SECTION 10

Landscape

Roger Harris
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Section 1 and Section 13 may contain related titles.

Carryover Affects of Sumagic Treatments on *Kalmia latifolia* Cultivars

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Nature of Work: It has been reported (Banko and Stefani, 1996, Bir and Bradley, 1996) that treating cultivars of container grown hybrid mountain laurel with sprays of Sumagic can decrease vegetative growth and increase the number of flower buds per plant. The objective of this research was to evaluate the carry over effects, if any, of these treatments on mountain laurel cultivars which were planted in simulated landscape situations. Previous unpublished research resulted in 87.5% plant death over winter from applied drench applications of 20 ppm Sumagic applied the previous April.

Methods and Materials: Uniform plants from previous research (Bir) were transplanted into simulated landscape beds at the Mountain Horticultural Crops Research Station (MHCRS), Fletcher, NC in late fall 1995. Beds had been rototilled prior to planting and nutritional status adjusted to recommended levels following a soil test. Plants were fertilized with 18-46-0 each spring at the rate of 0.5 oz. N per plant the first year and 1.0 oz. N per plant in the second year of the test. A two inch bark mulch was maintained throughout. Weed management was accomplished with manual removal and directed spray of 1 % glyphosate solution.

Survival, growth and development of all plants were observed in spring 1996 and 1997. Fifteen stems from each treatment were selected at random in Spring 1997. The total stem elongation to the flower bud cluster during 1996 was measured with results shown in Table 1.

Results and Discussion: All plants lived. All flowers developed normally, i.e., there was no distortion of form or color in any of the cultivars for any treatment. However, it was obvious which plants had been treated. Plants that had been treated with Sumagic were much more compact and flowered approximately one week earlier regardless of cultivar. Treated plants continued to have more flowers in 1996 although by 1997 there were abundant flowers on all plants whether they had been treated or not.

Significance to the Industry: The season following treatment with Sumagic, stem elongation of all threemountain laurel cultivars was significantly reduced for each rate of application in a simulated landscape situation. However, flowering and vegetative growth appeared normal.

Literature Cited

1. Banko, T. J., and M. A. Stefani.1996. Timing of Sumagic application influences Kalmia flower bud initiation and plant size. Proc. SNA Res. Conf. 41:218-222.

2. Bir, R. E. and Garry Bradley. 1996. Influence of Sumagic foliar sprays on flower development of container-grown mountain laurel cultivars. Proc. SNA Res. Conf. 41 :206-208.

Table 1. Average stem elongation (in.) at MHCRS in 1996 for Kalmia latifolia cultivars as affect by 1995 nursery Sumagic treatment .

	Cultivar		
Sumagic Rate(ppm)	Bullseye*	Carousel*	Olympic Fire*
0	5.25 a	5.07 a	4.95 a
50	4.48 b	3.12 b	2.45 b
100	3.00c	1.56c	0.83c
200	2.00d	0.55d	0.25d

*Rp05 Duncan's New Multiple Range Test

Evaluation of Ornamental Pear and Mountain Ash Species Hybrids for Georgia Landscapes

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Nature of the Work: Ornamental pears are utilized as small landscape trees which are noted for showy floral displays and brilliant fall foliage (Halfacre & Shawcroft, 1994). Mountain ash and chokeberry are also noted for their use as small landscape trees because of their handsome foliage and brightly colored fruit (Dirr, 1990). However, many species of ornamental pear, mountain ash, and chokeberry are only known in more northern regions of the country due to problems with heat tolerance and disease and insect resistance. As part of the Landscape Plant Development Center's breeding program at the University of Minnesota's Landscape Arboretum, several crosses and selections of *Pyrus, Sorbus*, and *Aronia* have been made in an effort to introduce new varieties. The University of Georgia, Griffin campus, participates in the Landscape Plant Development Center's breeding effort as a regional testing site. These new varieties are being evaluated as small trees for Georgia landscapes.

A field plot was established in Fall 1994 in Griffin, GA. Six *Pyrus* hybrids, three *Pyrus* selections, and two *Sorbus x Aronia* hybrids were planted in a completely randomized design. The plants are maintained with minimal management. The plots are mulched annually with coarse hardwood and irrigated only during extreme drought conditions.

Plants are visually evaluated each fall for disease resistance, drought resistance, heat tolerance, insect resistance, and overall general appearance. Each plant is given a rating of 1-5 based on overall appearance, percent canopy, and disease and insect resistance. Plant height and diameter were recorded during the third growing season. Cold resistance was also evaluated in Spring 1996 following an extremely cold winter. However, the winter included a warm period during which many trees broke bud prematurely and were damaged during a subsequent three-day cold spell which included a 12%F night. Trees were again rated on a 1-5 scale.

Results and Discussion: Preliminary results indicate that *P. ussuriensis x P. arrygduliformis*, *Pyrus* 785, and *Pyrus* 1274 are the least susceptible to insect and disease as well as being the most heat tolerant. In addition, *P. ussuriensis x P. arrygduliformis* exhibited the most growth in comparison to the other accessions being evaluated. *Sorbus x Aronia* and *Sorbus x Aronia* hybrids displayed the least resistance to insect and

disease and appear to be least heat tolerant as well as slowest in growth. However, cold damage data indicated that Sorbus x Aronia and Sorbus x Aronia hybrids in addition to *P. ussuriensis x P. eleagrifolia, P. salicifolia* 'Silver Frost' x *P. ussuriensis x P. calleryana*, and *P. salicifolia* 'Silver Frost' x *P. salicifolia* were the most cold tolerant. *Pyrus* 785 and *Pyrus* 1274 proved to be the least cold hardy. Average ratings and growth for all selections and crosses are listed in Tables 1.

Significance to Industry: Participation in a cooperative program with the Landscape Plant Development Center at the University of Minnesota's Landscape Arboretum allows for the evaluation and potential introduction of new and previously unknown northern small tree varieties for use in Georgia landscapes.

Literature Cited

1. Dirr, M.A. 1990. Manual of Woody Landscape Plants. 4th ed. Stipes Publishing Company.Champaign, IL.

2. Halfacre, R.G. & Shawcroft, A.R. 1994. Landscape Plants of the Southeast. 5th ed. Sparks Press. Raleigh, NC.

Table 1. Average Ratings and Growth

Appearance Rating System:

1 = Dead
2 = Lost greater than 60% of its leaves andJor exhibits severe disease and insect damage.
3 = Lost 20 to 60% of its leaves and/or exhibits average disease and insect damage.
4 = Lost 0 to 20% of its leaves, andlor exhibits slight disease and insect damage.
5 = No leaf loss and exhibits no disease and insect damage

Cold Rating System:

1 = Dead
2 = Damage into two- year-old wood
3 = Damage into one-year-old wood
4 = Cold damage on tips only
5 = No damage.

Code	Species	# of plants	Appearance	Cold	Avg. Diameter[1]	Ave.Height[2]
911042	*Pyrus fauriei x P. dimorphophylla*	7	44	3.4	1.5	70.4
911005	P. ussuriensis *x P. arrygduliformis*	10	4.5	4.8	1.8	92.5
911006	P. *ussuriensis x P. eleagrifolia*	1	3.5	5.0	1.7	88.0
911012	*P. ussuriensi* x (P. faurei x P. betulaefolia)	8	3.0	3.4	1 3	75.0
911037	P. *salicifolia* 'Silver Frost, *x P. ussuriersis x P. calleryana*	2	3.8	5.0	1.4	7C.5
911036	P. .*salicifolia* 'SilverFrost' x P. *salicifolia*	4	3.6	5.0	1.5	67.3
POM7	Sorbus xAronia hybrids	5	2.7	5.0	1.0	73.2
POM 17	Sorbus xAronia	2	2.9	5.0	0.6	41.5
Pyrus 785		5	4.8	1.8	1.4	73.4
Pyrus 788		5	3.4	3.6	1.3	74.6
Pyrus 1274		4	4.9	2.8	1.4	77 8

[1]Diameters were measured at 1' above the base of the tree.
[2] Height was measured to the tip of the tallest branch.

