determine the effect of several fungicides: benomyl (Benlate), Captan, Mancozeb (a combination of zinc ion and manganese ethylene bisdithiocarbamate, Dithane), and zinc dimethyldithiocarbamate (Ziram). Four concentrations (0, 0.5, 1, and 2 ppm) of each fungicide were used. Fungal growth was quantified by measuring colony diameters 3 and 6 days after incubation. Among the fungicides tested, only Benlate and Ziram significantly reduced fungal growth. Average growth reductions of *C. gloeosporioides* with Benlate and Ziram were 87% and 29%, respectively. In contrast, average growth reductions of C.a. with Benlate and Ziram were 60% and 52%, respectively. In conclusion, Benlate was the most effective fungicide in reducing overall fungal growth, while Ziram was more effective in reducing the growth of C.a.

PARTIAL OIL EXTRACTION EXTENDS THE SHELF LIFE OF PECAN HALVES

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Pecans, because of their high oil and polyunsaturated fatty acid content, have a relatively short shelf life due to oxidation of the oil. Using a nondestructive supercritical CO₂ extraction process, we evaluated oil reduction as a means for pecan shelf life extension. Pecan halves were extracted under sufficient conditions for 22% and 28% oil reduction, and then stored in modified-atmosphere packages with 21% O₂ at 22C for up to 37 weeks. Kernel hexanal content and sensory rancid flavor were monitored at various times throughout the study. The resistance of oils to oxidation, indicated by the onset of sustained hexanal production, was increased from 6 weeks for full-oil halves, to 18 weeks for 22% reduced-oil halves, to 22 weeks for 28% reduced-oil halves. Objectionable rancid flavor was detected by the 22nd week of storage for full-oil pecans. Reduced-oil pecans never developed objectionable rancid flavor. Supported by USDA grant 93-341508409, OCAST grant AR4-044, and the Oklahoma Agricultural Experiment Station.

COMPARISON OF BAND AND BROADCAST APPLICATIONS OF PHOSPHORUS ON SWEET CORN YIELD

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In 1994 and 1995, a study was conducted in Crossville, Ala., to determine if differences in leaf P concentration and crop yield occurred when P was broadcast or band-applied. Phosphorus (0, 34, 67,

101, and 134 kg P/ha) was banded (2×2) or broadcast and incorporated before planting. Other nutrients were applied based on current recommendations and soil testing. In 1994, as level of P increased from 0 to 150 kg P/ha, fresh weight of harvested ears increased quadratically. In 1995, fresh weight of harvested ears did not differ among broadcast treatments; however, there was a linear increase in yield among banded P treatments. There was no difference in fresh weight of harvested ears between banding and broadcasting in either year. Percent P in corn ear leaves did not differ among treatments. There was no difference in P leaf concentrations between the banded and broadcast treatments, indicating that yield response occurred because of rate of P application as opposed to method.

EFFECT OF LOCATION ON VITAMIN C CONTENT OF SELECTED BELL PEPPER CULTIVARS

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Vitamin C (VC) levels (mg/100 g FW) were determined in 10 varieties of colored bell pepper grown under different field conditions. VC was determined by the microfluorometric method. 'Orobelle' (169 mg), 'King Arthur' (143 mg), 'Valencia' (141 mg), and 'Chocolate Bell' (134 mg) had significantly higher VC levels than 'Dove' (109 mg), 'Ivory' (106 mg), 'Blue Jay' (93 mg), 'Canary' (90 mg), and 'Black Bird' (65 mg). The largest variability (53 mg) in VC levels were observed for varieties that had the highest VC content. Mean VC levels were 143a, 143a, 141a, 136a, 108ab, 93bc, and 63c for the yellow, red, orange, brown, white, purple, and black colors, respectively. Since the Recommended Daily Allowance (RDA) for VC is 60 mg per day, these results suggested that a 100-g serving of fresh bell pepper or less would supply 100% RDA of VC. Therefore, after selecting a color, growers still have the freedom to grow a variety that performs well in their area to produce peppers of high VC contents.

