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AGRICULTURAL EXPERIMENT STATION
UNIVERSITY OF KENTUCKY • COLLEGE OF AGRICULTURE

UNIVERSITY OF KENTUCKY

NURSERY AND LANDSCAPE PROGRAM

1999 RESEARCH REPORT

Nursery and Landscape Program

Kentucky Agricultural Experiment Station • University of Kentucky • College of Agriculture
Department of Horticulture • Lexington, Kentucky 40546

ABOUT OUR COVER

Fothergilla major, 'Mount Airy,' is a Theodore Klein Plant Award Winner for 2000. 'Mount Airy' *Fothergilla* was selected by Michael Dirr of Mt. Airy Arboretum in Cincinnati, Ohio. 'Mt. Airy' is the best of a number of selections currently being used in landscapes in and around Kentucky. The fall color is a spectacular mixture of yellow, orange, and red. An Atlanta Botanical Garden planting has repeatedly demonstrated this plant's ability to be heat tolerant and still have great fall color, quite a feat for a plant known to be hardy in Maine (USDA Zone 4). This easy-to-root plant grows very well in containers. Theodore Klein Plant Award Winners are selected by plant professionals for unique ornamental characteristics and the ability to perform successfully in Kentucky.

UK Nursery and Landscape Program

Faculty, Staff and Student Cooperators

Horticulture

FACULTY
Sharon Bale
Paul Cappiello
Win Dunwell
Richard Durham
Bill Fountain
Bob Geneve
Dewayne Ingram
Bob McNiel

TECHNICAL STAFF
June Johnston
Sharon Kester
Kay Oakley
Dwight Wolfe

FARM STAFF
Darrell Slone
Janet Pfieffer
Dave Lowry

STUDENTS
Tera Bonney
Gisele Martins
Jenny Heringer Vires

Agricultural Economics

FACULTY
Tim Woods

Biosystems and Agricultural Engineering

FACULTY
Richard Warner

Agronomy

FACULTY
Timothy Phillips
A.J. Powell Jr.

Entomology

FACULTY
Monte Johnson
Daniel Potter
Michael Potter

TECHNICAL STAFF
David Held
Rolando Lopez

STUDENTS
Eileen Eliason
Jerome Gels
Michael Rogers

Plant Pathology

FACULTY
John Hartman
Lisa Vaillancourt

TECHNICAL STAFF
Paul A. Bachi
Julie Beale
Ed Dixon
Shari Dutton

STUDENTS
Stéphane Kihl
Jill Howard

Nursery and Landscape Program

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1999 UK Nursery and Landscape Program Overview

Dewayne L. Ingram, Chair, Department of Horticulture

The faculty, staff, and students in the UK Nursery/Landscape Program are pleased to offer this 1999 Research Report. Its publication is one way we share information generated from a coordinated research program involving several departments in the College of Agriculture. The report has been organized according to our primary areas of emphasis: production and economics, pest management, and plant evaluation. These areas reflect stated industry needs, expertise available at UK, and the nature of research projects around the world generating information applicable to Kentucky. If you have questions and/or suggestions about a particular research project, please do not hesitate to contact us.

As was true with most agricultural endeavors this season, some of our field research was affected by the drought. That means there are fewer articles in this report. Information presented here that contains only 1999 data should be interpreted with the effects of the drought in mind.

Although the purpose of this publication is to report research results, please find below some 1999 highlights of our Extension program and undergraduate and graduate degree programs that address the needs of the nursery/landscape industries. An update of the activities of the Kentucky Horticulture Council and how they impact the nursery and landscape industry is also provided here.

Extension Highlights

Extension programs targeted at Kentucky's nursery/landscape industry include highly visible activities and some more subtle ones. The statewide and area educational conferences and seminars are probably the most visible. Publications, videos, slide programs, newsletters, articles in state and national industry magazines, newspaper articles, radio spots, and television programs are important, visible elements of our Extension program. However, training for county Extension agents so they can more effectively serve our industry and the plant disease diagnostic clinic, soil testing and interpretation, and diagnosis and solving of problems are more subtle activities.

Although the team of subject matter specialists and county agents conducts many facets of the Extension program, we want to use this opportunity to update you on the development of the arboretum on the UK campus.

The 100-acre **University of Kentucky Arboretum**, located in the heart of Lexington and the UK campus, was begun in 1991 as a joint project of the University of Kentucky and the Lexington-Fayette Urban County Government. Geoffrey Rausch, nationally recognized designer of arboreta and botanic gardens, designed the master plan. He is currently revising the plan to provide more detail for selected primary features in Phase II, including the visitor and education center. Phase I included a home demonstration garden, paved driveway, and parking lot, planting of over 2,000 native plants, and building of the primary path of the Walk Across Kentucky, which is a 2-mile trail displaying native plants of the seven geophysical regions of the state.

The plant collection at the arboretum is maturing. If you last visited the arboretum a few years ago you would be amazed—and I think, impressed—with the changes. It is a place for you and your customers to visit on a year-round basis to see all types of landscape plants. We have made several additions in the past two years. A Kentucky Department of Agriculture grant through the Kentuckiana Greenhouse Association has allowed us to add 1,200 square feet of trial gardens this year. We plan to add another 1,000 square feet next year. This is in addition to the approximately 2,500 square feet of trial garden space of annuals, perennials, and herbs we have used for several years. Annual and perennial plant evaluation results from these plots in 1999 are presented in this report. We have planted approximately 600 varieties of roses in three large beds. This collection is one of the top rose collections in the region. This summer's special project is evaluation of passion flowers for Kentucky gardens. Horticulture student Bailey Hale has collected 42 types of passion flowers and has them on display at the arboretum.

The facility is maintained by the UK Physical Plant Division with consultation from UK Horticulture faculty. Volunteer assistance and monetary support is provided by the Friends of the Arboretum. In the past year more than 50,000 people visited and participated in activities at the UK Arboretum. Educational and cultural events are planned at least monthly and programs this year included Arbor Day in the Arboretum; Trees, Trails and Creatures; Plant Exchange; Sculpture in the Arboretum; Art in the Arboretum; Environmental Tree Extravaganza; Saturday Children's Activities (all summer); and Shakespeare in the Arboretum. In addition, activities include professional development in biological and environmental sciences for area public school teachers, special lectures by prominent out-of-state professionals, and informal workshops on various topics. School groups, garden clubs, civic organizations, and various special interest groups took part in over a dozen planned tours. The Arboretum routinely hosts laboratory exercises as part of formal courses for three universities and colleges. Many of these activities require months of preparation and dozens of volunteers.

Sheltered meeting space, multipurpose work space, restrooms, and an office are required in order for the arboretum to properly support current activities and expand programs so it can fulfill its mission. The planned visitor and education center will provide that space, at a cost of approximately $1.8 million. The conceptual design calls for two wings connected by an atrium. Phase I will include one wing of the building and provide multipurpose space, restrooms, and an office and cost approximately $500,000. Dorotha Oatts has made a $200,000 challenge gift toward the first phase of this building. Subsequent construction projects will include a conservatory connected to the visitor and education center, an outdoor amphitheater, a water feature, and another display garden.

Undergraduate Program Highlights

The department offers areas of emphasis in horticultural enterprise management and horticultural science within a bachelor of science degree in plant and soil science. Following are a few highlights of our undergraduate program in 1999:

- The plant and soil science degree program had over100 students enrolled in the fall semester of 1999, of which almost half are horticulture students and more than one-third are turfgrass students. Nineteen horticulture students graduated in the past year.
- We believe that a significant portion of an undergraduate education in horticulture must come from outside the classroom. In addition to the local activities of the UK Horticulture Club and field trips during course laboratories, students have excellent off-campus learning experiences. Such opportunities in 1999 included:
  - A three-week study tour of China by 12 students was led by Drs. McNiel, Dunwell, Geneve and Nieman.
  - Horticulture students competed in the 1999 Associated Landscape Contractors of America (ALCA) Career Day competition in Lexington in March (Dr. Robert McNiel, faculty advisor). We hosted an event with representatives of more that 40 colleges and universities from New York to California.
  - Students accompanied faculty to the following regional/national/international meetings: the American Society for Horticultural Science Annual Conference, the Kentucky Landscape Industries Conference and Trade Show, and the Southern Nursery Association.
  - Students have interned recently in Australia, at Shelby Gardens in Sarasota, FL, and the Denver Zoo and Botanic Garden. At least one internship is required for all horticulture students, and students take internships in Kentucky, throughout the United States, and in other parts of the world.

Graduate Program Highlights

The demand is high for graduates with a master's degree or doctorate with an emphasis in horticulture, entomology, plant pathology, agricultural economics, or biosystems and agricultural engineering. Graduates of our master's level program are being employed in the industry, Cooperative Extension, secondary and post-secondary education, and governmental agencies. Last year, eight graduate students in these degree programs conducted research directly related to the Kentucky nursery/landscape industry.

Graduate students are active participants in the UK Nursery and Landscape Research Program and contribute significantly to our ability to address problems and opportunities important to the Kentucky nursery and landscape industry. For example, graduate students presented research results at the Southern Nursery Association's research conference in Atlanta, and several will present posters summarizing their work at the 2000 Kentucky Landscape Industry Conference and Trade Show.

Kentucky Horticulture Council's Prospectus for Kentucky Horticulture

Kentucky's professional associations for the nursery and landscape industries (KNLA, KAA, LNA, CKOTA) joined with other horticulture-related associations to establish the Kentucky Horticulture Council in 1991 for the purpose of:

- providing an avenue for the various segments of Kentucky horticulture to focus on common issues.
- promoting Kentucky horticulture to Kentucky citizens, state legislators, Kentucky's congressional delegation, university leaders, and other state and federal agencies.
- interacting with and fostering support for UK's statewide research programs, Extension, and horticulture teaching programs; teaching programs in horticulture at regional universities; and Kentucky's vocational teaching programs.

The council has gleaned information from industry, UK, and state agencies to develop a prospectus for Kentucky horticulture and has presented it in various versions since 1992. The current version of that prospectus contains detailed information about the current status, potential, constraints, and actions required for each segment of the horticulture industry in order to continue to prosper.

The Kentucky Horticulture Council has identified some of the constraints to continued prosperity that can be addressed through research and education and has worked with the UK Horticulture program to develop a plan to address these constraints.

Likewise, marketing constraints that have been identified include development, infrastructure needs, and market promotion, and the council has worked with the Kentucky Department of Agriculture's marketing division to develop a plan of action. Additional funding for the UK horticulture program and the Kentucky Department of Agriculture is being sought from the 2000 Kentucky General Assembly.

Here are a few highlights from the prospectus about the nursery and landscape industries:

- Wholesale value of plants sold from field and container production was $20 million in 1996.
- Landscape plants installed in Kentucky in 1996 totaled over $98 million, not including those for in-house installation at industrial and corporate grounds, horse farms, cemeteries, governmental facilities, universities, athletic fields, etc.
- Commercial landscape services and professional garden centers generated $388 million in 1996.
- Nursery crop and floral crop production has become the third largest commodity in U.S. agriculture, behind corn and soybeans.
- Nursery crop demand is linked to home and commercial construction (1.4 million new U.S. homes in 1998).
- Some of the constraints to continued industry growth include the need for:
  - commercial customers in Kentucky and elsewhere in the United States having access to current inventory of nursery crops available for sale.