Susceptibility of Deciduous Azalea Species and Cultivars to Cranberry Rootworm

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Nature of Work: Cranberry rootworm, *Rhabdopterus picipes* (Olivier), can be a serious, annual pest of many woody ornamentals including camellia, yaupon holly, viburnum, azalea, wax myrtle, cherry laurel, photinia, silver maple, sycamore and rose (Oliver and Chapin, 1980). Adult beetles feed on new growth, reducing the aesthetic value of plants and, in severe infestations, weakening the plants. Leaf damage from feeding causes elongated, curved cuts or holes. The most severe injury occurs to plants growing in shade along edges of woodlands or under dense canopies of pine or other species with pine bark or leaf litter as mulch. Beetles are about 1/4 in. long; they are shiny, greenish- bronze in color with reddish-yellow legs (Harman, 1940). They typically feed over a two-week period in late spring or early summer.

Deciduous or native azaleas of 14 species, three hybrid cultivars and an evergreen cultivar 'Delaware Valley White' were planted in a randomized complete block design consisting of 12 blocks, under the shade of a mixed canopy of pistachio, maple and sycamore. All of the species were clonally propagated through cuttings, except *R. prunifolium* and *R. prinophyllum*, in which seedling populations were evaluated. *R. calendulaceum* was represented by both seedlings and cuttings. The plot was established in the fall of 1994. Plants were mulched with pine straw or shredded bark and irrigated as needed with drip irrigation. Mulch was re-applied as necessary. No pesticides have been applied to this plot. Leaf damage from natural infestation of cranberry rootworm was observed in May or early June in each of the subsequent three years. Individual plants were rated each year for severity of damage. In addition, in 1997, the percentage of damaged shoots was calculated.

Results and Discussion: The species/cultivars are grouped in Table 1 according to the amount of damage caused by cranberry rootworm. Resistance levels of each species/cultivar relative to one another were consistent over the three years evaluated. The evergreen cultivar, 'Delaware Valley White' had the least amount of damage, with 23% of the shoots showing a small amount of feeding damage. Also showing low levels of damage were 'Nacoochee' and *R. serrulatum*. In the second group of plants, 40 to 50% of the shoots had feeding damage, though the amount of damage per leaf was low. Feeding was observed on 60 to 80% of the shoots in the third group of plants, and the damage was more severe, resulting in loss of about 20 to 30% of the leaf area of damaged leaves. Plants in the most severely damaged group had feeding damage

on 80 to 100% of the shoots, with 40 to 60% of the leaf area destroyed. The most susceptible plants were 'Buttercup' and the *R. japonicum* hybrid; 50% of the leaf area of every shoot on these plants were damaged.

Significance to Industry: Native or deciduous azaleas are becoming increasingly popular landscape plants in the southeast. Cranberry rootworm is a potentially serious pest on many of these azaleas. Information on resistance allows selection of appropriate species/cultivars for use in infested areas.

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Table 1. Relative resistance of azalea species/cultivars to cranberry rootworm based on ratings and % damaged shoots in 1995, 1996, and 1997.

Highest resistance	Somewhat resistant	Susceptible	Most susceptible
'Delaware Valley White'	*R. alabamense*	'My Mary' (Alabama)	*R. austrinum* (Florida)
'Nacoochee'	*R. arborescens* (Sweet)	*R. oblongifolium* (Texas)	*R. periclymenoides* (Pinxterbloom)
R. serrulatum (Hammock sweet)	*R. canescens* (Piedmont)	*R. viscosum* (Swamp)	*R. prinophyllum* (Roseshell))
	R. atlanticum (Coastal)	*R. prunifolium* Plumleaf)	*R. calendulaceum* seedling (Flame)
		R. vaseyi (Pinkshell)	*R. calendulaceum* 'Cherokee' (Flame)
			'Buttercup' *R. japonicum hybrid* (Japanese)

Superior Landscape Plants from the JC Raulston Arboretum

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Nature of Work: The JC Raulston Arboretum at NC State University continues to evaluate new and potentially useful woody and perennial plants for use in landscapes in USDA Hardiness Zone 7. To date, ca. 250 plants released by the Arboretum are estimated to be in commercial production in the U.S. nursery industry. Ongoing evaluations continue to suggest more plants with highly desirable garden attributes. Plants are released through an annual distribution at the North Carolina Association of Nurserymen (NCAN) tradeshow, direct propagation from Arboretum plants by certified nurserymen, and exchanges with interested nurserymen or horticultural professionals.

Results and Discussion: The following listing comprises plants newly acquired and still in the evaluation stage, and plants being released this year through cooperative arrangements with NCAN. Some plants are being re-released which have been more slowly accepted by the nursery industry, but which still have highly desirable ornamental merits.

Variegated *Daphniphyllum* — The JC Raulston Arboretum recently acquired three clones of daphniphyllum from Japan which exhibit striking variegation patterns. Due to the successful cultivation of *Daphniphyllum macropodum* in the Raleigh area, these variegated selections offer much promise. The first two selections are a white to cream-colored marginal variegated selection of *D. macropodum*, known only as “white variegated form”, and a form with gold splashed variegation in the center of the leaf, known as *D. macropodum* “gold variegated form”. Both selections have red petioles, giving a tricolor effect to the plant. The third clone is a variegated cultivar of a new daphniphyllum species, currently not being grown in the U.S., *Daphniphyllum teijsmannii* ‘Variegata’. Pending hardiness trials, these three plants offer exciting additions to the broad-leaved evergreen plant palette.

Manglietia yunnanensis — The specimen of this species at the Arboretum continues to prove its adaptability to the unpredictable Southeastern climate. Despite having 3-4" of tender new growth destroyed by a very late, hard freeze, the original plant (near the lathhouse in the Arboretum) recovered, and even flowered profusely. It now stands 20 feet tall. Yunnan manglietia promises to be a striking addition to southern landscapes, and should complement such wonderful Southern plants as ‘Little Gem’ magnolia in the near future. Propagation is still being researched.

Sinocalycanthus chinensis x Calycanthus floridus — "Sino-American sweetshrub" — This plant, first hybridized at the Arboretum under JC's direction, combines the best attributes of both parents. Wine-colored flowers with creamy-white centers and a sweet fragrance, and glossy foliage should make this sweetshrub a choice landscape plant in the near future. This new species will be named in JC's honor in an upcoming publication. Propagation is the same as for our native sweetshrub, rooting readily from ripened softwood cuttings.

Hedera nepalensis 'Marble Dragon' — This selection of the orange-fruited Nepal ivy possesses bluish-white mottling along the veins on the upper side of the leaves. The leaves are much smaller than those of the common English ivy, giving Nepal ivy a much finer texture. As with all Hedera, Nepal ivy roots readily from single node cuttings within weeks.

Emmenopterys henryi — This Asian counterpart to our native fevertree (*Pinckneya pubens*) is equally as beautiful in flower, and equally as obscure in the nursery trade. Trees in cultivation have been extremely slow to flower, but we anticipate that the Southern heat will soon push the plants at the Arboretum to maturity. E.H. Wilson, noted Chinese plant explorer, regarded *Emmenopterys* as the finest of all Chinese flowering trees. It's pink bracts subtending the flowers, set against dark black-green foliage, turn the Chinese forests pink. Plants are cutting grown from suckers.