THE IMPORTANCE OF PESTICIDE RESIDUE IN VEGETABLES FOR CONSUMERS IN THE UNITED STATES AND GERMANY
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Chemicals used in fresh vegetable production leave residue. Although the typical residue amount is below allowable limits, producers must recognize consumer preference for less residue. Atlanta and Berlin consumer surveys showed difference in opinions about chemical residue in fresh vegetables, need for government testing, impact of residue on amount of consumed vegetables, and willingness to pay for vegetables with less residue. In general, Atlanta residents were more likely to agree about certifying vegetables as containing only allowable residue amount, while Berlin consumers were more willing to pay for government testing and vegetables with less residue. Two equations were estimated to identify factors influencing the preference for less residue. Respondents with higher incomes showed less preference for less chemical residue; similar preferences were demonstrated by older and single Berlin respondents. Growing vegetables with less chemical use offers opportunity to market fresh vegetables differentiating them from vegetables produced using traditional practices, especially given the willingness of overseas consumers to pay higher prices for vegetables with less residue.

DOUBLE-CROP FALL CABBAGE AS A SCAVENGER OF RESIDUAL FERTILIZER NITROGEN

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High-value crops (tobacco and sweet corn) often receive high levels of N fertilizer during the growing season rather than risk yield and/or quality reductions. Following harvest, small-grain winter cover crops are sown to reduce soil erosion and recover residual fertilizer N.

Fall cole crops, such as cabbage, grow rapidly in early fall, respond well to N fertilization, and have the potential to be sold for supplemental income. The objectives of this study were to 1) compare fall cabbage and winter rye as scavengers of residual fertilizer N and 2) determine if a relationship between fall soil mineral-N (NO_3^-) levels and fall cabbage yield response to N fertilization exists. Soil mineral N levels following sweet corn and tobacco ranged from 22 to 53 $\text{mg}\cdot\text{kg}^{-1}$ in the surface 30-cm and declined with depth. Fall cabbage appeared to be as effective as rye at reducing soil mineral N levels. No fall cabbage dry matter yield response to applied N was measured in 1993 and 1995. However, following sweet corn in 1994, a small cabbage yield response to N at 56 $\text{kg}\cdot\text{ha}^{-1}$ was measured when the soil mineral level, prior to fall fertilization, was 22 $\text{mg}\cdot\text{kg}^{-1}$.

EVALUATION OF THE RHIZOBIUM POPULATION OF PIGEONPEA AND COWPEA RHIZOSPHERE AFTER INOCULATION WITH SEVERAL RHIZOBIUM STRAINS

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Pigeonpea [*Cajanus cajan* (L.) Millsp.] and cowpea [*Vigna unguiculata* (L.) Walp.] seeds were inoculated with broth cultures of *Rhizobium* strains 3278, 3458, and 3472 at a population of $\approx 9.5 \times 10^6$ viable cells/ml. They were planted at three air temperature regimes: 20/10C, 30/20C, and 38/25C (day/night), which generated variable rhizosphere temperatures of 17/6C, 26/15C, and 33/20C, respectively. Seeds and/or seedling roots were sampled at 3, 7, 11, and 15 days after planting and *Rhizobium* survival was enumerated as viable cells on agar media. Only strain 3458 in association with pigeonpea genotype ICPL8304 had a higher population at day 15 than that at the earlier sample dates. The duration of the strains in the rhizosphere, rather than temperature, influenced population changes. No strain showed a consistent increase in cell numbers from inoculation to 15 days after planting. There was no clear pattern of population changes for any strain within or across temperatures, hence it was difficult to identify any strain as having superior growth habits over another.

MECHANICAL AND CHEMICAL ALTERNATIVES FOR WEED CONTROL IN WATERMELON

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A study was conducted in southeastern Oklahoma to determine treatments or combinations of treatments that provided the best weed control and crop yield for watermelon. 'Allsweet' watermelons were grown with different combinations of mechanical and chemical weed control. Treatments included naptalam, clomazone, naptalam + clomazone, bensulide, naptalam + bensulide, napropamide, trifluralin, dcpa, ethalfluralin, sethoxydim, paraquat, glyphosate, cultivation, cultivation + hoeing, cultivation + paraquat, cultivation + glyphosate, and one treatment with no weed control. Glyphosate and paraquat were applied as wipe-on when weeds were taller than watermelons. The five treatments with greatest yields were (in descending order) cultivation + hoeing, trifluralin, cultivation + paraquat, cultivation, and dcpa. The treatments with lowest yield were the control, paraquat, glyphosate, and naptalam. A visual rating (0–10, 0 is poor, 10 is ideal) was taken about 5 weeks after seeding. Treatments with a visual rating of 6 or more were trifluralin (9.4), cultivation + hoeing (9.3), napropamide (9.3), cultivation + glyphosate (7.5), cultivation + paraquat (6.8), dcpa (6.7), and cultivation (6.5). With the exception of the cultivation + hoeing, all plots were weedy at harvest time. Suppression of selected weeds by a herbicide usually allowed rapid growth of the remaining weeds.