    - educated/experienced managers and skilled labor.
    - public education about product and service quality.
    - more efficient production systems.
    - new plants and plant packaging.
    - more effective/efficient landscape management practices.
- Recommended actions include:
    - research to develop crop-specific and sustainable production systems.
    - appropriately labeled pesticides.
    - education through Cooperative Extension.
    - increasing the number of university graduates in horticulture.
    - increasing vocational training to meet the need for skilled labor.
    - research to more fully understand changing market requirements and ways to access them.
    - promotion of Kentucky-grown plants.
- A $49 million state investment over 10 years in action recommended in the prospectus for Kentucky horticulture would result in increased sales of over $168 million.

A copy of the Prospectus for Kentucky Horticulture can be obtained by contacting the UK Horticulture Department or through the UK Horticulture Department home page on the World Wide Web.<http://www.uky.edu/Agriculture/Horticulture/proposal.html.> The prospectus has positioned our industry to effectively participate in the discussions and negotiations for funding infrastructure support, research, and education to diversify Kentucky's agricultural economy and to strengthen rural communities. The 2000 Kentucky General Assembly will consider this prospectus and the funding strategies it details as part of the budgeting process. For additional information, contact the president of your association.

Container Size and Root Pruning Method on Root and Shoot Development in Seedlings of Cherry Bark Oaks (*Quercus falcata pagodifolia*)

Gisele G. Martins, Robert Geneve, and Sharon Kester, Department of Horticulture

Nature of Work

Oaks can be difficult to transplant from field-produced liners, with frequent high losses due to slow root regeneration (3). One way to maximize root system development and minimize transplant shock is to produce plants in containers. Oaks produced in containers are, however, very susceptible to root deformation because their dominant taproot can grow in circles and produce a poor root system (2). Root pruning techniques can improve oak root systems and transplanting survival. Copper compounds mixed with latex paint and applied to the inner wall of containers have been shown to control root growth. Krieg and Witte (4) tested the effects of copper hydroxide on 41 species of containerized nursery stock and found it effective in controlling root growth in all species.

Acorns were collected from the University of Kentucky campus during fall 1997 and a hot water bath treatment was applied (45º C for 50 min.) in order to kill weevils (*Curculio* sp.). Then the seeds were stratified in plastic bags containing moist vermiculite (2 acorn:1 vermiculite, by volume) at 4º C for three months in order to break dormancy. Only acorns that started to crack were used to ensure 100% germination. One acorn was sown per Anderson-band containers (Anderson Die Manufacturing Company, Portland, OR) with same dimensions (7.3 x 7.3 cm) but different depths (5.7, 11, and 20 cm). Each container was filled with MetroMix 510 (Scott's; Sierra Horticultural Products Company, Marysville, OH) prior to sowing and irrigated with Peter's fertilizer at 200 ppm N with each watering. Containers were modified to give four treatments prior to sowing. These consisted of non-pruned, copper-treated, air-pruned, physical-pruned, and root barrier treatments. The non-pruned plants were grown during the whole period of the experiment in a deeper container (32 cm). In the root barrier treatment, the bottom of the container was sealed with a piece of weed barrier (Weedblock; Easy Gardener, Waco, TX) secured to the outside walls of the container with thermal glue, which provided a barrier to root penetration but was permeable to air and water. Seedlings were not pruned in this treatment. The copper treatment was done in the same manner as root barrier, except the inner surface of the weed barrier was treated with SpinOut (Griffin Company, Valdosta, GA). This was a 7.1% solution of copper hydroxide in latex paint. Air-pruned seedlings were in containers that remained open at the bottom and were placed on a wire frame bench to allow air pruning of roots that emerged from the bottom of the container. Physical treatment was the same as the air-pruned treatment except the root tips were cut with a sharp blade every time they become visible at the bottom of the container.

The experiment was located in the Department of Horticulture greenhouse at the University of Kentucky. Temperature was 20º C at night and 22º C to 30º C during the day and photoperiod of 14 hours supplemental by HID lamps at approximately 150m mol s^{-1} m^{-2} at the canopy height. The experiment was set on the first week of January 1998. Experimental design was completely randomized and 16 plants were assigned for each treatment. Half the plants were harvested when they were 90 days old. Root systems were washed and scanned using a flat bed scanner (HP Scan Jet 4c/T) to provide a 300 DPI Tiff file, and total length and was obtained using MacRhizo software (Regent Instruments Inc., Quebec, Canada). Then roots and shoots were placed in a circulation oven temperature at 60ºC for 48 hours, and weight of roots and shoots were collected. Root mass per root length was obtained by dividing root dry weight by root length. The remaining plants were transplanted to a deeper Anderson band container with dimensions 10 x 10 x 32 cm, and plants were harvested 60 days after transplanting and the same data was collected.

Results and Discussion

Before transplanting, no significant difference was found on total biomass (Table 1). Plants in deeper containers had heavier root systems (Table 1). The longest root system was found in plants grown in 20 cm deep containers copper-treated (779.62 cm) and air-treated plants (783.01 cm), while non-pruned control plants had the shortest root system (445.73 cm) (Table 2). Non-treated control plants had the highest specific root weight (0.561 mg/cm), while air-treated plants grown in 20 cm deep containers had the lowest value (0.231 mg/cm). This can explained, as most of the root system in non-pruned plants is composed of the taproot, while in the pruning treatment the taproot was removed, decreasing mass by length relation.

After transplanting, no significant difference was found in shoot dry weight and total biomass (Table 3). This is not in accordance with Arnold and Struve (1) who found 1-year-old

Table 1. Root dry weight (mg), shoot dry weight (mg) and root length (cm) of cherry bark oak grown in 6.7, 11, and 20 cm deep containers, submitted to root barrier, air, copper, and physical pruning, before transplanting.

Root Pruning Method	Container Depth (cm)	Root Dry Weight (mg)	Shoot Dry Weight (mg)	Total Biomass (mg)
non-treated	32	242a[z]	474b	716a
air	6.7	129 b	506ab	635a
	11	195ab	709a	904a
	20	230ab	691a	921a
root barrier	6.7	180ab	644ab	824a
	11	243a	522ab	765a
	20	239ab	495b	734a
copper	6.7	142b	502ab	644a
	11	159ab	527ab	686a
	20	249a	591ab	840a
physical	6.7	142b	573ab	715a
	11	188ab	539ab	727a
	20	271a	544ab	815a

[z] Means within columns followed by the same letter were not significant (P#0.05) by the LSD test.

copper-treated green ash (*Fraxinus pennsylvanica*) and 2-year-old northern red oak (*Quercus rubra*) had increased total plant and shoot dry weight. However, plants grown in the 20 cm deep copper-treated container had the longest root system (1768.34 cm) (Table 4). Non-pruned control plants had the shortest root system (1253.48 cm). Specific root weight increased after transplanting for all treatments, but for non-pruned treatment in 11 cm deep container (Table 4). Likewise, before transplanting, non-treated plants had the highest specific root weight.

Table 2. Total biomass (mg), root:shoot ratio, and specific root weight (mg/cm) cherry bark oaks grown in 6.7, 11 and 20 cm deep containers, submitted to root barrier, air, copper, and physical pruning, before transplanting.

Root Pruning Method	Container Depth	Root Length	Root: Shoot Ratio	Specific Root Weight
	(cm)	(mg)		(mg/cm)
non-treated	32	445.73bc[z]	0.512a	0.561a
air	6.7	463.95bc	0.282a	0.299c
	11	849.55a	0.305a	0.247d
	20	783.01a	0.277a	0.231e
root barrier	6.7	610.18ab	0.330a	0.303c
	11	585.72bc	0.590a	0.359c
	20	709.84ab	0.660a	0.342c
copper	6.7	600.96abc	0.290a	0.240d
	11	683.52ab	0.262a	0.320c
	20	779.62a	0.273a	0.281c
physical	6.7	537.06bc	0.364a	0.264d
	11	717.78bc	0.464a	0.487b
	20	768.64ab	0.426a	0.342c

[z] Means within columns followed by the same letter were not significant (P#0.05) by the LSD test.

Table 3. Root dry weight (mg), shoot dry weight (mg), and root length (cm) cherry bark oak grown in 6.7, 11, and 20 cm deep containers, submitted to root barrier, air, copper, and physical pruning, after transplanting.

Root Pruning Method	Container Depth	Root Dry Weight	Shoot Dry Weight	Total Biomass
	(cm)	(mg)	(mg)	(mg)
non-treated	32	1,061abc[z]	1556a	2617a
air	6.7	715d	1539a	2254a
	11	1,362ab	2030a	3392a
	20	1,327a	1944a	3271a
root barrier	6.7	970bc	1566a	2536a
	11	1,027abcd	1706a	2733a
	20	1,083abc	1635a	2718a
copper	6.7	995bcd	1899a	2894a
	11	1,063abc	1653a	2716a
	20	1,056abc	1669a	2725a
physical	6.7	912bc	1876a	2788a
	11	1,082bcd	1750a	2832a
	20	1,327bc	1461a	2788a

[z] Means within columns followed by the same letter were not significant (P#0.05) by the LSD test

Table 4. Total biomass (mg), root:shoot ratio, and specific root weight (mg/cm) of cherry bark oak grown in 6.7, 11 and 20 cm deep containers, submitted to root barrier, air, copper, and physical pruning, after transplanting

Root Pruning Method	Container Depth	Root Length	Root: Shoot Ratio	Specific Root Weight
	(cm)	(cm)		(mg/cm)
non-treated	32	1,253.5d[z]	0.71a	0.901a
air	6.7	1,268.1d	0.63c	0.726c
	11	1,634.9ab	0.65bc	0.714d
	20	1,550.8abc	0.68a	0.838b
root barrier	6.7	1,336.d	0.67a	0.849a
	11	1,407.6bcd	0.64bc	0.642f
	20	1,595.1ab	0.71a	0.678e
copper	6.7	1,652.6ab	0.52cd	0.594f
	11	1,466.7bc	0.48d	0.550f
	20	1,768.4a	0.49d	0.685e
physical	6.7	1,344.1cd	0.56c	0.741b
	11	1,412.5bcd	0.66bc	0.715d
	20	1,402.0cd	0.64c	0.596f

[z] Means within columns followed by the same letter were not significant (P#0.05) by the LSD test.

Significance to the Industry

Cherry bark oak seedlings grown in 20 cm deep containers copper-treated for 90 days before transplanting had a root system 40% longer than plants grown in a deeper non-treated containers. Plants with a longer root system before transplanting are desirable because transplanting shock is less severe and plants resume growth quickly. Plants grown in copper-treated containers did not experience root-circling problems because copper was efficient in preventing roots from growing when roots touched the treated container wall.