Rhamnella franguloides — This relative to our native buckthorn is a great four-season plant, with dark glossy green and highly textured foliage, summer yellow to orange fruit, and vibrant yellow fall color. The plant appears as if it is plugged in to an electrical socket (a yellow neon plant). Propagation is still experimental, but softwood cuttings should root in early summer. Root sprouts may also offer further means of propagation.

Euscaphis japonica — A re-release of a great plant, *Euscaphis* ("sweetheart tree") also offers multi-season interest. Glossy spring and summer foliage, bright red fall fruit, and intriguing striped winter bark are the main attractors to this small tree, desirable for small residential properties.

Carpinus fangiana and other *Carpinus* species — The hornbeams offer tremendous promise for American landscapes. Nearly all species have outstanding foliage, bark, and tree form aspects. Fang's hornbeam, a Chinese species, has been called the most beautiful of all hornbeams. It possesses 6-8" long leaves and female catkins which can be as long as 18". The JC Raulston Arboretum is very pleased to have a young plant of this exceedingly rare species in cultivation. Like other Carpinus, Fang's hornbeam should make a handsome small tree for southeastern urban landscapes.

Aucuba japonica 'Rozannie' — This dwarf, non-variegated, self-fruiting cultivar of Japanese aucuba is being re-released by the Arboretum this year as a fine, compact broadleaf evergreen for the Southeast. The large red berries on this cultivar are produced in abundance, against a backdrop of the medium-green foliage. As with other aucubas, 'Rozannie' will grow best, and retain a deeper green foliage color, in partial to full shade.

Illicium mexicanum 'Aztec Fire' — Collected in Mexico by JC, along with the Yucca Do guys, 'Aztec Fire' Mexican anise-tree is noted for its exceptional flowering. The abundant red flowers are followed by reddish star-shaped fruit (versus the normal green fruits on most *Illicium*). 'Aztec Fire' is best grown in shade. Foliar bleaching will occur on specimens grown in brightly sunlit areas. Propagation is easy — softwood cuttings taken throughout the summer root readily, albeit slowly.

Nyssa sinensis — Another re-release, Chinese black gum is a handsome small tree for suburban landscapes. As with the native black gum, Nyssa sinensis possesses intense red to orange fall color. Growth in young specimens is vigorous. Propagation by seed.

Cornus walteri — "Giant dogwood" is an upright, tree-sized dogwood with attractive late spring flowers. Unlike the flowering or kousa dogwoods, giant dogwood flowers are without showy bracts, but instead appear in dense terminal clusters, giving a frothy white appearance to the entire tree. The tree in the Arboretum now measures 20-25 feet in height, while only 8-10 feet in width. A superior tree for today's landscapes.

Chamaecyparis thyoides — "Atlantic white-cedar" -- This small, but fast-growing tree is an exciting native conifer, found in boggy swamps throughout the coastal southeastern U.S. and north to Maine. Its broad adaptability to harsh soil conditions, outstanding disease resistance, and quick growth rank this plant as a potential Leyland cypress replacement. A re-release of an exciting, long-neglected plant.

Hypericum frondosum — "Golden St. Johnswort" — This shrubby southeastern native is another spectacular four-season plant. Pleasant spring steel-blue foliage gives way to shocking sunny-yellow summer flowers. In winter, plants exhibit attractive, exfoliating, mahogany-colored winter bark. A 15+ year-old plant in the Arboretum stands only 4 feet high.

Baptisia alba (*Baptisia pendula*) — "false white indigo" -- This native herbaceous perennial is a tough, robust plant with multi-season interest. Spring asparagus-like shoots produce elongated clusters of white pea-like flowers, and later reveal stunning blue-green foliage. Tolerant of the

most abusive of soil conditions. Propagated by seed or softwood 2-3 nodal cuttings. Overwintering may be a problem for cutting-produced plants due to rot.

Ligustrum japonicum 'Green Meatball' (formerly listed as a cultivar of *Ligustrum lucidum*) — This dense selection of Japanese privet is sure to satisfy all who crave yet another "green meatball" in the landscape. Roots readily and quickly from softwood cuttings in late spring thru summer. Ultimate size is unknown.

Significance to Industry: The JC Raulston Arboretum at NC State University, long recognized as a leader in the introduction of superior, new landscape plants for the southeastern U.S. horticulture industry, continues to select and promote exciting new plants with ornamental merit and economic value. The plants presented here represent improved selections of already-grown species (e.g. *Illicium mexicanum* 'Aztec Fire', Aucuba japonica 'Rozannie', and *Ligustrum japonicum* 'Green Meatball'), or new species of a genus currently cultivated (e.g. Carpinus fangiana, *Nyssa sinensis, Cornus walteri*), or a related genus of a native southeastern plant (e.g. *Rhamnella franguloides, Euscaphis japonica, Emmenopterys henryi*). Exciting new plants, with tremendous potential horticultural value, are also newly exhibited (*Sinocalycanthus* (*Calycanthus*, variegated *Daphniphyllum's*), with future release anticipated. Finally, a native conifer (Chamaecyparis thyoides) is proposed for further evaluation as a potential replacement for the overplanted, disease-prone Leyland cypress. It is the hope of the JC Raulston Arboretum that these plants will be embraced by the nursery industry in order to enrich our Southern landscapes so that we can all "Plan and plant for a better world".

The JC Raulston Arboretum at NC State: A Living Laboratory for the Green Industry

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Nature of Work: The JC Raulston Arboretum at NC State University (formerly; the NCSU Arboretum) has served as a research, teaching and outreach facility. The very heart of it's mission has been to seek out new ornamental plants, evaluate them for their suitability in North Carolina and introduce them to the green industry in the south east region of the United States. Within that context, the Arboretum has developed into a very reputable public garden that serves countless groups of people, including, students of all ages, community members, scholars, and members of the green industry across the world.

The JC Raulston Arboretum is a unique living laboratory. NC State undergraduate students from the Departments of Horticultural Science and Landscape Architecture have many of their formal laboratories at the Arboretum. Students get hands on experience in plant identification, nursery management, tree and grounds maintenance, landscape construction, and many other related subjects at this eight acre facility. Graduate students also use the Arboretum and the plant collections to carry out research for their degrees. Students represent the future members of the green industry.

The Arboretum also serves as a direct living laboratory for our industry. The All America Selections Trial Grounds is located within the facility. The newest bedding plant cultivars are tested here. A Bedding Plant Field Day is held in July of each year. Local industry members attend a morning session in the garden and indoor educational sessions in the afternoon. The Landscape and Turf Field Day is also held at the Arboretum every May. Members of the North Carolina Association of Nurserymen and the North Carolina Landscape Contractor's Association attend a series of concurrent workshops in the garden. Some members also spend the day prior to the field day donating their time and materials to building one or more gardens or garden features within the Arboretum. Located adjascent to the Arboretum is the Certified Plant Professional Collection. This is a living collection of the plants on the NCAN and NCLCA Certified Plant Professional list. Plant ID tests are given at least twice a year for certification.

Results and Discussion: NCAN and the JC Raulston Arboretum introduce new plants to the industry through the Plant Introduction Program which identifies new and promising plants to the nursery industry and provides ways for nurserymen to acquire these new plants.

Significance to Industry: the JC Raulston Arboretum serves to educate a diverse group of students, ranging from those who attend NC State University to those who visit the Arboretum to get ideas about garden building or about new plants. The garden and plant collection enable our industry to move forward in a time where demand for plants and plant information is so very high. The future of the green industry depends on places like the JC Raulston Arboretum and on those who use it as a living laboratory.