'TENDER CREAM': A NEW MULTIPLE-PEST- AND DISEASE-RESISTANT CREAM-TYPE SOUTHERNPEA

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The USDA has released a new cream-type southernpea [*Vigna unguiculata* (L.) Walp.] cultivar that is well adapted for production

throughout the southern United States. The new cultivar, named 'Tender Cream', is the product of a backcross breeding procedure to transfer the dominant *Rk* gene for root-knot nematode resistance from 'Floriceam' into 'Carolina Cream'. 'Tender Cream' is resistant to cowpea curculio, root-knot nematodes, southern bean mosaic virus, cercospora leaf spot, southern blight, rust, and powdery mildew. 'Tender Cream' outyielded the cream control in the 1992, 1993, and 1994 Regional Southernpea Cooperative Trials by 5.4%, 11.0%, and 18.8%, respectively. It outyielded its root-knot-nematode-susceptible 'Carolina Cream' isoline by 22.3% in a replicated 1994 test conducted in a field infested with a natural population of the southern root-knot nematode. Canned samples of fresh 'Tender Cream' peas scored well during 3 years of testing at the Univ. of Arkansas.

METHYL BROMIDE ALTERNATIVES IN FRESH MARKET TOMATO PRODUCTION

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Pest management is of primary importance to the vegetable industry in our nation. In recent years producers have undergone much scrutiny concerning their pest control strategies, which often include the use of chemical pesticides. Due to the detrimental effects of many fumigants, growers are being forced to incorporate more environmentally sound agricultural practices while still producing a healthy, marketable commodity. The effects of three different fumigants and reflective mulches on plant growth and development were studied in field-grown, staked tomatoes. Methyl bromide, Telone II, or Telone C-17 were used in fumigation of plots. The establishment of mulch color was done via applications of exterior enamel paint, white or red in color, to the surface of black polyethylene mulch. With the exception of total marketable yields, no interactions existed between mulch color and fumigant. Red mulch and Telone II treatments resulted in the highest total marketable yield. Telone II application increased early marketable yield. White mulch color increased preharvest yield and black mulch color decreased early marketable yield. Low initial populations of nematodes may be the cause for lack of response due to fumigation.

TRANSIENT EXPRESSION OF GUS IN ONION TRANSFORMANTS

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Particle bombardment using the Bio-Rad PDS-1000/HE system is being investigated as a means to develop a stable transformation system for the bulb onion. Donor materials for bombardments included sterile meristems and radicals from newly germinated seeds, callus of *Allium cepa* 'TG1015', 'Sunlite', and 'Buffalo', *A. fistulosum* 'Heshiko', and suspension-cultured cell lines with confirmed regeneration capability, as well as regenerated plants of an F_1 interspecific hybrid. Transient expression assays using the B-glucuronidase (GUS) reporter gene system were used to optimize the conditions for transformation. Various promoters combined with the GUS coding sequence were tested. Results indicate genotype specificity for promoter expression. Some tissue continued to exhibit GUS activity after several months in culture, indicating potential for achieving stable transformation of onion.

CREATING A RESPONSE SURFACE FOR FRUIT SET AND FRUIT PRODUCTION IN TOMATOES GROWN AT HIGH TEMPERATURE

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Global temperature increases are predicted over the next several decades. Earth surface temperatures in 1995 were the highest ever recorded. At day temperatures above 30C or night temperatures above 21C, tomato fruit production decreases. However, the temperature dependence of fruit production has not been described in terms of

whether day temperatures, night temperatures, or mean temperatures are the most limiting. The process or tissue most sensitive to heat and most limiting to fruit production is also not known. The objectives of this experiment are to establish the temperature dependence of fruit set in tomatoes and to determine the importance of post-pollen production effects. We imposed a total of nine temperature treatments in a series of four separate experiments. Each experiment consisted of a 30/24C treatment and two other day/night temperature combinations with differing means and/or day/night temperature differentials. As mean daily temperature increased from 25 to 29C, fruit set, fruit number, total fruit weight, and seediness index (a quantitative rate of fruit seed content) declined. Temperature treatments did not affect average fruit weight. Higher mean temperatures promoted flowering except at the highest temperature. Mean temperature was more important than day/night temperature differentials or the specific daytime or nighttime temperature treatment.