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Evaluation of Coneflower *(Echinacea)* Species for Nursery Production under Field Conditions

Jenny Heringer Vires, Robert Geneve, and Robert Anderson, Department of Horticulture

Nature of Work

There are nine species of coneflower (*Echinacea*), all native to central or eastern North America. Only purple coneflower (*Echinacea purpurea*) is extensively cultivated in nurseries. Coneflowers are hardy herbaceous perennials in the Asteraceae family. They produce large, terminal composite flowers with an outer ring of showy ray florets. These florets can be various shades of purple, white, or yellow. The numerous, inner central disk florets form the characteristic "cone" for this genus and are subtended with a stiff bract that is usually pigmented yellow and provides an interesting contrast with the showy ray florets. Plants bloom over a long period in the summer. Purple coneflower has been used in formal and informal perennial plantings and is the mainstay of naturalized prairie wildflower mixtures. It is also effective as a cut flower.

Coneflowers are also the main ingredient in the medicinal herb preparation sold as Echinacea. It is currently the top-selling over-the-counter herb supplement in a multimillion dollar industry. Echinacea is touted for its immunostimulatory and antibacterial properties. Although all parts of the plant contain the pharmaceutical compounds, the dried root has the most commercial value for drug extraction.

The objective of this study was to evaluate the cultural requirements for production of coneflower species under field conditions in Kentucky either for nursery production or drug extraction. The species evaluated in this study are listed in Table 1.

Materials and Methods

Seeds for all species were stratified between two and eight weeks prior to sowing in plug flats under standard greenhouse conditions. Eight-week-old seedlings were transplanted to the field in raised beds with drip irrigation in May. Plants were spaced 8 inches apart on center with two rows of plants per raised bed. Each raised bed was on a 2-foot spacing to facilitate mechanical weeding between beds. Weeds were removed by hand from raised beds. Plants received approximately 1 inch of water per week. Plants were harvested in October and evaluated for biomass production.

Table 1. Root biomass in field-grown *Echinacea* species after one season.

Coneflower Species	Overall Plant Dry Weight (grams/plant)
Echinacea purpurea (open pollinated)	124.3
E. purpurea cv. Bravado	115.6
E. purpurea cv. Bright Star	122.5
E. purpurea cv. Clio	122.4
E. purpurea cv. Magnus	115.6
E. purpurea cv. White Swan	87.5
Echinacea angustifolia	26.6
Echinacea pallida	79.1
Echinacea paradoxa	65.5
Echinacea tennesseensis	120.0

Treatments included fertilizer application and flower bud removal and were applied only to the *Echinacea purpurea* open pollinated and *Echinacea purpurea* cv. Magnus. For the fertilizer treatment, half the plants were fertilized once in May with 20-20-20 Peter's soluble fertilizer through the irrigation line, while the other plants were fertilized twice with the second application in July at the same fertigation rate. Within each of these fertilization groups, plants either were allowed to flower normally or the flower buds were removed as they appeared once a week.

Results and Discussion

All species and cultivars evaluated in this study produced plants of acceptable size and commercial quality except *Echinacea angustifolia* (Table 1). This species did not establish as robustly as the other species and experienced the greatest mortality. In this group, two species currently not widely available in the nursery trade stood out for their unique horticultural qualities (Figure 1). These were *Echinacea tennesseenis* and *Echinacea paradoxa*.

Echinacea tennesseenis produced more flowers than any of the other species tested. They were similar in size, color (more mauve than purple), and shape to flowers in purple coneflower (*Echinacea purpurea*), but they were produced on long, wiry stems that appear to be heliotropic (following the sun). The vegetative portion of the plants were also more spreading and low growing compared to the other species in this trial, but in-flower plants reached a height of 3 feet. We feel that this plant has enormous commercial potential for the herbaceous perennial market. Not only does it have numerous ornamental qualities as a garden and cut flower plant, but it is also a Kentucky native plant that is on the Federal Endangered Species list, which should add to the marketability of this species.

Echinacea paradoxa is the most unusual member of this genus. It is the only *Echinacea* with yellow flowers. It is the least recognizable of the coneflowers and is not usually listed in even comprehensive herbaceous perennial references. It produces a clear yellow flower on strong, erect plants that reaches between 2.5 and 3 feet tall. Its market appeal should be in the unique color, flowering time, and strong growth habit that separate it from other coneflowers and near relatives like *Rudbeckia*.

All *Echinacea purpureal* cultivars produced commercially acceptable plants. 'White Swan,' a white flowering purple coneflower, was the smallest cultivar, while 'Clio' and open pollinated derived plants had the highest biomass. By preventing plants from flowering, there was a significant increase in root biomass. Plants responded to the first fertilization, but there was no significant increase in biomass associated with the second fertilizer application.

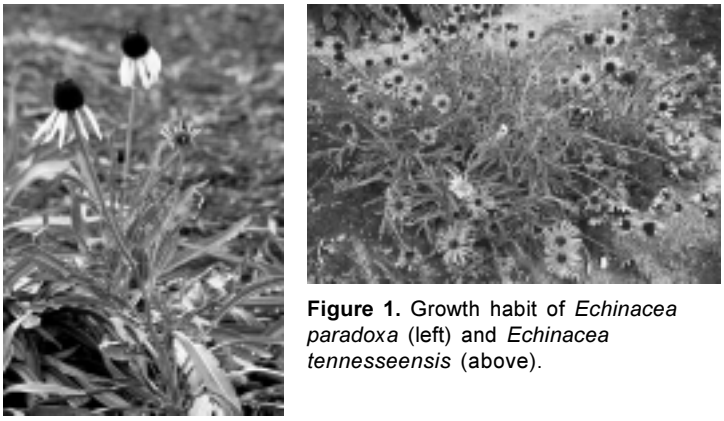


Figure 1. Growth habit of *Echinacea paradoxa* (left) and *Echinacea tennesseensis* (above).

Significance to the Industry

Several species of *Echinacea* not usually found in production nurseries were evaluated for growth under field conditions. Two (*Echinacea tennesseenis* and *Echinacea paradoxa*) have potential for mass production. These plants have unique horticultural characteristics not found in the commonly cultivated purple coneflower (*Echinacea purpurea*) and could be used to exploit a market niche for nurseries interested in new plants native to North America.

Dogwood Borer Exploitation of Horned Oak Galls on Pin Oak

Eileen Eliason and Daniel Potter, Department of Entomology

Nature of Work

The dogwood borer, *Synanthedon scitula* (Harris), is a native pest of woody ornamentals, especially flowering dogwood (*Cornus florida* L.). Adults lay eggs in bark crevices, and larvae feed in the phloem and cambium, eventually girdling branches or killing trees. *Synanthedon scitula* has the broadest host range of any North American sesiid and infests apple, hickory, pecan, oak, and other trees in addition to dogwood (1). Stem galls made by the horned oak gall wasp, *Callirhytis cornigera* (Osten Sacken) (Hymenoptera: Cynipidae), on pin oak are also hosts of *S. scitula* (1).

Earlier studies of *S. scitula* flight phenology in apple orchards and urban landscapes using pheromone traps indicated a long, bimodal flight period with peaks in early June and early August. Based on monitoring of emergence and pupal exuviae left by emerging adults and relative trap captures of males in different habitats, Potter and Timmons (2) suggested that the earlier flight pulse largely consists of moths emerging from dogwood and that the second pulse consists mainly of adults emerging from the other hosts. So, we tested the hypothesis that moths emerging from dogwoods largely account for the first flight pulse, whereas emergence from stem galls contributes disproportionately to the second pulse.

From May to October 1999, seasonal flight activity of *S. scitula* was monitored with pheromone traps baited with 250 µg of 99 + % Z,Z-3,13-octadecadien-1-ol acetate. Six traps were located near plantings of dogwoods in cemeteries, residential neighborhoods, or on the University of Kentucky campus. Five other traps were located on horse farms and other sites with abundant pin oaks that were heavily galled by *C. cornigera.*

In addition, 23 flowering dogwood trees on the University of Kentucky campus that were naturally infested with *S. scitula* were inspected weekly for presence of pupal exuviae, which indicated recent moth emergence. Inspections began on 7 May and ended 29 September 1999, when no moths were caught in pheromone traps and no pupal exuviae had been found for two weeks. Pupal exuviae were removed when found protruding from the tree bark. The proportion of pupal exuviae found on dogwood trees during each flight period was compared to the proportion of male moths caught in pheromone traps near dogwood plantings during the same intervals, using 2 x 2 chi-square tests for independence (SAS Institute 1995).

Emergence was also monitored from galls that were collected in mid-April and mid-July (about 1,500 galls each), and held in outdoor rearing cages. Woody stem galls (>2 yr old) induced by *C. cornigera* on pin oak were collected from three different heavily-galled sites in Lexington, KY. The proportion of total moths that emerged from horned oak galls during either flight period was tested against the null hypothesis of a 1:1 ratio using a chi-square test for homogeneity (3).

To determine the percentage of galls infested with *S. scitula* and the approximate age and size of infested galls, additional stem galls of various ages were collected and individually placed into plastic containers in the laboratory. Maximum diameter of each gall was measured using a dial caliper held perpendicular to the branch axis.

Results and Discussion

Flight activity of *S. scitula* began on 5 May and ended on 6 October, with peaks in late May and in late July to early August (Fig. 1A). The flight pattern was similar for both types of trapping sites, and moths emerged from both hosts during both flight periods. Proportionately more moths emerged from dogwood trees during the first flight pulse than during the later one, but emergence from stem galls was nearly evenly divided between both flight periods.

Figure 1. (A) Total number of male *S. scitula* caught per week in pheromone traps in Lexington, KY. Five traps were hung in stands of pin oak trees heavily infested with horned oak gall, and six traps were hung in stands of dogwood trees in suburban landscapes.

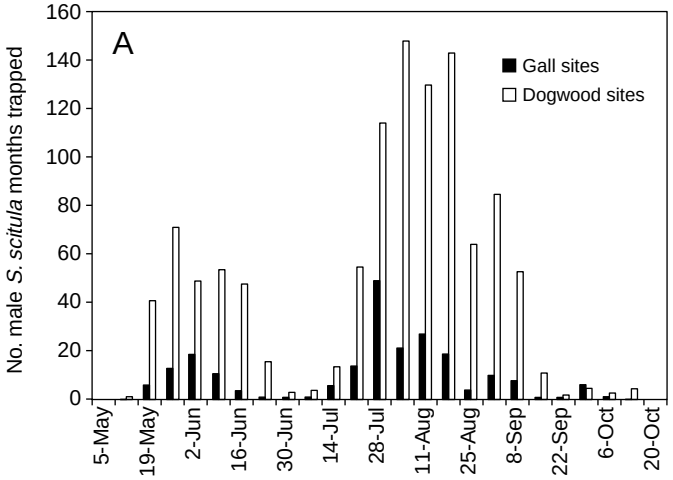
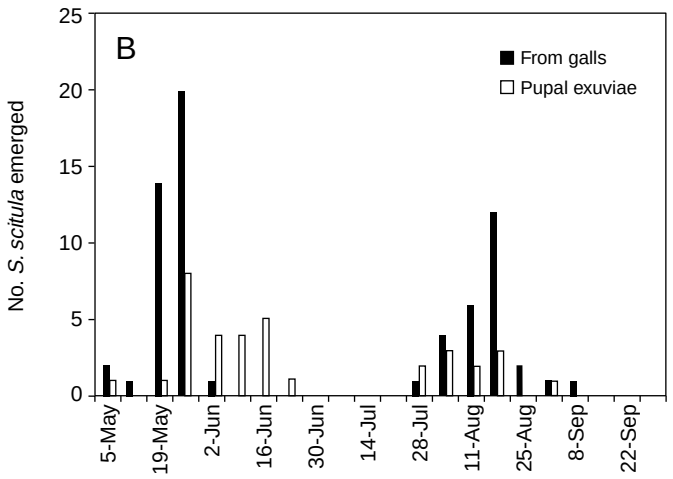


Figure 1. (B) Weekly counts of *S. scitula* pupal exuviae from 23 flowering dogwood trees and emergence of adult moths from two cohorts of horned oak galls (about 1,500 galls each) collected in April or July 1999.