Cold Hardiness of Redbud

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Nature of Work: There is a demand in the landscape industry for small flowering trees. The genus *Cercis,* with its wide range of flower colors, from magenta-pink to white, and members include 3 foot shrubs to trees 50 feet tall, can serve this need (Raulston, 1990). The taxonomy of *Cercis* is tangled, but there are reported to be between 7 and 13 species of *Cercis* and in the US redbuds range from New Jersey to California and southward into Mexico (Raulston, 1990). With this wide range of natural distribution many characteristics such as cold hardiness could differ by seed source. The literature reports maximum cold hardiness ratings of *Cercis* spp. to range from USDA cold hardiness zone 3 to 6, but the specific cold hardiness for many taxa has not been obtained (Hortus III, 1976; Dirr, 1990; Krussmann, 1976; Rehder, 1940; Royal Horticultural Society, 1992). Therefore we have evaluated, in the laboratory, the cold hardiness of several taxa of: *C. canadensis, C. chinensis, C. mexicana, C. recemosa, C. gigantea*, and *C. yunnanensis*. The laboratory cold hardiness evaluations were done as previously described by Lindstrom and Dirr, (1989). Samples of *C. canadensis, C. mexicana*, and *C. racemosa* were taken from outdoor plants in Griffin and/or Athens, Georgia, while *C. chinensis, C. gigantea*, and *C. yunnanensis* were sampled from outdoor plantings at the National Arboretum in Washington, D.C.

Results and Discussion: The cold hardiness for December 1993 and January 1994 of the redbud taxa evaluated in this study are shown in table 1. *C. canadensis* showed some variation in cold hardiness (10 to -8 F) among the taxa evaluated during the December sampling date. By January, there were no differences in cold hardiness (-22 F, which is the lower limit of the laboratory freezing equipment). These data indicate that there are significant differences in cold hardiness among *C. canadensis* taxa during the cold acclimation phase. December is a critical time of the year for cold hardiness injury, selections that do not harden sufficiently by this time are susceptible to freezing injury. The other species evaluated also show variation in cold hardiness in December and most were as cold hardy as *C. canadensis*. In January, however, only one species (*C. racemosa*) was as cold hardy as *C. canadensis*. These data are preliminary and the taxa studied need to be evaluated for cold hardiness during the fall, winter, and spring to determine their cold hardiness levels at various times of the year and should be repeated in another winter season.

Significance to Industry: Redbuds are valuable to the industry especially for their uses as a flowering short-statured tree. Our research will help growers, landscapers, and homeowners to select the appropriate taxa for use in their geographic or market area.

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Table 1. Cold hardiness of *Cercis* spp.

	Dec. 1993		Jan. 1994	
	(C)	(F)	(C)	(F)
C. canadensis				
species	-22	- 8	-30	-22
Alba	-14	7	-30	-22
Oklahoma	-20	- 4	-30	-22
Ruby Atkins	-20	- 4	-30	-22
Forest Pansy	-17	1	-30	-22
Flame	-21	- 6	-30	-22
Silver Cloud	-22	- 8	-30	-22
C. chinensis				
species	-17	1	-26	-15
Avondale	-17	1	-30	-22
C. mexicana	-21	- 6	-24	-11
C. racemosa	-15	5	-30	-22
C. gigantea	-11	12	-27	-17
C. yunnanensis	-21	- 6	-29	-20

Evaluation of Little Bluestem Cultivars in the Carolina Sandhills

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Nature of Work: The use of native warm season perennial grasses has recently increased in popularity. A wide range of uses vary from wildflower meadows to parks and rights-of-ways were low maintenance and erosion control are essential (2,3). Previous research has shown that little bluestem cultivars are adaptable to southeastern conditions (1). Little bluestem, *Schizachyrium scoparium*, is described by Darke and Griffiths (4) as a clump- forming perennial that tolerates poor, infertile soils and full sun.

The evaluation of warm season perennial native grasses is part of a research program at the Clemson University Sandhill Research and Education Center near Columbia, SC. This report deals with an evaluation initiated in 1994 following an earlier study which eliminated numerous species.

This study consisted of 4 little bluestem cultivars; SCS9029926, 'Pastura', 'Aldous', and 'Cimmeron' and 2 methods of stand establishment, direct seeding and transplanting. Soil type was a Lakeland sand with irrigation provided as needed to maintain growth. The direct seeded plots were planted in early May, 1994 and the greenhouse grown transplants were planted in the field in mid-June, 1994 at a spacing of 9 inches. The transplants consisted of 1 x 2 1/4 inch plugs. All plots received fertilizer (125 lbs 20-0-20 per acre) following initial planting and in the spring each succeeding year. All growth data was collected in September of each year.

Results and Discussion: This field evaluation was established and designed based upon data provided from the initial field evaluation started in 1992. Parameters used for evaluation of the little bluestem cultivars were biomass production, plant height and percent of soil surface covered by the vegetation. The means of 3 years data on plant height and percent coverage for both the direct seeded and transplanted are presented in Table 1 for all 4 cultivars. Direct seeding resulted in significantly (P= 0.05) shorter plant height for 'Pastura' cultivar when compared to the other cultivars. However, when using transplants, the cultivar SCS9029926 was significantly taller than 'Pastura', 'Aldous' and 'Cimmeron'. Ground coverage was similar whether the plantings were direct seeded or transplanted. SCS9029926 and 'Aldous' provided significantly better coverage than 'Pastura' or 'Cimmeron'.

Planting methods influenced the eventual stand. Transplanted plots showed a greater difference between cultivars than direct seeded plots (Table 1). Plant height differences were more evident with transplants. The cultivar 'Cimmeron' does not respond well to transplanting were as SCS9029926 responded excellently. SCS9029926 and 'Aldous' provided much better color throughout the growing season and even into the fall. The aesthetic value of these 2 cultivars would definitely enhance a landscape.

Significance to Industry: The present trend toward low maintenance prairie-like plantings requires the use of improved native plant species. Little bluestem would definitely fit into such a situation based upon the data provided in this study. This specie should be utilized more in southeastern landscape because of its durability, color and natural appearance.

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Table 1. Evaluation of 4 little bluestem cultivars and 2 planting methods over a 3-year period, 1994-1996.

Cultivar	Plant Height, in.	Ground cover, %
DIRECT SEEDED:		
SCS9029926	42.10 A	98.33 A
'Pastura'	27.93 C	57.80 C
'Aldous'	36.43 AB	82.77 AB
'Cimmeron'	33.83 AB	66.10 BC
TRANSPLANTED:		
SCS9029926	40.05 A	97.50 A
'Pastura'	25.50 B	60.85 B
'Aldous'	29.55 B	82.50 A
'Cimmeron'	28.30 B	28.35 C

NOTE: Means, within columns and planting methods, not followed by a common letter are significantly different at the P = 0.05 level using the Duncan's Multiple Range test.

Landscape Awards Program in North Carolina

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Nature of Work: The North Carolina Landscape Contractors Association sponsors an annual Environmental Improvement Awards program. The program began in 1985 and has grown each year with an increase in participation. There is an average of 30 to 35 entries with a 90% recognition rate. The awards program is designed to recognize landscape professionals who execute quality landscape projects and clients who underwrite such work. In sponsoring the awards project, NCLCA is striving to increase public awareness of quality landscaping that improves the environment, and encourage landscape professionalism in business and technical skills.