GROWTH CHARACTERISTICS OF 'BEAUREGARD' AND 'DARBY' SWEETPOTATO

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'Beauregard' and 'Darby' sweetpotato cultivars were developed and released by the Louisiana Agricultural Experiment Station in 1987 and 1994, respectively. In total acreage, 'Beauregard' is the dominant cultivar of sweetpotato grown in Louisiana and the remaining United States. However, very little is known about the growth characteristics of these two cultivars. Therefore, the objectives of this research were to examine storage root and shoot growth. Uniform transplants of both cultivars were transplanted in mid-July 1995 at the LSU Sweet Potato Research Station and sequentially harvested biweekly. Optimum leaf area of both cultivars was attained ≈ 60 days after transplanting. 'Beauregard' had less leaf area than 'Darby' at each stage of development, but partitioned more assimilates to the storage roots. At harvest, the harvest index of 'Beauregard' was $\approx 75\%$ compared with 50% for 'Darby'. 'Beauregard' had a significantly greater total yield of storage roots than 'Darby'.

NITROGEN FERTILIZER EFFECTS ON GROWTH AND YIELD OF SWEETPOTATO

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Nitrogen effects on 'Beauregard' sweetpotato were investigated from 1992 to 1995 at the LSU Sweet Potato Research Station to determine the optimal rate and timing of nitrogen application. Five rates of preplant nitrogen were applied: 0, 33.6, 50.4, 67.2, and 84 kg-ha⁻¹. Increasing the rate of nitrogen to 50.4 kg-ha⁻¹ significantly increased marketable yield. Five treatments of pretransplant/sidedress nitrogen (kg-ha⁻¹) were applied: 0/0, 50.4/0, 0/50.4, 33.6/16.8, and 16.8/33.6. Withholding nitrogen resulted in significantly more storage root initiation 21 days after transplanting (DAT). Application of 50.4 kg N/ha 21 DAT resulted in significantly greater yields of US #1 sweetpotatoes in 1992 and 1995 and equaled the pretransplant nitrogen treatment in 1993 and 1994.

DETERMINING FERTILIZER NITROGEN NEEDS FOR FRESH MARKET TOMATO IN KENTUCKY

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Tomato fertility trials (1992-94) showed no yield response to fertigation N rates between 101-393 kg-ha⁻¹. In 1995, soil Cardy NO₃-N readings taken just prior to fertigation showed 53 kg NO₃-N/ha in the top 30 cm. Laboratory test on the same sample showed 72.4 kg/ha (NO₃ + NH₄-N). Forty percent of the available nitrogen was NH₄-N, which is not detected by Cardy meters. Soil mineral N levels were measured at fourth injection, second harvest, and 9 days after last harvest. On these dates the 0 kg N/ha treatment had 28, 24, and 8 mg N/kg available in the top 15 cm of soil, similar to the N fertigation treatments. As the growing season progressed, soil mineral N levels decreased, and 9 days after the last harvest residual soil N levels were close to those seen initially. Tomato petiole sap Cardy NO₃-N readings

showed a significant difference between the 0 kg-ha⁻¹ treatment and those (84, 168, and 252 kg-ha⁻¹) receiving N (512 ppm vs. 915, 1028, and 955 ppm NO₃-N, respectively). Treatments receiving fertigation N gave petiole sap NO₃-N readings higher than those listed by Hochmuth as sufficient for tomatoes. While the data showed a clear separation between the three N treatments and 0 N rate, no significant difference in yield of US #1 or US #2 large fruit occurred. This suggests that adequate N fertility was provided from O.M. mineralization. The highest N rate also had significantly more US #1 small and cull tomatoes than the other treatments. Some Kentucky soils have adequate residual N capable of producing commercial fresh-market tomato crops with little or no additional N. In addition to potential ground water pollution, overfertilization of tomatoes may decrease fruit size and reduce fruit quality by causing NH₄-K⁺ ion competition, as well as increase the risk of certain fungal and bacterial diseases.