The appearance of pupal exuviae on dogwood trees coincided with both flight periods, but we found proportionately more exuviae on dogwoods during the first flight period than during the second period (Fig. 1B). In addition, cohorts of galls collected before the first or second flight pulses yielded proportionately similar numbers of moths.

The percentage of stem galls infested with *S. scitula* depended on gall age. Galls <2 yr old had no apparent borer damage. About 13% of older (>3 yr) galls contained old, dry frass or pupal cases of *S. scitula*, but none contained active borer larvae. About 15% of 2 to 3-yr-old galls were actively infested. These galls had maximum diameters averaging 3.6 cm, with weights averaging 17 g. As many as four borer larvae were found simultaneously developing in some of the larger galls. Feeding and tunneling by borers contributed to gall desiccation and reduced horn development, but rarely killed *C. cornigera* larvae.

Given these results, we therefore reject the hypothesis that the earlier flight pulse largely consists of moths emerging from dogwood and that the second pulse consists mainly of adults emerging from galls. It remains possible that moths emerging from several of the dogwood borer's other hosts may explain the relatively greater size of the second flight pulse.

Significance to the Industry

Horned oak galls are important pests of pin oak trees, and serve as resources for the dogwood borer. Given that pin oaks heavily infested by *C. cornigera* may have hundreds of succulent stem galls and that about 15% of such galls contained active borer larvae, stands of heavily galled trees may harbor large populations of borers that may oviposit on nearby dogwoods. The borer's relatively broad host range and flight capability and its synchronous emergence from dogwood and horned oak galls seemingly would facilitate cross-infestations, although the extent to which this occurs presently is unknown.

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Characterization of the Compound in Zonal Geranium, *Pelargonium hortorum,* Responsible for Paralysis in Japanese Beetles

David W. Held and Daniel A. Potter, Department of Entomology

Nature of Work

Japanese beetles (*Popillia japonica*) that feed upon flowers of geranium quickly become paralyzed. The narcotic effects are strongest with flowers from plants grown in full sun, suggesting that the active compound(s) may be light-activated, possibly flavonoids. Despite this, we have found that beetles will overwhelmingly choose geranium over a suitable host such as linden and that they do not learn from these dietary mistakes (1). We are studying toxicosis of flowers of different colors to Japanese beetles and working to extract and identify the compound(s) responsible for the strong attraction and paralysis. Flowers were extracted in boiling ethanol, and extracts were fractionated in a separatory funnel into chloroform and aqueous fractions. Fractions were tested on leaf discs of Virginia creeper, *Parthenoscicus tricuspidata*, to confirm activity. Active aqueous fractions were analyzed using HPLC in collaboration with scientists at Boyce Thompson Institute, Cornell University.

Results and Discussion

Geranium flowers from varieties 'Orbit Red,' 'Salmon,' and 'White' all were palatable and produced narcotic effects in beetles. We hope to complete identification of the narcotic components next summer. In related work, we found that Japanese beetles fail to learn from their dietary mistakes, at least insofar as geranium is concerned. Beetles offered a choice between palatable, but toxic, geranium and highly suitable linden leaves repeatedly fed on geranium, causing self-paralysis and greatly reducing their fecundity.

Significance to the Industry

Despite the Japanese beetle's broad feeding habits, some plant species are markedly resistant. However, the chemical basis for resistance to this pest has not been determined for any plant. Understanding this phenomenon in geranium may help us target other sources of resistance that could be bred or genetically engineered into ornamental plants. Geranium could possibly be deployed via interplanting in small garden settings, or perhaps extracts or synthetic versions of the narcotic substance could be used directly for plant protection.

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Investigations into the Nature of Resistance of Bradford Pear, *Pyrus calleryana* 'Bradford,' to Japanese Beetles

David W. Held, Daniel A. Potter, and Robert L. Houtz, Departments of Entomology and Horticulture

Nature of Work

Bradford pear is one of the few Rosaceous plants that is entirely resistant to Japanese beetles. This resistance, however, can be manipulated by freezing and thawing the leaves, which results in enzymatic browning and causes the leaves to become both palatable and suitable as food (1). Our work suggests that freezing and thawing causes vacuoles to burst and nomally compartmentalized cell contents to mix, resulting in enzymatic degradation of feeding deterrents, probably phenolics (1). Our discovery that resistance can be manipulated in this manner provides an opportunity to study its chemical basis. Using HPLC, we are analyzing extracts of fresh leaves and leaves that were frozen and then thawed under aerobic or anaerobic conditions. These analyses are coupled with feeding tests using leaf discs.

Results and Discussion

These assays suggest that deterrents responsible for resistance to Japanese beetles are present in the fresh and frozen/nitrogen-thawed leaves but are reduced or absent from frozen/air-thawed leaves. This pattern was consistent with the HPLC data, which show reduced peaks corresponding to phenolic compounds in the enzymatically altered leaves. Mass spectrometry of the active fraction, planned for next summer, hopefully will reveal the compound responsible for resistance in Bradford pear. If so, this will be the first plant for which the secondary compounds responsible for resistance to Japanese beetles will be identified.

Significance to the Industry

Understanding the basis of resistance in Bradford pear may help us understand the chemical nature of plant resistance or susceptibility to Japanese beetles. This knowledge would help focus future efforts to develop cultivars or nursery and landscape plants that are resistant to this pest.

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Desensitization of Japanese Beetles to Neem Applied for Plant Protection

David W. Held, Tyler Eaton, and Daniel A. Potter, Department of Entomology

Nature of Work

Neem, or azadirachtin, is a botanical insecticide derived from seeds of the neem tree, *Azadirachta indica*. Neem acts as a growth regulator, disrupting metamorphosis, and as a feeding deterrent. Several neem-based products are labeled for use against adult Japanese beetles, *P. japonica*. We tested the potential for *P. japonica* to overcome the deterrence of neem through desentitization. Azadirachtin (Azatin®) was applied at label rate (1X), or ¼ label rate (0.25X), to leaves of *Tilia cordata*, a preferred host. Leaf discs (21 mm diam) were cut from treated and control leaves. Both no-choice and choice tests were conducted. Feeding assays with initially naive beetles were conducted for 4 h per day, the same beetles being exposed on four consecutive days. To study effects of longer prior exposure to neem, 100 females were confined with moist soil and fresh linden shoots. Three separate groups were exposed to untreated foliage, leaves treated with neem only (0.25X), or a mix of both neem and control leaves. After 24 h, beetles were tested in choice assays as before.

Results and Discussion

Both rates of neem deterred feeding by naive beetles in choice tests, but deterrence relative to untreated discs declined upon successive exposures. In no-choice tests, beetles became desensitized to the lower rate of neem upon subsequent exposures, but not to the higher rate. Beetles conditioned with untreated foliage or the mixed treatment, were repelled by neem, whereas those conditioned for 24 h with neem-treated leaves were not.

Significance to the Industry

These results suggest that while neem-based plant protectants may initially repel Japanese beetles, individual beetles may become less sensitive and fail to be repelled upon repeated exposures. Knowledge of how Japanese beetles respond to neem and other "soft" pesticides is essential, as these products are used more and more in place of traditional organophosphates and carbamates.

Is Imidacloprid (Merit) Toxic to Bumblebees Foraging on Flowers or Weedy Turf?

Jerome Gels and Daniel A. Potter, Department of Entomology

Nature of Work

Parasitic mites and insecticides have contributed to a substantial decline in honeybee populations, making pollination by bumblebees and other native pollinators increasingly important. Imidacloprid (Merit), a systemic chloronicotinyl insecticide, is widely used on landscapes and turf. Applied topically, imidacloprid is toxic to bees. Other studies have shown that in small doses, it can dramatically affect behaviors of social insects. If a long-term residual insecticide such as imidacloprid was translocated into the nectar or pollen of flowering plants, it could endanger bumblebee colonies whose workers forage on treated areas.

We evaluated the impact of granular imidacloprid applications on post-treatment foraging and hive health of bumblebees confined on tall fescue grass with flowering white clover. Ten large pollination cages were placed on plots paired according to pre-treatment clover density. One plot of each pair was treated with granular imidacloprid at label rate, followed by irrigation to leach the residues into the soil. One week later a hive of Bombus impatiens was placed in each cage. Foraging as well as other behaviors were periodically recorded. On August 7, six weeks after treatment, the hives were frozen and dissected for comparison. To test whether bumblebees avoid treated clover, 14 plots were paired according to pre-treatment clover densities. Half of the plots were treated as before. Numbers of bumblebees foraging on each plot were recorded during hourly observations.

Results and Discussion

Our results indicate that, applied as it would be for soil insect control, imidacloprid had no adverse effects on colony behavior or hive health. However, foraging workers did not avoid treated areas. Further research on potential impact of surface treatments of imidacloprid on bumblebees is warranted.

Significance to the Industry

So far, this work suggests that application of imidacloprid to lawns or golf courses does not pose a hazard to bumblebees foraging on flowering weeds, so long as the treatment is watered into the soil. We also are studying whether or not translocation of soil-applied imidacloprid into the nectar or pollen poses any threat to bees, butterflies, or other pollinators that visit flowering woody or herbaceous ornamentals.

Does Summer Weed Control with Herbicides Attract Japanese Beetles and Increase Grub Infestations in Nurseries?

Daniel A. Potter and David W. Held, Department of Entomology

Nature of Work

Federal and state regulatory efforts directed at preventing spread of Japanese beetles have resulted in quarantines on shipment of nursery stock produced in Kentucky and other infested states. Stress often alters plant suitability for herbivores. For example, Chinese rose beetle, another scarab, preferentially feeds on host leaves treated with ethephon, which accelerates senescence. Anecdotal reports in the literature suggest that diseased plants and those injured by other insects may be more attractive to Japanese beetles.