Results and Discussion: All members of the association and registered Landscape Contractors are eligible to submit their work for judging. The only time requirement is in the maintenance category, and the contractor has to have been on the project one year prior to entering the project. The deadline for entries is usually July 31, the judging takes place in August, and the awards banquet is in September, coupled with a fund raising golf tournament. The contractors are notified of their awards so that the clients can be invited guests at the awards banquet. This is great public relations for the contractors.

There are 8 entry categories:
1. Erosion Control / Revegetation / Sedimentation Control
2. Commercial Landscape Contracting
3. Residential Landscape Contracting: a. Below $5000, b. Above $5000
4. Commercial Design / Build
5. Residential Design / Build a. Below $5000, b. Above $5000
6. Commercial Maintenance
7. Residential Maintenance
8. Specialty Category a. Below $5000, b. Above $5000

Most of the categories are self explanatory. The design / build projects include those of which the participating firm drew the landscape plan and performed the construction. A landscape plan must accompany the slides for judging. The specialty category is for projects that don't necessarily fall into the other categories. Examples would be exhibits at home and garden shows, holiday decorating, specialty parts of a garden (but not the entire garden), such as a water garden, deck or gazebo.

Each of the projects are judged independently of the others. Projects do not compete with other projects for one award. There are 3 levels of awards; Grand, Merit and Distinction. It is possible for all entries to be 'Grand' award winners. A jury of landscape experts judge the entries. Typically there is a landscape architect, landscape contractor, and grower. Work is judged on the basis of difficulty, craftsmanship, and contribution to the quality of the environment. Each participant must complete a competition form, include a release form from the client, limit the slides to 15, and the script must be submitted on the official form (within the allocated space). All of the forms and slides become the property of NCLCA and are not returned. Most of the contractors who enter, include an optional letter of reference from the client.

Significance to Industry: The awards program is important for several reasons. It recognizes quality landscape design, construction and grounds maintenance by contractors. Winning an award is great publicity for a landscape business. Many clients prioritize quality work and performance over the lowest price. Companies that have won an award proudly display the awards in their offices and potential clients are impressed with the company. They immediately realize they are dealing with a professional.

The award winning projects are used for educational purposes. Extension specialists and agents, community college instructors and industry professionals use the slides and scripts periodically to show outstanding landscape efforts. Video tapes have been developed for use by educators. Showing and discussing what is involved in an award winning landscape helps raise the standard of landscaping. It encourages other contractors to get involved with the association and perform on a higher standard.

Landscape Performance of *Scaevola* Cultivars - 1996

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Nature of Work: Scaevola (*Scaevola aemula*), commonly called fan flower, is a warm season annual, possibly perennial in USDA hardiness zones 8b-10. It appears to have great potential for use in hanging baskets, containers, mass plantings, and borders. Scaevola prefers full sun. Generally, two cultivars are known in the commercial trade _ Petite Wonder and New Wonder (formerly Blue Wonder). New Wonder scaevola was recognized as a Louisiana Select, Mississippi Medallion, and Georgia Gold Medal plant in 1997.

The primary objectives of a 1996 landscape performance scaevola trial conducted by the LSU Agricultural Center were to evaluate seven cultivars for flowering, visual quality, and pest resistance. This was conducted in cooperation with the Texas Agricultural Extension Service's Coordinated Educational and Marketing Assistance Program (CEMAP) that is currently trialing ornamental plant species in Texas, Louisiana, Mississippi, and several other states.

Scaevola growing in 4" pots were transplanted May 10 into a landscape bed composed of an Olivier silt loam, pine bark and sand (7:2:1 by volume) medium. Cultivars evaluated were New Wonder, Petite Wonder, Outback Colonial Fan, Outback Royal Fan, Outback Purple Fan, Outback Mini Pink Fan, and Outback White Fan. The bed was located in full sun and plants were irrigated as needed throughout the growing season. Plants were spaced 1' x 1' and topdressed with 2 pounds N/ 1000 ft^2 Stagreen Nursery Special 12-6-6 immediately after planting. Prior to planting (April 12), beds were fumigated with methyl bromide at 1 pound/100 ft^2 . Plants were not dead-headed or pruned during the growing season.

Flower ratings based on a scale from 1 to 10 (1=no open blossoms, poor visual impact; 10=maximum blossoms, excellent visual impact) and visual quality ratings based on a scale from 1 to 10 (1=worst, 10=best) were taken May 15, June 15, July 15, August 15, September 15 and October 15. Included in the visual quality ratings was evaluation based on growth habit, foliage color/appeal and flower quality. Pest resistance ratings based on a scale from 1 to 10 (1=least resistance, 10=most resistance) were taken July 15, August 15, September 15 and October 15. Included in the pest resistance ratings was evaluation for diseases, insects, and spider mites.

Results and Discussion: In general, scaevola cultivars had good flower and visual quality ratings May through July with decline occurring August through September. By October, flower ratings were still favorable for Outback White Fan, New Wonder, and Outback Purple Fan. Outback White Fan was most attractive and drew the most consumer comments during the rating period. Petite Wonder had good visual quality ratings in October but flowering had declined. Outback Royal Fan declined July through October. It exhibited strong foliage growth initially in the rating period, but declined quicker than the other cultivars once the weather got hot. Petite Wonder, New Wonder and Outback White Fan were good overall performers and are worthy of commercial consideration. Flower cycling occurred in some of the scaevola cultivars.

Significance to Industry: The evaluation of scaevola cultivars in landscape settings will determine the marketing potential of these exciting new plants. The CEMAP trials are also currently evaluating perennial salvias, perennial verbenas, and lantanas for landscape performance and marketing potential.

Table 1. Flower ratings of scaevola cultivars during 1996

	May 15	June 15	July 15	Aug 15	Sept 15	Oct 15
Outback White Fan	4.5	8.0	9.0	7.0	8.0	6.0
Outback Mini Pink Fan	4.5	7.5	8.5	5.5	6.0	2.0
Outback Royal Fan	6.0	7.5	5.0	3.5	3.0	2.0
New Wonder	5.0	8.0	5.5	6.0	6.5	5.5
Petite Wonder	5.5	8.0	6.5	5.0	7.5	2.5
Outback Colonial Fan	4.0	6.5	5.5	2.0	4.5	1.5
Outback Purple Fan	5.5	7.5	8.5	6.5	4.5	5.0

Note: Flower rating based on a scale from 1 to 10 with 10=maximum number of blossoms and excellent visual impact, 1=no blossoms and poor visual impact.

Table 2. Visual quality ratings of scaevola cultivars during 1996

	May 15	June 15	July 15	Aug 15	Sept 15	Oct 15
Outback White Fan	5.0	8.5	9.0	8.0	8.0	7.0
Outback Mini Pink Fan	5.0	8.0	7.0	5.5	6.0	5.0
Outback Royal Fan	6.0	8.0	5.5	4.0	3.5	2.0
New Wonder	5.0	8.0	8.5	7.0	6.0	5.5
Petite Wonder	6.0	8.0	8.5	7.5	8.0	6.5
Outback Colonial Fan	4.5	6.5	6.5	4.5	4.0	4.0
Outback Purple Fan	6.0	8.0	8.0	6.5	6.0	5.0

Note: Visual quality rating based on a scale from 1 to 10 with 10=best, 1=worst. Included in this evaluation was growth habit, foliage color/appeal, and flower quality.

Table 3. Pest resistance ratings of scaevola cultivars during 1996

	July 15	Aug 15	Sept 15	Oct 15
Outback White Fan	9.0	9.0	8.0	7.0
Outback Mini Pink Fan	7.0	6.5	6.0	5.0
Outback Royal Fan	4.5	5.0	3.5	2.0
New Wonder	8.0	7.0	6.0	6.0
Petite Wonder	8.0	8.0	7.0	7.0
Outback Colonial Fan	7.0	7.0	6.0	5.0
Outback Purple Fan	8.0	8.0	6.0	5.0.