NITROGEN FERTILIZER EFFECT ON POSTHARVEST QUALITY OF 'ARAPAHO' THORNLESS BLACKBERRY FRUIT

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An investigation was conducted in 1994 and 1995 to evaluate the effect of N rate and timing of application on postharvest performance of 'Arapaho' thornless blackberry fruit. Treatments were 0 kg N/ha, 56 kg N/ha, 112 kg N/ha single application, and 112 kg N/ha split application. The N source was ammonium nitrate. Fruit samples were hand-harvested and stored for 0–8 days. In general, 'Arapaho' fruit quality was not affected by N applications. Increasing N rates increased soluble solids content but had no effect on pH, titratable acidity, sugar : acid ratio, total solids, firmness, and weight loss. Nitrogen applications increased fruit N content.

TOLERANCE OF RADISH (*RAPHANUS SATIVUS* L.) CULTIVARS CHERRY BELLE AND WHITE ICICLE TO BORON, MOLYBDENUM, AND ZINC SOIL APPLICATIONS

Bielinski M. Santos and Jose Pablo Morales-Payan, "Pedro Henriquez Ureña" National University, Santo Domingo, Dominican Republic

Greenhouse experiments were carried out to determine the tolerance of two radish cultivars to soil-applied B, Mo, and Zn. Sources used were boric acid (0, 54, 108, 216, 324, and 432 ppm), molybdic acid (0, 1.4, 2.8, 5.6, 8.5, and 11.3 ppm), and zinc sulfate (0, 40, 80, 160, 240, and 360 ppm) applied at planting in addition to the control. Plants were grown in plastic containers of 1.5 L, filled with a potting medium composed of 50% vermiculite, 30% sphagnum peat, and 20% perlite. Treatments were arranged within a randomized complete block design with six replications. Fresh weight of commercial roots was not affected by Mo or Zn applications in either cultivar. However, B applications decreased root fresh weight as rate increased. These results suggest that these radish cultivars perform well in a relatively wide range of Mo and Zn application rates, whereas tolerance to B appears to be low.

RESPONSE OF CILANTRO (*CORIANDRUM SATIVUM*) TO COMBINATIONS OF GIBBERELIC ACID, FOLCYSTEINE, AND NITROGEN

Jose Pablo Morales-Payan and Bielinski M. Santos, "Pedro Henriquez Ureña" National University, Santo Domingo, Dominican Republic

Field experiments were conducted in the Dominican Republic to determine the effect of combinations of N with folcysteine and gibberellic acid 3 on cilantro (*Coriandrum sativum*) yield. Nitrogen levels (0, 36, 55, 73, 91 kg-ha⁻¹) in soil application at sowing were combined with foliar spray of the biostimulant folcysteine or gibberellic acid (0, 100, 200, 300, and 400 ppm) 15 days after emergence. Treatments were applied in a factorial arrangement on a randomized complete block design with three replications. Fresh weight of the aerial part of the plants was determined 40 days after emergence. No significant difference was found due to folcysteine treatment. Nitrogen had a significant effect, with optimal yield at 55 kg-ha⁻¹. Significant interaction was detected for the combinations of gibberellic acid and N, with yield increasing as the rate of the two factors increased.

EFFECT OF FOLCYSTEINE AND KINETIN ON 'KAPOHO' PAPAYA (*CARICA PAPAYA*)

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Flowering plants of 'Kapoho' papaya were sprayed with aqueous solutions of kinetin and folcysteine. Plants were treated four times at 3-week intervals with 0-, 50-, 90-, or 130-ppm solutions of either biostimulant or their combinations. Fruit number, size, and weight were recorded weekly during 15 weeks after treatment. Folcysteine treatment at 90 to 130 ppm significantly increased 'Kapoho' papaya yield. Kinetin treatment alone did not significantly affect fruit yield at any rate tested. Moreover, none of the kinetin plus folcysteine combinations significantly differed from the control in terms of fruit yield. These findings suggest that folcysteine rates of 90 to 130 ppm can increase fruit yield in this cultivar, and that kinetin had an antagonistic effect on the activity of folcysteine on the yield of 'Kapoho' papaya.