We have heard testimonials from others that certain weeds that have been sprayed with sublethal doses of glyphosate (Roundup™) herbicide seem to be preferred by Japanese beetles over unsprayed plants. Indeed, elevated grub populations were reported in glyphosate-treated nursery plots in Tennessee (C. Mannion, pers. comm.). If this phenomenon holds, it has important implications for nursery management because regulatory efforts to prevent shipment of grubs in root balls of nursery stock advocate weed control to reduce the larval food supply. If egg-laden females are attracted to volatiles emitted by senescing weeds, then use of herbicides may actually aggravate the grub problem.

We tested this hypothesis in 1999 using glyphosate-susceptible and glyphosate-resistant soybean cultivars, as well as velvetleaf plants. Test plants were grown outdoors in large pots. During peak flight (beginning July 12), the plants were arranged in split-plot arrangement adjacent to soybean fields with heavy beetle populations. One set of plants within each block was sprayed in the morning (0800h) with full, ½ or ¼ label rates of glyphosate, or left unsprayed. Beetles that have accumulated on each plant were counted over several days

Results and Discussion

Despite high beetle populations nearby, relatively few beetles were recruited to either the unsprayed or the glyphosate-affected plants. Although velvetleaf plants and glyphosate-susceptible soybeans were killed by the herbicide, there was no significant attraction of beetles to these plants as they senesced.

Significance to the Industry

This study indicates that use of glyphosate for weed control in nurseries probably will not result in increased attraction of Japanese beetles and higher subsequent populations of grubs. Rather, managing grassy and broadleaf weeds between nursery rows may help to limit incidence of grubs in balled-and-burlapped nursery crops by reducing available larval food.

Landscape Plant Disease Observations from the Plant Disease Diagnostic Laboratory

Julie Beale, Paul Bachi, and John Hartman, Department of Plant Pathology

Nature of Work

Plant disease diagnosis is an ongoing educational and research activity of the UK Department of Plant Pathology. We maintain two branches of the UK Plant Disease Diagnostic Laboratory, one on the UK campus in Lexington, and one at the UK Research and Education Center in Princeton. Of the more than 4,000 plant specimens examined annually, about 40% are landscape plant specimens (1).

Making a diagnosis involves a great deal of research into the possible causes of the plant problem. Most visual diagnoses involve microscopy to determine what plant parts are affected and to identify the microbe involved. In addition, many specimens require special tests such as moist chamber incubation, culturing, enzyme-linked immunosorbent assay (ELISA), electron microscopy, nematode extraction, or soil pH and soluble salts tests. Computer-based laboratory records are maintained to provide information used for conducting plant disease surveys, identifying new disease outbreaks, and formulating educational programs.

After a relatively mild winter, the 1999 growing season in Kentucky was very dry. For the 26-week growing season (April 1 - October 1), 21 weeks received below normal rainfall and the rainfall deficit statewide averaged about 9 inches. Some stations recorded deficits of over 13 inches, receiving less than half of the 25 inches of rain which would normally fall during the growing season. Although drought was a season-long problem, progressing from severe to extreme in the central and eastern regions of the state, the months of July, August, and September were especially dry; indeed, they were the driest reported in Kentucky for the past century. Exacerbating the drought, 18 of the 26 weeks of the growing season recorded above-normal temperatures, and some weeks were as much as 8-10 degrees (F) above normal.

Thus, much of the 1999 growing season was not very favorable for foliar diseases of landscape plants. However, vascular wilts and some root decay diseases were made worse by the drought stress.

Results and Discussion

Deciduous tree diseases—Although spring weather in Kentucky was not particularly rainy, the brief showers that did occur were well timed for the cedar rusts (*Gymnosporangium juniperi-virginianae, G. clavipes, G. globosum*). Rust-susceptible crabapples showed significant leaf spots, and hawthorn fruits were heavily infected with cedar-quince rust. Showers during flowering pear and crabapple bloom in most of Kentucky were sufficient to initiate primary and then heavy secondary fire blight infections. Flowering crabapple scab (*Venturia inaequalis*) and the various shade tree anthracnose fungi were much less active because of the drought. This was one of the few years that one could observe fall color of scab-susceptible flowering crabapples, because they ultimately retained their leaves. Dogwood powdery mildew (*Microsphaera, Phyllactinia* spp.), a disease that has become important in recent years, was not very serious in many landscapes; the weather was apparently so dry that high relative humidity levels needed for infection did not exist much of the time. Bacterial leaf scorch (*Xylella fastidiosa*) was easily detected visually in late summer because of the increased water stress imposed by the drought. Branch dieback continues to follow many years of bacterial leaf scorch symptoms in large, mature pin oaks. Verticillium wilt appeared on maples and catalpa.

Needle evergreen tree diseases—Assisted by drought, maturing Austrian and Scots pines continue to die from tip blight (*Sphaeropsis sapinea*) and pine wilt nematode (*Bursaphelenchus xylophilus*). White pine root decline (*Verticicladiella procera*) continues to be a problem in Christmas tree and landscape plantings. White pine decline (associated with soils having high clay content, high pH levels, heavy compaction, or with root disturbance) continues to take its toll.

Shrub diseases—Black root rot (*Thielaviopsis basicola*) of hollies remains a problem. Rhododendrons facing environmental stresses such as cold, heat, drought, or poor soils showed cankers (*Botryosphaeria dothidea* and others) which caused wilt and branch dieback. Azalea leaf and flower gall (*Exobasidium vaccinii*) was common in spring.

Perennial and annual plant diseases—Black root rot (*Thielaviopsis basicola*) of annuals such as petunias and pansies was a problem in many flower beds in spring and again in fall. Southern blight (*Sclerotium rolfsii*) was more commonly observed this year on hosta, portulaca, rudbeckia, and vinca. Stem rot (*Rhizoctonia solani*) also affected landscape flowers.

Landscape lawn diseases—Many lawns were killed by the dry weather; many communities imposed bans on lawn watering. Yellow patch and Southern blight appeared on Poa annua turfgrasses, but perennial ryegrass gray leaf spot (*Pyricularia grisea)* did not appear; additional cases of DMI-resistant bentgrass dollar spot were documented.

Significance to the Industry

The first step in appropriate pest management in the landscape is an accurate diagnosis of the problem. The UK Plant Disease Diagnostic Laboratory assists the landscape industry of Kentucky in this effort. To serve their clients effectively, the landscape industry, including arborists, nursery professionals, and landscape installation and maintenance organizations, need to be aware of recent plant disease history and the implications for landscape maintenance. This report provides useful information for landscape professionals.

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Isolation of *Spheropsis sapinea* from Landscape Austrian Pines

John Hartman, Stéphane Kihl, and Lisa Vaillancourt, Department of Plant Pathology

Nature of Work

Austrian pines (*Pinus nigra*) growing in the landscape are subject to tip blight disease caused by the fungus *Sphaeropsis sapinea* (*Diplodia pinea*) (1). In Kentucky, the disease is severe enough that trees infected for several successive years are often removed from the landscape long before they become mature (80 years in their native environment). Despite spraying and pruning efforts, Austrian pines continue to die in many landscapes. We had made a survey of Austrian pines on the University of Kentucky campus in 1992-1994 and found that of the 563 pines ranging in age from 7 to 30 years, the disease was nearly absent in pines under 13 years, and became progressively worse as pines aged (2). Onset of disease was associated with production of cones. Cones of Austrian pines are retained for three years, appearing as small brown conelets the first season after spring pollination, elongating into green cones with tight scales the second year, and finally changing into typical brown cones with open scales the third year.

We re-surveyed the same trees in 1999, recording their health status. In the laboratory, isolations were made of the causal fungus from diseased and healthy trees. In addition, the fungus was recovered from different tissues dissected from Austrian pine. Pine tissues were surface sterilized and plated onto acidified potato dextrose agar using standard fungal isolation techniques. Sphaeropsis isolations were confirmed by subculturing the fungus on water agar with sterilized pine needles and observing development of pycnidia on these needles.

Results and Discussion

Evaluation of the most prominently located 387 Austrian pines in 1999 revealed a continuing decline in the population from 1994. Within this population, 59% have been removed, mostly due to tip blight disease. The remaining trees are fairly healthy; 75% have less than 10% tip blight.

The tip blight fungus, *Sphaeropsis sapinea*, was readily isolated from healthy (asymptomatic) shoots of diseased trees, but the more diseased the tree, the greater the likelihood that the fungus would be isolated from healthy tissues (Table 1).

The fungus was present in new candles as well as in the previous season's growth in diseased and healthy twigs of both Austrian and Scots pines (Tables 2 and 3).

Table 1. Recovery of *S.sapinea* in culture from current-year healthy (asymptomatic) Austrian pine twigs as a function of disease levels in the tree.

Tree: percent infected twigs	1-15 (n=17)	16-30 (n=10)	31-45 (n=21)	46-60 (n=16)
Percent recovery of *S. sapinea*	50	61	78	87

Table 2. Percent recovery of *S. sapinea* from last season's twig and new candle segments and cones of diseased (stunted, dead candle) and healthy (asymptomatic) landscape Austrian pine shoots in early summer.

Twig and candle parts	Healthy	Diseased
Base of previous year's lignified stem	41	82
Top of previous year's lignified stem	30	--
Base of candle	8	100
Middle of candle	11	--
Top of candle	25	92
New bud	35	--
New female cone	36	--
Spent male cone	--	33
Previous year's cone	25	--

Table 3. Percent recovery of *S. sapinea* from last season's twig and new candle segments and needles of diseased (stunted, dead candle) and healthy (asymptomatic) landscape Scots pine shoots in early summer.

Twig and candle parts	Healthy	Diseased
Base of previous year's lignified stem	27	87
Top of previous year's lignified stem	--	87
Base of candle	60	--
Middle of candle	60	87
Top of candle	53	--
Needles at base of previous year's lignified stem	--	40
Needles at top of previous year's lignified stem	15	60
Needles at candle middle	20	87
Needles at candle top	13	--

At first, the fungus was found primarily in the bark tissues of healthy shoots (Table 4), but continued isolations (data not presented) suggest that the fungus can be isolated from phloem tissues about 40% of the time and 5% of the time from xylem and wood tissues.

Our studies support the concept that *S. sapinea* lives as a latent pathogen inside symptomless tissues of mature Austrian and Scots pines in the landscape. Additional work is needed to determine the extent to which this phenomenon occurs and the potential implications for maintenance of the health of Austrian pines.

Table 4. Percent recovery of *S. sapinea* from different tissues within current-year diseased and healthy (asymptomatic) Austrian pine shoots in late summer.

Specimen	Bark	Phloem	Xylem	Pith	Needle Base
Diseased (n=4)	75	75	25	25	100
Healthy (n=3)	67	0	0	0	67

Significance to the Industry

Information on Austrian pine tip blight identification, disease progress, and prognosis made in Lexington can be extended to Austrian pines in other regions of the state. This knowledge may assist landscape architects and managers in deciding whether or not to use Austrian pine in the landscape. Indeed, for longevity and ease of maintenance, Austrian pines may not be a good choice for Kentucky landscapes. The finding that the fungus already exists in the tree or parts of the tree before symptoms develop will have an enormous impact on tip blight disease management decisions, should the work be expanded.