Note: Pest resistance rating based on a scale from 1 to 10 with 10= most resistance and 1=least resistance. Included in this evaluation was diseases, insects and spider mites.

Relative Ranking as a Measure of Turfgrass Performance Under Natural Tree Shade

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Nature of Work: Shade is a common component of many residential lawns thus resulting in the necessity to grow turfgrass in shaded areas. Establishing and maintaining turfgrass in the shade is one of the most challenging problems facing turfgrass managers and homeowners alike.

Selection of shade tolerant turfgrasses is the major tool that turfgrass managers have in dealing with shaded sites. Of the major warm season turfgrasses, centipedegrass [*Eremochloa ophiuroides* (Munro) Hack.], bermudagrass [*Cynodon dactylon* (L.) Pers.], carpetgrass [*Axonopus affinis* Chase], zoysiagrass [*Zoysia* sp.], and St. Augustinegrass [*Stenotaphrum secundatum* (Walt.) Kuntz], zoysiagrass and St. Augustinegrass have been found to be the most tolerant of shaded conditions. Centipedegrass and carpetgrass are intermediate in shade tolerance while bermudagrass is poorly adapted to shade (2, 3, and 4). Zoysiagrass is tolerant of shade but not as tolerant as St. Augustinegrass. St. Augustinegrass is one of the most commonly used turfgrasses in the South.

Information regarding shade tolerance of warm season turfgrasses would be very useful to people in the turfgrass industry. A quick and easy reference could provide turf professionals and homeowners with a valuable tool in choosing turfgrasses for shaded areas. A study was initiated to determine the relative shade tolerance of 25 St. Augustinegrasses and six other warm season turfgrasses.

Plugs of 25 cultivars of St. Augustinegrass, 4 types of zoysiagrass, common carpetgrass, and common centipedegrass were planted under a stand of spruce pine trees [*Pinus glabra* Walt.] on August 3, 1994 at the Burden Research Plantation. Light penetrating the tree canopy was estimated to be only 15% of full sun. Individual 4.25 inch diameter plugs of each turfgrass were established on a Olivier silt loam on three foot centers in a randomized complete block design with four replications. The soil pH was adjusted to approximately 6.5 with pelletized dolomitic lime and an 8-24-24 fertilizer was applied at a 2 lb P_2O_5 and K_2O/1000 ft^2 rate one week prior to planting. Plots were irrigated only to prevent wilting and soil moisture was monitored using 12 in soil tensiometers. The turfgrass plots were mowed weekly at 3.5 inches. Spread rate was measured monthly by determining the colonization of a 4 ft^2 area. At the conclusion of the study, dry weight, stolon number, and total stolon length were recorded for each plot.

Results and Discussion: The performance of these turfgrasses to natural tree shade was determined from four variables (Table 1). Shoot dry weight, percent coverage, stolon number, and total stolon length were used to rank the grasses in order of their performance under shade. The grasses were ranked in descending order for each of the four variables where one was the highest and 31 was the smallest value for each variable. For each turfgrass, their ranking for each of the variables was averaged. Smaller numbers represent greater turfgrass performance. The grasses were listed in the order of their average rank. These four variables were chosen because each of them are important in the establishment and maintenance of quality turfgrass. When turfgrass performance is mentioned here, it will be in reference to this ranking.

An experimental variety labeled 'TR 6-10' performed best under tree shade. It ranked first in dry weight, percent cover, total stolon length, and total stolon number under tree shade. It was not among the commercially available varieties listed by the USDA in 1995 (1). Of the 25 St. Augustinegrass cultivars planted under tree shade, only ten are listed by the USDA as commercially available (1). These include 'Delmar', 'Raleigh', 'Jade', 'Sunclipse', 'Seville', 'FX-261', 'Floralawn', 'FX-33', 'Floratam', and 'FX-10'. 'Mercedes' and 'Bitterblue' were listed as commercially available in 1994 by the National Turfgrass Evaluation Program (5). Of the 10 commercially available varieties, only three ranked in the top ten based on average performance ranking. They were 'Delmar' (7.3), 'Mercedes' (7.5), and 'Jade' (6.0). The remaining seven cultivars in the top ten were experimental and commercially unavailable St. Augustinegrass cultivars. The ten grasses that ranked lowest in average performance ranking included four commercially available St. Augustinegrass cultivars: 'FX-10' (27.0), 'Floratam' (25.8), 'FX-33' (23.0), and 'Floralawn' (24.0). The remaining grasses in this group included an experimental St. Augustinegrass (DALSA8401 at 22.8), centipedegrass (27.0), carpetgrass (24.8), and 'Emerald' (28.5), *Z. matrella* (29.3), and 'Meyer' (30.3) zoysiagrasses. 'Raleigh', the most commonly used St. Augustinegrass, had an average ranking of 11.3 which placed it number 12 among the 31 turfgrasses rated for shade tolerance.

'TR 6-10' was the most tolerant grass to natural tree shade in this study. It outranked all other grasses studied here for all four variables measured. The release and distribution of this variety to the landscape industry would be beneficial. Of the commercially available varieties of St. Augustinegrass, 'Delmar', 'Jade', and 'Mercedes' were the best adapted to shaded conditions. 'Raleigh' was slightly less shade tolerant than those three grasses. 'Floralawn', 'FX-33', 'Floratam', and 'FX-10' appeared to be especially intolerant of shade relative to the other St. Augustinegrass varieties and should be avoided in shaded conditions. When compared to the St. Augustinegrasses, centipedegrass and

carpetgrass were similarly intolerant of natural tree shade. 'El Toro' zoysiagrass is certainly the most shade tolerant zoysiagrass in this study but is not shade tolerant relative to most St. Augustinegrasses.

Significance to Industry: A simple ranking of warm season turfgrasses based on their relative shade tolerance could be a useful tool to turfgrass professionals and homeowners. Normally several variables are necessary to determine the performance or quality of a turfgrass. By combining these variables into one ranking, it allows a simple interpretation of a large amount of data. Combining four variables that are important components of turfgrass growth into one ranking provides information that can be quickly and easily interpreted. This method of providing simple and easy to understand information to the public could be valuable in other fields as well. A simple ranking system may be less intimidating to the public than large amounts of data on individual variables. Rankings for turfgrass tolerance to other environmental stresses would be beneficial as well.

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Table 1. Turfgrass performance under natural tree shade. Rankings for percent cover, shoot dry weight, stolon number, total stolon length, and average ranking.