YIELD RESPONSE OF 'SUNRISE' PAPAYA (*CARICA PAPAYA*) TO KINETIN AND FOLCYSTEINE APPLICATIONS

Jose Pablo Morales-Payan, Productora Agricola Oriente, S.A./ "Pedro Henriquez Ureña" National University, Santo Domingo, Dominican Republic

Field experiments were conducted in the Dominican Republic to determine the effects of different rates of the biostimulants folcysteine and kinetin on fruit yield of 'Sunrise' papaya. Aqueous solutions of either 50, 70, 90, 110, or 130 ppm. Four applications were made at 3-week intervals. Fruit number, size, and weight were recorded weekly during 15 weeks after application. Yields for the control and kinetin-treated plants were not significantly different. Significant yield increase was found in plants treated with 70 and 90 ppm of folcysteine solution. Fruit yield in plants treated with 30, 50, 110, or 130 ppm of folcysteine did not differ significantly from that of the control. These results indicate that folcysteine treatment at 70 and 90 ppm at flowering can significantly increase fruit yield in 'Sunrise' papaya.

USE OF BIOLUMINESCENCE FOR THE DETECTION OF THE EFFECTIVENESS OF BIOLOGICAL CONTROL AGENTS ON BLACK ROT DISEASE OF CABBAGE

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A genetically engineered, bioluminescent strain of *Xanthomonas campestris* pv. *campestris* (Xcc) was used to study the effectiveness of plant growth-promoting rhizobacteria (PGPR) as disease control agents. Black-rot-susceptible cabbage plants were wound-inoculated with PGPR and wound- or mist-inoculated with bioluminescent Xcc 10 days later. Growth of the bioluminescent strain in the plants was followed over time with a low-light, charge-coupled device camera. Several PGPR strains effectively reduced growth of the bioluminescent pathogen in the plants when bacteria were introduced into the plant by wound. PGPR inoculation was less effective when bioluminescent bacteria were introduced into the plant by mist inoculation. Little effect on symptom reduction was observed.

National Sweetpotato Collaborators

BORON APPLICATION TIMING AND RATE ON BLISTER-LIKE SYMPTOMS IN 'HERNANDEZ'

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Boron has been used to overcome the disorder blister in varieties such as 'Jewel'. 'Hernandez' is an attractive, good-yielding variety with uniform shape that will consistently pack out at 80% to 90%. Over time in storage, however, roots develop blister-like symptoms, rendering roots unmarketable for fresh market. Our objective was to evaluate the effect of different B rates and application times on the yield and quality of 'Hernandez' roots. Rates were varied up to 2.24 kg actual B/

ha 6 days after planting, while various soil and foliar application times (6, 34, and 69 days after planting) were evaluated at 1.12 kg-ha⁻¹. In 1994, three row plots were arranged in a randomized complete block design and replicated four times. Planting was on a deep sand to maximize the effect of the B carrier Solubor. Roots were harvested, graded, and weighed 120 days after planting and storage roots evaluated for blister-like symptoms in Mar. 1995. No significant differences in yield were attributed to B rate or application method. Blister-like symptoms were more severe when no B was applied; however, application of B did not eliminate symptoms, as most roots had the blister-like appearance. Boron application did not solve the problem, but symptoms were less apparent when some B was applied.

RESPONSES OF SEVERAL SWEETPOTATO GENOTYPES TO SOLUTION REPLENISHMENT IN HYDROPONIC CULTURE

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A study was initiated in an environmental growth room to examine the effects of container size on the growth of several sweetpotato genotypes grown under a nutrient replenishment protocol. Plants were grown from vine cuttings of 15 cm in length, planted in 0.15 × 0.15 × 1.2-m growth channels using a closed nutrient film technique system. Nutrient was supplied in a modified half-strength Hoagland's solution with a 1 N : 2.4 K ratio. Nutrient replenishment protocol consisted of daily water replenishment to a constant volume of 38.4 liters in the small reservoir and 345.6 liters in the large reservoir. Nutrients were replenished as needed when the EC of the nutrient solution fell below 1200 mhos/cm. The design used was a split-plot with the main plot being container size and genotypes the subplot. Nine genotypes were evaluated: J6/62, J6176, J8/1, PX/6, PX/10, PX/36, TU-82-155, TU-J1, NCC58. Results showed no effect of container size on storage root yield, foliage fresh and dry mass, leaf area, or vine length. However, plants grown in the large container accumulated more storage root dry mass than those in the small container. All genotypes evaluated showed variation in their responses for all parameters measured.