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Hydrangeas for Cut Flowers: 1999 Observations

Winston Dunwell, Dwight Wolfe, and June Johnston, Department of Horticulture

Nature of Work

Cut flowers from field-grown *Hydrangeas* are a potential alternative source of income for Kentucky growers, and early production is important in order to receive immediate return on investment. Typically, *H. macrophylla* are grown for the cut-flower market, while other species, such as *H. arborescens* and *H. paniculata*, have traditionally only been grown as landscape plants (1, 2). Expansion of cut flower production to include these species offers the potential for other uses of these species of *Hydrangea*, and, consequently, other possibilities for cut flower production for Kentucky growers.

In April of 1998 *Hydrangeas* (planted as rooted cuttings in October 1996) were dug, pruned to the ground, and planted into two cut-flower trials. The first planting consists of 12 plants each of nine cultivars allocated to 12 rows (blocks) in a randomized block design. These plants were spaced at 12 feet between rows and 10 feet between plants in the row. No fertilizer or irrigation was provided to this planting. The second planting is trickle irrigated and consists of eight plants each of six cultivars allocated to eight rows in a randomized block design. No fertilizer has been applied to this planting. These plants were space at 10 feet between rows and 5 feet between plants. Throughout the 1998 and 1999 growing seasons the plots were observed weekly to record the date of first bloom. At the end of the flowering seasons data were collected on the number of stems that had bloomed and the length of the stems with blooms (18 inches would be a saleable *Hydrangea* stem with bloom, personal communication, Sharon Bale).

Table 1. Flowering characteristics of *Hydrangea* cultivars, 1999.

Cultivar	Date of First Bloom	Average Number of Stems Per Plant	Average Length of Stems (Inches)
Hydrangea aborescens 'Annabelle'	June 1, 1999	13	18.7
Hydrangea quercifolia 'Alice'	June 10, 1999	3	22.8
Hydrangea paniculata 'Boskoop'	July 11, 1999	7	19.4
Hydrangea paniculata 'Kyushu'	June 21 (26)[1], 1999	35 (35)	14.5 (18.1)
Hydrangea paniculata 'Pee Wee'	July 10 (11), 1999	37 (42)	14.0 (16.4)
Hydrangea paniculata 'Pink Diamond'	July 5 (6), 1999	20 (23)	16.9 (17.8)
Hydrangea paniculata 'Tardiva'	July 17 (15), 1999	23 (46)	15.2 (17.8)
Hydrangea paniculata 'Unique'	June 9 (10), 1999	23 (34)	17.8 (19.2)
Hydrangea paniculata 'White Moth'	June 16 (17), 1999	4 (3)	20.9 (18.1)
Least Significant Differences [2]	5 days (5 days)	13 (1)	3.1 (2.4)

[1] Numbers in parentheses are for cultivars in the trickle irrigated planting.
[2] Differences within a column equal to or greater than the "least significant difference" are statistically significant at the 0.05 probability level.

Results and Discussion

Results from 1998 have been published (3, 4). The 1999 results are shown in Table 1. There were 12 plants per cultivar (except for 'Alice,' which was missing two plants). Averages in Table 1 were calculated using the total number of plants even if some had no blooms. 'Whitemoth' had four and 'Alice' had five plants without blooms. 'Kyushu' and 'Pee Wee' averaged the greatest number of stems (blooms) per plant.

Significance to the Industry

As previously noted, *H. arborescens* and *H. paniculata* offer the potential of cut-flower production for Kentucky growers. It has been observed that the flowers of 'Boskoop' frequently touch the ground because the stems are too flexible.

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Preliminary Evaluations of Kentucky Daylilies

Winston Dunwell, Dwight Wolfe, and June Johnston, Department of Horticulture

Nature of Work

Evaluation of *Hemerocallis* daylily cultivars at the University of Kentucky Research and Education Center (UKREC) at Princeton, KY, is in response to the strong demand for plants and information on daylily cultivars. Daylily cultivars supplied by Kentucky hybridizers were evaluated for aesthetic appeal and production characteristics.

Kentucky daylily cultivars for the 1999 trial were supplied by: Thoroughbred Daylilies (T), Paris, KY; Schott Gardens (S) Bowling Green, KY (for more on Schott Gardens cultivars see previous research reports); and Swanson Daylilies (Octavian = diploid and Milano = tetraploid), Lexington, KY.

Weekly observations were made on all cultivars in the evaluations to record time and color of bloom for the 1999 season. The Schott, Swanson, and other daylilies were dug and divided on August 17, 1999. The divisions were distributed by the UKREC Nursery Crops Development Center (UKNCDC), Princeton, to UK College of Agriculture county Extension horticulture agents and plant evaluation cooperators of the Southern Extension/ Research Activities and Information Exchange Group (SERA-IEG 27): Nursery Crops and Landscape Systems, for expanded evaluation under different climatic and environmental conditions.

The Thoroughbred daylilies were divided on October 4, 1999, the number of divisions recorded, and the plants put back in evaluation plots with the excess divisions put into the UKNCDC nursery.

Results and Discussion

The bloom dates are reported as the first bud and the first bloom observed for any of the plants in the planting and the last bloom on any of the plants of a particular cultivar. The number of divisions are reported for Thoroughbred daylilies only and should be regarded only as an observation, as the plants were planted from different production systems (i.e., container and bareroot). The length of the bloom period can also be influenced by the production system; container plants tend to bloom earlier than bareroot plants, and in the first season may bloom on shorter scapes than established landscape plants.

Significance to the Industry

There continues to be an increase in the number of Kentucky nurseries producing daylilies and the number hybridizing daylilies. Evaluations of cultivars for time of flowering and number of divisions are important to a cultivar's economic survival. Three divisions per original plant is considered the absolute minimum in order for a cultivar to be considered commercially viable, and then only if the bloom characteristics are exceptional. Knowledge of a cultivar's special bloom characteristics, i.e., early bloom, continuous bloom, or fall bloom, has been used to tailor marketing strategies. An example would be a cultivar that bloomed during the fall festival season expanding product diversity for roadside stands and entertainment farms as well as increasing the window of time for marketing by daylily growers. Cultivars blooming early and displayed in bloom in the spring during the peak retail season would enhance sales.

Note: A single plant of each cultivar evaluated since the first daylily evaluation trial in 1992 has been planted in a display garden available for public viewing at the UKREC, Princeton, KY. Some cultivars have been planted at the UK Arboretum, Lexington, KY.

Table 1. 1999 Kentucky daylily characteristic[1] observations.

Cultivar	Date of First Bud	Date of First Bloom	Date of Last Bloom	Color	Number of Divisions
Angel's Braid (T)	na	12 Jun	14 Jul	Yellow-Lavender blush	3
Baby Blanket (T)	16 Jun	29 Jun	09 Aug	Pink	4
Candie Dwyer (T)	na	12 Jun	09 Aug	Lavender	2
Chuck Wheeler (T)	22 Jun	14 Jul	20 Jul	Purple	3
Crown of Creation (T)	na	01 Jun	16 Aug	Gold-Orange	4
Dave Bowman (T)	na	16 Jun	01 Oct	Mauve w/ Burgundy eye	5
Magical Mystery (T)	na	01 Jun	09 Aug	Pale Burgundy	3
Mexican Siesta (T)	na	10 Jun	09 Aug	Dark Rose w/Yellow	5
Mystery Lover (T)	na	01 Jun	na	Purple Red	2
Nancy Ligon (T)	na	10 Jun	09 Aug	Yellow-Peach	6
Truly Angelic (T)	16 Jun	20 Jul	07 Sep	Pink-Lavender	3
Wes Kirby (T)	na	01 Jun	na	Lavender	4
Upper Echelon (T)	na	12 Jun	07 Jul	Violet	3
Janice Wendell (S)	16 Jun	07 Jul	27 Jul	Yellow	na
Milano Maraschino	16 Jun	07 Jul	23 Oct frost	Wine/Yellow	na
Milano Violet Mark	na	10 Jun	20 Jul	Violet	na
Milano Rocket	na	12 Jun	29 Jun	Burnt Orange	na
Octavian Marble Ring	na	10 Jun	25 Jun	Peach	na
Octavian Marble Model	na	12 Jun	na	Violet	na
Octavian Orchid	16 Jun	22 Jun	07 Jul	Purple Pink w/Yellow	na
Octavian Glow	NB	NB	NB	Light Cream	na
Octavian Exotic Marble	na	12 Jun	27 Jul	Peach w/Violet eye	na
Octavian Cherry Doll	na	15 Jun	29 Jun	Reddish Peach	na

[1] Color descriptions are limited and do not include throat colors, ruffling of edges, or edge color. See growers catalog for more thorough descriptions.
NB—no bloom observed.

Table 2. 1999 Non-Kentucky daylily characteristic observations.

Cultivar	Date of First Bud	Date of First Bloom	Date of Last Bloom	Color
Siloam Virginia Henson	na	16 Jun	27 Jul	Pink w/Red eye
Buttercurls	16 Jun	22 Jun	29 Jun	Yellow
Barbara Mitchell	10 Jun	10 Jun	22 Jun	Pink
Chicago Sunrise	16 Jun	22 Jun	07 Jul	Orange
Eric Jr.	16 Jun	25 Jun	29 Jun	na
Lisa My Joy	na	16 Jun	29 Jul	Off-White/Purple eye
Anzac	16 Jun	07 Jul	23 Sep	Orange
Pardon Me[1]	16 Jun	25 Jun	31 Aug	Red
Cantique	16 Jun	07 Jul	27 Jul	Pink
Juanita	16 Jun	25 Jun	7 Jul	na
Always Afternoon	16 Jun	22 Jun	7 Jul	Mauve/Purple eye
Aten	16 Jun	25 Jun	7 Sep	Orange

[1] Buds preparing to bloom 01 Oct. 2

Annual and Perennial Garden Flower Performance

Robert Anderson, Department of Horticulture

Nature of Work

The performance of annual and perennial garden flowers is quite important to the greenhouse and landscape industries across the state. Fifteen years ago, we had one of the top trial gardens in the country, the Landscape Garden Center, on the UK campus. At a time when the garden was maturing, we had to give up the space for a new building.

Over the last 10 years, the trial garden, plant collection, and teaching activities of the old Landscape Garden Center have been transferred to the UK Arboretum. It is great to report that the plant collections and the trial gardens at the arboretum are now maturing. This is due to support from many greenhouse and nursery operators from across the state, the University of Kentucky, the Lexington-Fayette Urban County Government and the Friends of the Arboretum. The recent additional support from the Kentucky Department of Agriculture Value-Added Grants Program and the Kentuckiana Greenhouse Association have continued to add to our opportunity to evaluate annual and perennial garden flowers for Kentucky conditions.

Recent Grant Received

A simple marketing program for greenhouse products in Kentucky was started in June, 1999. This program is supported by the Kentucky Department of Agriculture Value-Added Grants Program and the Kentuckiana Greenhouse Association. The Kentucky Department of Agriculture has granted approximately $13,000 to match $7,000 from the Kentuckiana Greenhouse Association. The project is entitled "The Use of Demonstration Gardens and a World Wide Web Site to Enhance Consumer Education and Marketing of Kentucky-Grown Annual and Perennial Flowers."