Cultivar/ Species	Percent Cover	Shoot Dry Weight	Stolon Number	TotalStolon Length	Average Ranking
TR 6-10'	1	1	1	1	1.0
'S-71-770'	3	3	6	9	5.3
'Jade'	11	8	2	3	6.0
'S-6-72-2090'	5	7	5	7	6.0
'TR 6-3'	7	11	4	2	6.0
'Delmar'	4	2	10	13	7.3
'Mercedes'	8	5	7	10	7.5
'MSA-2'	12	4	9	5	7.5
'M1'	6	14	8	4	8.0
'FX-313'	9	13	3	11	9.0
'S-6-71-138'	2	15	11	8	9.0
'Raleigh'	10	9	14	12	11.3
'S-6-72-107'	13	12	15	6	11.5
'Sunclipse'	14	10	16	15	13.8
'Bitterblue'	16	6	18	16	14.0
'MSA-20'	15	18	12	18	15.8
'Seville'	17	17	17	17	17.0
'FX-261'	19	21	13	19	18.0
'El Toro' zoysiagrass	21	16	19	22	19.5
'FX-332'	18	20	20	20	19.5
'MSA-11'	20	23	21	23	21.8
'DALSA8401'	22	22	23	24	22.8
'FX-33'	24	21	22	25	23.0
'Floralawn'	23	28	24	21	24.0
carpetgrass	27	26	31	15	24.8
'Floratam'	26	24	26	27	25.8
centipedegrass	25	27	25	31	27.0
'FX-10'	28	25	27	28	27.0
'Emerald' Zoysiagrass	29	29	30	26	28.5
Zoysia matrella	30	30	28	29	29.3
'Meyer' zoysiagrass	31	31	29	30	30.3

Influence of Nitrogen and Potassium on Zoysiagrass

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Nature of Work: Zoysiagrasses are warm season turfgrasses native to China, Japan, and Southeast Asia that are adapted to the very warm humid, warm humid, warm semiarid, and transitional regions of the United States (1). They are perennial grasses and, when maintained under proper cultural and climatic conditions, form a uniform, dense, and high quality turfgrass. Zoysiagrasses are utilized as a lawn turfgrass and may be used on golf course tees and fairways, athletic fields, and parks. They have deep root systems and excellent heat and drought hardiness.

There are three species of zoysiagrass that are utilized as turfgrasses. Japanese lawngrass or Korean lawngrass (*Zoysia japonica* Steud.) has coarser leaf texture, lower shoot density, and better low temperature tolerance than the other two species. *Zoysia matrella* (L.) Merr., referred to as Manilagrass, is intermediate in leaf texture, shoot density, and low temperature tolerance. Korean velvetgrass or mascarenegrass (*Zoysia tenuifolia* Willd ex. Trin.) has the finest leaf texture, greatest shoot density, and least cold tolerance of the three. Two of the most commonly utilized cultivars of zoysiagrasses are 'Meyer' and 'Emerald'. 'Meyer' is an improved cultivar of *Z. japonica* and forms a very dense turf stand with good color and cold tolerance. 'Emerald' is a hybrid between *Z. tenuifolia* and *Z. japonica* that combines the fine leaf texture of the former with the cold tolerance of the latter and is somewhat similar in appearance to *Z. matrella* (3). Zoysiagrasses have great potential for use in the Gulf Coast states as a lawn grass (2). There has been minimal work done on the fertility response of zoysiagrass and the effect on turf color and quality. The objective of this study was to evaluate the effects of nitrogen and potassium fertility on several zoysiagrasses.

Fertility studies were initiated on established turfgrass plots of 'Emerald', 'Meyer', and *Z. matrella* in July of 1996 at the Burden Research Plantation in Baton Rouge, LA. Treatments began in July and continued through November. The treatment combinations consisted of high (H) and low (L) rates of nitrogen (N) and potassium (K) at the following levels: N levels of 454 and 227 g N/92.9 m^2/month (1.0 and 0.5 lb N/1000 ft^2/month) and K levels of 454 and 227 g N/92.9 m^2/month. The treatment combinations were (N and K): HH, HL, LH, and LL. Fertility treatments were applied in 2 split applications each month in order to provide half of the total N and K amount for each treatment at any one application. The study was a randomized complete block design with 3 replications. Individual plots were divided into four sub-plots with N applications applied in one direction and K applications applied in the perpendicular

direction. All plots received two applications of a micronutrient fertilizer (late June and August). Plots were irrigated as needed and maintained at a height of 3.8 cm (1.5 inch).

Color, density, texture, uniformity, and quality were determined visually for each month. Each of these were determined on a 1 to 9 scale as follows: a) color: 1=brown, 9=dark green; b) density: 1=lowest shoot density, 9=highest shoot density; c) texture: 1=widest leaf blades (most coarse leaf blades), 9=finest (least coarse); d) uniformity: 1= least uniform (presence of weeds, bare areas), 9=most uniform (absence of weeds, bare areas); and e) quality: 1=lowest, 9=highest. Quality takes into account color, density, and uniformity of the turf stand and provides an indication of the overall appeal of the stand (4).

Results and Discussion: There were significant differences for color, density, and quality for the following months: September (color and density); October (quality); and November (color and quality) as shown in Table 1. There were differences in leaf texture for all months (data not shown). There were no differences for uniformity for any cultivar under any treatment.

'Meyer' under the HH and HL treatments had the best turf color for September compared to 'Meyer' and *Z. matrella* under the LH and LL treatments and all 'Emerald' treatments (Table 1). By November, 'Emerald' under the HH and HL treatments had better color compared to all *Z. matrella* plots. 'Meyer' under the HH and HL treatments and 'Emerald under the LH and LL treatments had similar color to all the *Z. matrella* plots. This indicates that 'Emerald' zoysia, under the two high N rates, maintained its color longer into the fall than did *Z. matrella*.

All of these zoysiagrasses have very good to excellent shoot density. September was the only month in which any zoysiagrass under any treatment resulted in differences in density (Table 1). 'Emerald' had the highest shoot density and was different from 'Meyer' for all treatments. Generally for each month, 'Emerald' had the highest shoot density with *Z. matrella* second and 'Meyer' third, regardless of the treatment.

'Emerald', under all treatments, had the highest quality ratings for October while all treatments resulted in similar ratings for both *Z. matrella* and 'Meyer' (Table 1). In November, 'Emerald' under the HH and HL treatments resulted in the highest quality and under the LH and LL treatments had better quality than 'Meyer' under the same two treatments. The quality of 'Emerald' under the HH and HL treatments increased from October to November while the quality of *Z. matrella* remained the same. This may be attributed to the higher color ratings of 'Emerald' during November.

'Emerald' and *Z. matrella* under all treatments had higher ratings for texture than did 'Meyer' for each month (data not shown). The mean texture across all treatments was 7.2 for *Z. matrella*, 6.9 for 'Emerald', and 4.2 for 'Meyer'. This is consistent with descriptions of leaf texture for both *Z. matrella* and 'Emerald' (1 and 3). Nitrogen and K fertility resulted in little to no effect on zoysiagrass texture.

Significance to Industry: Zoysiagrass has very good potential to be utilized as a lawn grass in the Gulf Coast states including Louisiana. Once established, it forms a very dense turf, is usually weed-free, and maintains its color well into the fall even into November. Since it is very heat and drought tolerant, it survives periods of no rainfall. In contrast, it is slow to establish, availability may be a problem in some places, and it requires more cultural management than many other warm season turfgrasses.

This study indicates that all three of the zoysiagrasses that were studied provided more than adequate color and quality during the summer and early fall in southern Louisiana. The high rate of N provided better color in the fall, especially for 'Emerald' which under the HH and HL treatments resulted in the best overall color and quality. This, along with its very high density, makes it a good choice for a high quality lawn. In conclusion, all three of the zoysiagrasses would provide a high quality lawn if properly maintained but 'Emerald' resulted in a denser turf with better color and quality, especially in the fall months.

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Table 1. Visual Color, Density, and Quality Ratings for 'Emerald', *Z. matrella,* and 'Meyer' zoysiagrasses at varying N and K rates.