WEED INTERFERENCE AND WEED PROBLEMS IN LOUISIANA SWEETPOTATOES—A REVIEW

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High annual rainfall and frequent torrential deluges have always made weed control a tenuous affair in Louisiana. Herbicide leaching and soil erosion often take preemergence herbicides to the nether regions. Before the time of postemergent grass herbicides, frequent cultivation was the only method to try to salvage the sweetpotato crop when preemergence weed control was lost. For many years, the most serious weed problems were prickly sida, cocklebur, and purple nutsedge with occasional hotspots of morning-glory. However, due to the change in herbicides used, the species of problem weeds have shifted to rice flatsedge, yellow and purple nutsedge, carpetweed, and various pigweeds. Before the registration of Command herbicide for use in sweetpotatoes, many sweetpotato growers used herbicides that effectively controlled or suppressed the current problem weeds. With the widespread use of Command, prior problem weed species are effectively controlled, but these other problem weeds are released.

NITROGEN USE EFFICIENCY IN SWEETPOTATO

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Eight clones of sweetpotato [*Ipomoea batatas* (L.) Lam.] at five N levels in 1992 and five clones at three N levels in 1993 were evaluated for genotypic variation in N use efficiency [NUE (yield/unit N fertilizer applied)], uptake efficiency (N accumulated/unit N fertilizer applied), and utilization efficiency (yield/N accumulated). There were significant genotypic differences for all NUE components and the variables used for calculation. When total marketable yield was used in calculating NUE, utilization efficiency was always more important than uptake efficiency in accounting for NUE variation. Regression equations developed from 1992 NUE components and selected non-N

variables used to calculate them ranked the 1993 NUE components correctly when averaged over all clones. Uptake efficiency could be predicted by biomass; utilization efficiency by total marketable yield.

IMPACT OF NUTRIENT REPLENISHMENT ON HYDROPONIC SWEETPOTATO CULTURE

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In a greenhouse experiment, the effect of the addition of higher levels of potassium (K) in the replenishment stock used to supply nutrients in a nutrient film technique system was examined. For this study, 'TU-82-155' sweetpotato was grown hydroponically for 120 days under four nutrient application/replenishment treatments: 1) REG—solution was changed at 14-day intervals and volume allowed to fluctuate; 2) MHH—replenishment with 10× concentrate of a modified half Hoagland solution (MHH) or with water to regain set volume (30.4 liters) and maintain set point of electrical conductivity (EC, 1050–1500 µmho); 3) MHH + 2K—daily replenishment with 10× concentrate of a modified half Hoagland solution (MHH) or with water to regain the set volume and adjust EC to 1400 followed by application of 50 ml of a 2K stock solution to an EC of 1500; 4) MHH/2K—replenishment with 10× concentrate of a modified half Hoagland solution that incorporated the 2K component or with water to regain set volume (30.4 liters) and maintain set point of electrical conductivity (EC, 105–1500 µmho). The storage root yield (g fresh weight per plant) was significantly higher when the 2K treatment was incorporated with the 10× MHH stock. The storage root yield averaged 324.8 g/plant compared with a yield of 289.6 and 252.9 g/plant, respectively, for the REG and MHH nutrient application protocol. As in earlier experiments, the MHH treatment was comparable to the REG protocol, validating the use of a replenishment approach for nutrient supply in hydroponic sweetpotato culture.

SWEETPOTATO PLANT BED FERTILIZATION

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Eight plant bed fertilizer treatments (N–P–K) were evaluated for the effect on plant production and sweetpotato yield. The treatments ranged from 0–0–0 to 450–450–450 lb/ac. 'Beauregard' roots were bedded. After the first plant cutting, 50 lb/ac 34–0–0 was applied to half of the beds. For the second cutting, the 0N–0P–0K treatment without additional N produced plants with less green weight compared to the other treatments; there were no differences between the other 15 treatments. For the first plant cutting, 150–150–150 and 150–300–450 lb/ac produced plants with less green weight compared to 0–0–0, 75–150–300, 300–450–600, and 450–450–450 lb/ac. There were no differences in sweetpotato yield due to plant bed fertilization.

National Cowpea Improvement Association

DEVELOPMENT OF SOUTHERNPEA CULTIVARS WITH GREEN COTYLEDON PHENOTYPES

Richard L. Fery*, U.S. Vegetable Laboratory, U.S. Department of Agriculture, Agricultural Research Service, 2875 Savannah Highway, Charleston, SC 29414-5334

A breeding program was initiated in 1990 to develop cream-, blackeye-, and pinkeye-type southernpea [*Vigna unguiculata* (L.)] cultivars homozygous for the *gc* gene conditioning green cotyledons. The green cotyledon trait allows harvest at the near-dry seed stage of maturity without loss of the seed's fresh green color. The ability to select for the *gc* gene in the embryo stage greatly facilitated its use in breeding programs, and the development of advanced breeding lines has proceeded at an accelerated rate. Sixteen F₉ and 15 F₁₀ breeding

lines homozygous at the *gc* locus were available for preliminary field testing in 1995. The results of this field testing indicate that the efforts to incorporate the *gc* gene into elite horticultural germplasm have been successful. More importantly, the results of tests conducted with seed harvested at the dry stage of maturity indicate that several of the lines should produce an excellent processed product.