In the first year of this grant, we have established trial gardens at the UK Arboretum in Lexington and at the West Kentucky Research and Education Center in Princeton to demonstrate plant performance for consumers as well as greenhouse operators.

We are building a World Wide Web site that lists Kentucky's highest-rated flowers for landscape use. This site will also distribute plant care information and offer garden ideas. The Web site will greatly expand the release of information on plant performance.

In 2000, we have proposed to add a demonstration and trial garden in the Louisville area to our goal of a statewide network of gardens used to evaluate plants and to show people how to grow them. The focus of this marketing program is that people need to see plants in a garden setting in order to appreciate that they can grow them and to have an idea of expected performance.

Plant List and 1999 Comments for Trials at UK Arboretum and West Kentucky Research and Education Center:

Perennials

Tickseed**—*Coreopis verticillata* 'Moonbeam'

Pinks—*Dianthus gratianapolitanus* 'Bath's Pink,' *D. x allwoodii* 'Frostfire,' *D. plumarius* 'Itsaul White'

Purple Coneflower—*Echinacea purpurea*, 'Bravado,' 'Bright Star,' 'Clio,' 'Magnus,'** 'White Swan,' *E. angustifolia*, *E. pallida*, *E. paradoxa, E. tennessensis*

Coral Bells**—*Heuchera micrantha* 'Palace Purple'

Lavender—*Lavandula angustifolia* 'Hidcote,' 'Goodwin Creek,' 'Munstead Dwarf,' *L. x intermedia* 'Provence,' *L. stoechas* 'Otto Quast'
*Penstemon***—*Penstemon* 'Husker Red'
Russian Sage**—*Perovskia ambrosifolia*
Black-eyed Susan**—*Rudbeckia fulgida* 'Goldsturm'
Pincushion Flower**—*Scabiosa caucasica* 'Butterfly Blue™'

** *Perennial Plants of the Year*

Most of these perennials have been evaluated at the UK Arboretum and the Western Kentucky Research and Education Center in past years, but we wanted to establish a good collection of the Perennial Plant Association's "Perennial Plants of the Year" to observe their long-term performance in Kentucky. *Coreopis verticillata* 'Moonbeam,' *Echinacea purpurea* 'Magnus,' *Perovskia ambrosifolia*, and *Rudbeckia fulgida* 'Goldsturm' performed superbly as in past years even with the severe drought across the state. Scabiosa, Penstemon, Heuchera, and the Dianthus cultivars were weaker. The Dianthus cultivars have really grown during the fall. We need a few more years to evaluate the lavenders and coneflowers. Both grew well, but we need to follow the cold hardiness of the lavenders and how well the coneflowers develop. *Echinacea tennessensis* appears to be a great plant for our area and the few yellow flowers of *E. paradoxa* are quite striking.

Annuals

Summer Orchid (vegetative): *Angelonia angustifolia* Blue, Blue Pacific, *A. salicarifolia* Pink—I have grown these *A. angelonias* in the greenhouse as cut flowers for the last three years. They are easy to grow when they receive plenty of water, high light conditions, and warm temperatures. There were very few flowers on them during the summer outdoor trials, although the plants grew well. I don't know if it was drought, insufficient fertilizer, or insect damage that made them such a disappointment.

Vinca: *Catharanthus roseus* Pacifica White, Pacifica Blush, Raspberry Red Cooler—All vincas are superb in our trials every year; these were no exception.

Annual Hibiscus: *Hibiscus trionum* Simply Love—This hibiscus is in some seed catalogs. It was scraggly in the greenhouse in the spring but had nice, creamy white flowers. I hoped it would fill out in the summer trials, but it did not. Additionally, I have learned that it self-sows very well and can become a significant weed. Cross this one off your list.

Summer Snapdragon (vegetative): *Otacanthus caerulus*—Another warm season cut flower that I have grown successfully in the greenhouse for a few years. As with *A. angelonia*, very few flowers in our trials. I assume drought and insufficient fertilizer were responsible.

Annual Phlox: *Phlox drummondii* '21st Century Mix'— A brand new plant with great possibilities. Annual phlox is a cool-season plant. These were great early, with strong primary colors and a continuous flowering nature, but the heat and drought were too much for them in August. I think this will be one of the main 4-inch (3½-inch) pots for spring sales in the next few years. The plants are easy to grow, and the colors are just what the consumers want.

Petunia (vegetative): *Petitunia Cascadia* Bright Dreams, Sweet Dreams, Happy Dreams, Violet Dreams, Purple Velvet, Doubloon Cascadia Pink, Pink Star, Blue Star, Lilac Star—Great performance, just like the Wave petunias! The flowers of the petitunia are smaller than Waves, about midsize between Waves and Callibrachoa. The Doubloon double petunias perform just fine all summer.

Petunia (seed): Purple Wave, Pink Wave, Rose Wave, Misty Lilac Wave, Coral Wave, Tidal Wave—Outstanding plants for Kentucky, all of them!

Purslane (vegetative): *Portulaca oleracea* Yubi Summer Joy (Wine Red, Scarlet, Yellow, White, Rose, Orange and Duet Yellow, Duet Rose)—The flowers open three to four hours after sunrise and had the most spectacular show in the trials through early August. I think the drought and watering restrictions slowed them after that. I was impressed that the plants stayed vigorous all summer (compared to moss rose), even though flowering slowed in late summer.

Blue Salvia: *Salvia farinacea* Victoria—Great performance!

Verbena (vegetative): Aztec™ Pink, Violet, Lavender; Tapien™ Violet, Pink, Lavender; Temari™ Bright Red, Bright Pink, Violet, Burgundy—The Temari varieties performed well all summer, while the Aztec and Tapien varieties had few flowers during the drought and watering restrictions. All verbenas are excellent, vigorous ground cover annuals (often perennial in Southern and Western Kentucky). They just need plenty of water and some fertilizer during the summer.

Zinnia: Profusion Cherry and Orange—These zinnias are spectacular, especially the orange. The Profusion zinnia takes the heat tolerance, vigor and disease resistance from its *Z. angustifolia* parents and join it to the upright habit and larger flowers from its *Z. elegans* parents. These are great plants for Kentucky gardens.

Trials at the Arboretum

Sharon Bale, Department of Horticulture

Nature of Work

I don't think anyone is unaware that the 1999 growing season was a test for plants and people. Water restrictions meant a priority list for use of alternative water sources. Naturally, trees were a top priority, and the annual flowers were the lowest priority. Lack of consistent water and the extreme heat made evaluation of the plant material difficult.

In 1997 a new perennial bed was established at the UK Arboretum. Instead of planting common perennials that perform well in this area, it was decided to use the new area as a testing ground for new or unfamiliar plants that might have perennial plant potential here. The following plants are those that show the most potential as additions to the perennial garden:

Results and Discussion

Anemone tomentosa 'Robustissima,' *Anemone heuphensis* 'Prince Henry,' *Anemone robustissimus, Anemone x hybrida* 'Margarete'—All plants survived and bloomed well in late summer, early fall.

Antirrhinum hispanicum 'Roseum'—A very low growing plant with small snapdragon-like blooms in early summer. This plant did not survive in the arboretum but did survive in another location. In this case it is hard to determine if rabbit damage was a factor. Comments regarding this plant will be withheld until it is given another try.

Aster novae-angliae 'Alma Potschke', *Aster laevis* 'Bluebird'—Both produced a good display. 'Alma Potschke' is pink and more compact than 'Bluebird.'

Eupatorium hyssopifolium—White blooms late in the season. This plant is hardy but not as attractive as *Eupatorium rugosum* 'Chocolate.' It tends to lodge and may not be the best addition to the garden unless a rather wild look is desirable.

Eupatorium rugosum 'Chocolate'—Flowers are white and appear late in the season. The dark purple foliage is attractive and "holds" a place in the garden until these plants come into bloom. Considering that most Eupatoriums prefer a wet location, this plant tolerated the drought conditions fairly well. Plant is fairly compact and maintains a good habit. Height—2 ½ to 3 feet. Width—2 ½ feet.

Lespedeza thunbergii 'Gilbraltar'—Plant appears to be reliably hardy. It produces a terrific display of pink blooms in late summer. The bloom display this summer was affected by the drought conditions, but this plant should be considered a potential good choice for the garden. This plant is much larger than anticipated and needs plenty of room. This plant is a little overbearing in its present location. We will definitely find a new home for this vigorous plant. Height—5 feet. Width—5 feet.

Monarda 'Petite Delight'—A nice compact plant. Appears to have potential, but the drought conditions really affected the display. We'll see how this one come through the winter.

Salvia guarantica 'Black and Blue'—Approximately 3 feet in height, this salvia produces black and blue blooms for a long period during the summer through the fall. It was obvious that the heat and drought conditions this past season affected the overall display. Cooler temperature and increased moisture intensified the bloom color and bloom production. *Salvia guarantica* was also grown and is also hardy, but the distinct coloration of 'Black and Blue' makes it a better choice.

Salvia greggii 'Wild Watermelon,' 'Maraschino,' and 'Raspberry Royale'—Various cultivars of *Salvia greggii* produce small blooms in various shades of pink. They bloom all season long, with the best display coming late in the season. Drought conditions and intense heat appeared to reduce the display. More cultivars of this species have been added to the collection this year. Plants are generally 2 to 3 feet tall. In some locations these plants were hardy, and in other locations, they did not survive. This species appears to have potential but needs a few more seasons before a definitive comment can be made.

Salvia uglinosa—Produces light blue flowers all season until frost. Plants are very vigorous, reaching a height of 4½ feet and a spread of at least 4 feet. This plant is commonly called bog sage, and it was obvious that the drought conditions reduced the display of this plant. Although the plant may be a useful addition to the perennial garden, some may find the odor of the foliage undesirable.

Stokesia laevis 'Omega Skyrocket'—Blue flowers mid to late summer. Not extremely vigorous, but does produce attractive flowers.

Veronica peduncularis 'Georgia Blue'—Very low growing plant. Produces small, bright blue flowers in early summer. Spreads, but is not invasive. Has potential as an attractive ground cover. Very attractive when in bloom.

Those that didn't make it as a perennial:

Salvia buchanii—Plants have very attractive glossy green foliage. Of all the salvias tried in the garden, this plant showed the least amount of vigor. Even though the bright pink blooms are very attractive, this plant is probably not a good choice, even as an annual flower.

Salvia leucantha 'Midnight'—Another tender plant that can still be an attractive addition to the garden. Midnight has a solid blue bloom rather than a white and blue bloom. Plants are easily propagated by cuttings and can be grown as an attractive annual hedge. Plants require short days to produce bloom, so the display is often cut short by frost.

Salvia puberula 'Hildago'—This plant was not hardy but is still desirable for the annual garden. Plants are easily propagated from cuttings. Growth habit is loose, and the plants are very vigorous, reaching a height of at least 4 feet. The bright pink blooms are not produced until late summer or early fall but are worth waiting for. A very striking plant when in bloom.