CONTRIBUTION OF HOST PLANT RESISTANCE TO CONTROL OF COWPEA CURCULIO IN SOUTHERNPEAS

A.G. Hunter, O.L. Chambliss, and L.O. Wells, Department of Horticulture, Auburn University, AL 36849

Nine southernpeas, varying in their resistance to cowpea curculio, and the susceptible California Blackeye # 5 (CBE) were tested with six treatments: methyl parathion and endosulfan at recommended and one-quarter rate, a control with tractor traffic, and one without traffic. CBE had 42.7% curculio-damaged seeds over all treatment, while resistant entries ranged from 3.7% to 9.5%. Over all entries, methyl parathion at the recommended rate resulted in the lowest percentage of curculio-damaged seed (7.3%); endosulfan at the recommended rate was next with 9.1%. The percentage of damaged seed was not significantly different for the methyl parathion and endosulfan treatments using one-quarter recommended rates, the control with traffic, and the control without traffic—10.8%, 11.2%, 12.6%, and 11.7%, respectively. 'Carolina Cream' (3.7% damaged seed over all treatments) and methyl parathion at the recommended rate resulted in the lowest percentage of curculio damaged seed: 1.3%.

SEEDBORNE MOSAIC VIRUSES IN SOUTHERNPEA CULTIVARS

A.G. Hunter, G.E. Boyhan, E.H. Simonne, and O.L. Chambliss, Department of Horticulture, Auburn University, AL 36849

Seed harvested from 41 entries in the 1994 southernpea variety trial was grown in a greenhouse for evaluation of seedborne mosaic viruses. When second trifoliate leaves were fully expanded, 100 plants per plot per block (4) were evaluated for blackeye cowpea mosaic virus (B1CMV), cucumber mosaic virus (CMV), cowpea severe mosaic virus (CSMV), and southern bean mosaic virus (SBMV). The average number of plants with virus symptoms ranged from 2% (Pinkeye

Pinkpod) to 44% (Bettergreen). Plants with symptoms were assayed using enzyme-linked immunosorbent assay (ELISA). At least one virus was detected with ELISA in all entries, except for 'Zipper Cream' in which none were evident. All viruses were detected in seven entries. B1CMV and CMV were present in 13. CMV was present in all but 'Zipper Cream', 'Mississippi Cream', and 'Texas Pinkeye'. Symptomatology was poorly correlated to ELISA results: six entries having all four viruses had symptoms on less than 13% of their plants.

Vigna Crop Advisory Committee

A CORE SUBSET ESTABLISHED FOR THE USDA COWPEA [*VIGNA UNGUICULATA* (L.) WALP.] GERMPLASM COLLECTION

A.G. Gillaspie, Plant Genetic Resources Conservation Unit, U.S. Department of Agriculture, Agricultural Research Service, Griffin, GA 30223; O.L. Chambliss, Department of Horticulture, Auburn University, AL 36849; R.L. Fery*, U.S. Department of Agriculture, Agricultural Research Service, Charleston, SC 29414; A.E. Hall, Department of Botany and Plant Sciences, University of California, Riverside, CA 92521; J.C. Miller, Jr., Department of Horticultural Sciences, Texas A&M University, College Station, TX 77843; and T.E. Morelock, Department of Horticulture, University of Arkansas, Fayetteville, AR 72701

The Vigna Crop Germplasm Committee has established a core subset for the USDA cowpea germplasm collection. The subset consists of 9.3% (700 accessions) of the 7525 accessions currently contained in the collection. The subset was selected on the basis of country of origin, taxonomic characteristics, and known disease and pest resistance characteristics. Theoretically, the lines in the subset represent the genetic diversity present in the entire collection. A listing of the accessions in the subset is available from the *Vigna* germplasm curator (A.G. Gillaspie). The listing can also be accessed through the USDA's Germplasm Resources Information Network (GRIN).