A few notes on the annual flowers:

It is always fun to try a new look, and this season the use of Leeks 'Electra' and Swiss Chard 'Bright Lights' worked well in combination with a mixture of other annual flowers. Both plants really took the abuse and added an unusual look to the garden. As expected, the 'Bright Lights' did look more robust during the cooler temperatures later in the season, but it also took the heat well. Both were a nice addition for the effect of the foliage.

All America winners:

Cosmos sulphureus 'Cosmic Orange'—It may be an All America Selection winner, but these plants just don't seem to perform that well in this area. It isn't just this particular cultivar. All the short, compact forms of this plant produce an early show and then just seem to lose vigor and fizzle out. There are better choices for the addition of yellow or orange to the garden than this plant—to name a few: Melampodium, various cultivars of sun-tolerant coleus, and even marigolds.

Tithonia 'Fiesta Del Sol'—Generally speaking, *Tithonia* begins to look a little rough late in the summer. Some leaf spot problems can make the plants unsightly. Keeping that in mind, 'Fiesta Del Sol' is definitely an improvement over the common cultivar 'Torch.' Plants are more compact, reaching a height of 3½ to 4 feet, and produce an excellent hedge. Vigor of the plant may be improved by dead heading.

Ipomoea batata 'Margarita,' 'Blackie,' 'Pink Frost'—All the sweet potatoes tolerated the drought well. Although 'Blackie'and 'Margarita' are more vigorous, all three plants are still excellent choices for containers as well as bedding.

What to look for next year:

A large number of verbenas, more salvias, All America Selection winners and the trials, and some second chances on plants that we think the rabbits found too interesting or plants that may have had some problems caused by human error.

Update on Industry Support for the University of Kentucky Nursery and Landscape Program

The UK Nursery/Landscape Fund was initiated in 1993 to provide an avenue for companies and individuals to invest financial resources to support research and educational activities of UK to benefit the industry. Many industry personnel recognized that a dependable, consistent supply of support funds would allow faculty to increase research and education programs addressing industry needs. Such an investment by the industry is wise and essential.

A fund development committee established a minimum goal of $35,000 per year to support UK programs. Broad participation by Kentucky nursery and landscape firms in this program would help a dedicated, hard-working faculty and staff accomplish more for you.

Since its establishment, the UK Nursery/Landscape Fund has provided an average of $13,000 annually to support this program. The majority of these funds have been used for student labor and specialized materials/equipment. These investments have allowed us to initiate new research and to collect more in-depth data from existing plots.

All contributors are recognized by listing in the annual report and in a handsome plaque that is updated annually and displayed at the Kentucky Landscape Industry Trade Show and in the UK Agricultural Center North Building. Giving levels are designated as: Fellows ($10,000 over 10 years), Associates (more than $500 annual contribution), 100 Club members (more than $100 annual contribution), and Donors (less than $100 annual contribution). Fifteen individuals/companies have committed to contribute at least $10,000 each over a 10-year period. Those contributing at this level are Nursery/Landscape Fund/Endowment Fellows and can designate an individual or couple as University of Kentucky Fellows and members of the Scovell Society in the College of Agriculture.

It was the goal of the initial advisory committee to develop the annual giving to a level that would enable us to endow a fund. The interest from the fund could be used to support this program. This year that goal became a reality through the encouragement of a state match, dollar-for-dollar, of private contributions to support research at UK. The Research Challenge Trust Fund was created by the Kentucky General Assembly at the recommendation of Governor Paul Patton to assist UK in reaching the goal of becoming a top 20 public research institution by 2020. At this time, all state funds made available to UK for matching have been utilized; however, Governor Patton has indicated that he will request continuation of the program in 2000. As was true last year, commitment of state funds for this match will go fast, and we need to be ready to move with any additional endowment contributions this spring/summer.

A Family of Endowments Established to Support Nursery/Landscape Research at the University of Kentucky

Several Kentucky nursery/landscape industry leaders have seized the opportunity and made a significant and long-lasting impact on research to support our industry. Three named endowments and a general endowment that will total more than $250,000 within three years have been established at the University of Kentucky to support nursery and landscape research through the Department of Horticulture.

Named endowments were established by a minimum of $25,000 commitment over three years. The named endowments include:

- The James and Cora Sanders Nursery/Landscape Research Endowment, provided by the Sanders Family and friends
- The Don Corum and National Nursery Products Endowment, funded by Bob Corum
- The Ammon Nursery/Landscape Research Endowment, established by Richard and Greg Ammon.

UK Nursery/Landscape Research Endowment

The general UK Nursery/Landscape Research Endowment was established with cash and pledges over three years totaling $34,000, which was matched with state funds. Contributors include:

Continuing Fellows level commitments redirected to the Endowment:

- Patrick A. and Janet S. Dwyer, Dwyer Landscaping Inc.
- Robert C. and Charlotte R. Korfhage, Korfhage Landscape and Designs
- L. John and Vivian L. Korfhage, Korfhage Landscape and Designs
- Herman R., Sr. and Mary B. Wallitsch, Wallitsch Nursery
- Fred (In memoriam) and Jenny Wiche, Fred Wiche Lawn and Garden Expo

New Fellows level commitment to the Endowment:

- Herman, Jr. and Deborah Wallitsch, Wallitsch Nursery

100 Club level contributions to the Endowment:

- Rudy Volz, R.L. Volz Landscaping and Nursery
- Helen Powell, Powell and Company Inc.

James and Cora Sanders Nursery/Landscape Research Endowment

Larry and Carolyn Sanders of the James Sanders Nursery in Paducah have created the James and Cora Sanders Nursery/Landscape Research Endowment at the University of Kentucky. The Sanders family has committed $25,000 that was matched by the state through its Research Challenge Trust Fund, established through funds appropriated by the Kentucky General Assembly. Contributions were also made by Paducah area residents to honor James and Cora Sanders. Funds appropriated by the Kentucky General Assembly established the Research Challenge Trust Fund that provided a

one-to-one match of contributions to this endowment.

"The Sanders' gift reflects the dedication they've shown to their community and profession for decades and is extremely gratifying," said Dewayne Ingram, chair of UK's Department of Horticulture. "The commitment from this family and the Paducah community is appreciated."

The endowment fund honors Larry's parents, James and Cora Sanders. Members of the Sanders family has been active business owners and leaders in Paducah for more than 40 years. They've provided leadership through the Hendron Volunteer Fire Department, Lions and Lioness clubs, beautification boards, the UK Cooperative Extension Service, and several other organizations.

The James Sanders Nursery was established in 1957. Today, it is a multifaceted organization with a complete lawn and garden center, equipment sales, and landscape contracting services. The business serves customers in Western Kentucky and throughout the midwestern United States.

Thanks to the Sanders family and friends for their commitment to our industry.

Don Corum and National Nursery Products Endowment

Bob Corum of National Nursery Products created the Don Corum and National Nursery Products Endowment at the University of Kentucky this summer. Research supported by the endowment will benefit Kentucky's nursery and landscape industry and its customers.

The Corums have committed $50,000, $25,000 of which was matched in 1999 by the state through its Research Challenge Trust Fund and $25,000 in line to be matched if state funds are available in 2000, bringing the total endowment to $100,000. The endowment is a memorial to Bob's brother, Don, who worked with him in the nursery business.

"Bob Corum was a respected, national leader in the nursery industry, and the establishment of this fund reflects his belief that people should support their profession by giving both time and resources," said Dewayne Ingram, chair of UK's horticulture department.

Ingram joined Bob in presenting in July a beautiful plaque to Don's widow, Joann E. Corum. The plaque recognizes the memorial fund.

National Nursery Products Inc. was founded in 1971. Since that time it has grown into a national supplier of nursery plants with offices in Louisville, Baltimore, Chicago, Detroit, Kansas City, Seattle, St. Louis, and St. Paul.

Thanks to the Corum family for its commitment to our industry.

Ammon Nursery/Landscape Research Endowment

Richard and Greg Ammon of Ammon Wholesale Nursery have created the Ammon Nursery/Landscape Research Endowment at the University of Kentucky. Research supported by the endowment will benefit Kentucky's nursery and landscape industry and its customers.

The Ammons have committed a $25,000 gift, which has been matched by the state through its Research Challenge Trust Fund, bringing the total endowment to $50,000. The Ammon's endowment is one of a family of endowments providing the extra edge of excellence that only increased state and private support can make possible.

"The Ammons have been respected national leaders in the nursery and landscape business for many years and have made significant impact on our industry," said Dewayne Ingram, chair of UK's Department of Horticulture. "The annual proceeds from this endowment will allow us to address more industry needs and opportunities through research."

The Ammon family began its landscape business in 1950. Today it is the largest nursery and landscape business in Northern Kentucky, with 127 greenhouses on 18 acres and 230 acres of field stock.

Thanks, Dick and Greg, for supporting research for our industry.

UK Nursery/Landscape Advisory Committee

The UK Nursery/Landscape Advisory Committee advises the chair of the UK Horticulture Department on the use of available funds to benefit the industry through research and education and assists in the continued development of the funds. The committee members are appointed to three-year terms and represent the various segments of the industry and geographic areas. All industry personnel are welcome to attend the meetings of the advisory committee. The 1998-99 advisory committee included: Greg Ammon (Ammon Wholesale Nursery), Bob Corum (National Nursery Products), Pat Dwyer (Dwyer Landscaping Inc.), Stephen Hillenmeyer (Hillenmeyer Nursery), Bob and John Korfhage (Korfhage Landscape and Designs), Mike Land (Hillcrest Nursery), David Leonard (consulting arborist), Shelly Nold, Gary Phelps (Green Ridge Tree Farm), Bob Ray (Bob Ray Company), Larry Sanders (James Sanders Nursery), Casey Schott, (Leichhardt Landscape Company), Lee Squires (Cave Hill Cemetery), Herman Wallitsch Jr. (Wallitsch Nursery) and Charles Wilson (Wilson's Nursery).

Those individuals and companies contributing to the UK Landscape Fund in 1999 (through December 1) are listed in this report. Your support is appreciated and is an excellent investment in the future of the Kentucky nursery and landscape industries.

On behalf of the faculty, staff, and students in the UK Nursery and Landscape Program, thanks for the contributions to help us do a better job in serving you. In addition to the financial support, do not underestimate the effect of such contributions as a vote of confidence for our work. The contributions of these industry leaders and the matching state funds will result in a family of endowments approaching a quarter of a million dollars within three years. Through the generosity and commitment of these leaders, we were able to take advantage of available state funds to make a real and lasting impact on our ability to serve the industry. Annual contributions will continue to be an important mechanism for industry to support this program. It is simply not possible without industry support for us to provide the quality research, Extension, and teaching programs we all want.

For more information on how to contribute to an endowment or the annual giving program, please contact Dewayne Ingram at 606-257-1758 or the UK College of Agriculture Development Office at 606-257-7200.

UK Nursery and Landscape Fund and Endowment Fellows

Gregory L. Ammon
Ammon Wholesale Nursery

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