Cultivar	N	K	September		October	November	
			Color	Density	Quality	Color	Quality
'Emerald'	H	H	6.0 bc[1]	9.0 a	6.7 a	6.7 a	7.3 a
	H	L	5.6 bc	9.0 a	6.7 a	6.7 a	7.3 a
	L	H	5.3 bc	9.0 a	6.7 a	5.7 ab	6.3 b
	L	L	5.0 c	9.0 a	6.7 a	5.7 ab	6.3
Z. matrella	H	H	6.3ab	8.3 ab	6.0 b	5.3 b	6.0 bc
	H	L	6.3 ab	8.3 ab	6.0 b	5.3 b	6.0 bc
	L	H	5.0 c	8.3 ab	6.0 b	5.3 b	6.0 bc
	L	L	5.0 c	8.3 ab	6.0 b	5.3 b	6.0 bc
'Meyer'	H	H	7.3 a	7.6 b	6.0 b	5.7 ab	6.0 bc
	H	L	7.3 a	7.6 b	6.0 b	5.7 ab	6.0 bc
	L	H	5.3 bc	7.6 b	6.0 b	5.0 b	5.3 c
	L	L	5.3 bc	7.6 b	6.0 b	5.0 b	5.3 c
LSD			1.1	0.8	0.5	1.1	0.7

[1] Means within columns followed by the same letter are not significantly different according to LSD mean separation test, alpha = 0.05.

Effects of Container Type on Root Circling and Landscape Establishment

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Nature of Work: The type of nursery container used for producing trees can influence root morphology, and this can impact a tree's longevity once planted in the landscape. Trees grown in containers treated with SpinOut have fewer circling roots (6); whereas roots branch more when grown in containers with holes in the sides (5). Other container designs such as those with a low profile may also reduce root deformities (4). We wanted to determine if container production method influenced root growth in the container and root regeneration and shoot growth after transplanting to a landscape under two irrigation regimes.

One gallon seedling red maples were planted in February 1995 into seven types of containers: #15 black plastic, #15 black plastic coated with SpinOut, #15 low profile black plastic, #15 corrugated (with vertical ribs) aluminum air root pruning (ARPC) containers, #15 low profile ARPC, #15 wooden square box, and #15 wooden box treated with SpinOut. Trees were planted into 3450 in2 substrate (40% aged pine bark: 50% domestic peat: 10% sand) and placed 4 ft apart on ground cloth in a randomized complete block design with one replicate of each treatment in each of 30 blocks. Plants were irrigated three times each day in the warm months, less often in the cooler months, and received 85 g Osmocote 18N-2.6P-9.9K, 13 and 29 weeks after planting.

All trees from five blocks were harvested 70 weeks after planting. Roots greater than 2-mm diameter growing along the sides of the root ball (ASRB) were collected and sorted based on location in the top or bottom half of the root ball and angle of growth. Angle of root growth was classified into one of two categories: "H" - an angle < 45 degrees from the substrate surface, and "V" - an angle > 45 degrees. Roots not growing ASRB (roots inside the root ball) were cleaned, sorted by diameter and dried. Dry weight of shoots, and trunk diameter were measured at planting and at harvest.

In May 1996 trees from twenty blocks were transplanted into a well drained sand soil on 8 feet centers. Ten blocks were irrigated frequently (daily with 10 gallons for 9 weeks, every other day weeks 10-24) and ten were irrigated infrequently (weekly through week 3, every third day weeks 4-9, every 10 days weeks 10-19, then no irrigation through week 24). Irrigation was withheld from all trees in week 9 so that stem water potential could be measured under water stressed conditions.

After 24 weeks, all roots growing into landscape soil of all trees in five blocks were harvested, washed, and dried from two one-quarter circle wedge-shaped sections beginning at the edge of the root ball, one on the northeast and one on the southwest sides of the trees. Diurnal (all day) and midday xylem potential was measured with a pressure bomb (Soil Moisture Inc., Santa Barbara, CA) periodically to evaluate stress. Differences were considered significant at $p < 0.05$.

Results and Discussion: Tree height (average of all trees 9.2 feet), trunk diameter (average of all trees 1.5 inches), shoot dry weight, and total root dry weight were similar among container types at the end of the production phase of the experiment (data not shown). The black plastic and low-profile container produced more horizontal oriented roots than vertical oriented roots ASRB, and black plastic had the most horizontal oriented roots than any other production method. Black plastic and ARPC had the most vertical oriented roots ASRB. Compared to the standard black plastic container, all container types reduced circling roots equally well. The ARPC had significantly more vertical oriented roots than horizontal roots probably because the vertical ribs directed roots down.

Averaged across all container designs, root length and weight ASRB were greater in the top half of the root ball, 6.2 feet and 0.30 oz., respectively, compared to in the bottom half, 4.3 feet and 0.14 oz. In agreement with Fitzpatrick (3) ARPC had less root weight inside the root ball than all production methods except low profile black plastic.

Tree height, trunk diameter and total root growth were similar among container types after 5 months of growth in the landscape (data not shown). Averaged across all container type, frequent irrigation following transplanting increased trunk diameter (2.28 inches) and tree height (11 feet) compared to infrequent irrigation (1.85 inch trunk diameter, 8.8 feet height). Following transplanting, irrigation frequency and compass direction influenced root growth but container type did not. This contrasts with Arnold (1) who showed that 0.5 gallon liners produced in SpinOut treated containers generated more new root growth into landscape soil than trees from untreated containers. Brass et al. (2) found that one cultivar of red maple had increased new root growth one year after to landscape soil when grown in #5 copper treated containers, whereas, another cultivar showed no difference in new root growth compared to those in untreated containers. Perhaps larger, landscape-sized plant material grown in copper treated containers responds differently after transplanting than does smaller-sized material.

More roots were generated from frequently irrigated trees (3.6 oz.) than from those receiving less frequent irrigation (1.9 oz). Most new roots occurred from the sides of the root ball with few roots being recovered

from under the root ball. New root weight from sections harvested on the NE side of the tree was 3 oz. which was significantly greater than the 2.4 oz harvested from the SW side. This could have been due to the greater exposure to the sun raising the temperature above optimum in soil on the SW side of the canopy.

Significance to Industry: Averaged across irrigation frequency, there were no differences among container types in diurnal xylem potential 3 and 9 weeks after transplanting. However, infrequently irrigated trees from wooden boxes were less stressed in the middle of the day than trees from black plastic with SpinOut, low-profile black plastic, and boxes with SpinOut. Nine weeks after transplanting, low-profile ARPC were more stressed than other container types. A reduction in tree stress and an increase in trunk diameter, height and new root growth on trees frequently irrigated after transplanting points to the importance of regular irrigation to maintain rapid tree growth.

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Growth and Flowering Phenology of Six Crapemyrtle Cultivars in North Florida

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Nature of work: Long-term records of growth and flowering can help consumers, landscapers and nurserymen select cultivars based on individual cultivar characteristics as well as comparative performance. Here we report the growth and flowering phenology of six crapemyrtle cultivars, *Lagerstroemia (indica x fauriei)*. The cultivars were selected based on their growth habit, market demand, and landscape value (Knox, 1996). Grouped by size category, they are: tree Natchez, Miami; intermediate Apalachee, Sioux; and semi-dwarf Acoma, Tonto. These cultivars are amongst 77 *Lagerstroemia* taxa currently under evaluation on two planting sites located at the University of Florida's North Florida Research and Education Center in Monticello. The planting sites are approximately one-quarter mile apart. Site location and conditions were described previously (Knox and Norcini, 1991; Knox, 1996). Both sites consist of fine sand soil with low fertility and have a slightly acidic pH. The average annual rainfall is about 56 inches most of which is accumulated during the summer months. Mean high and low temperatures are 91°F (August) and 39°F (January). There are two plants per cultivar per evaluation site, and plants were generally not fertilized or pruned. Plant height and width were measured in the spring and late fall. Flowering was recorded by counting the number of panicles in which 2/3 or more of the florets were in bloom (and remaining florets were buds or senesced). Flower count was recorded weekly beginning with each cultivar's first flowering panicle and scored successively to show the progression and duration of flowering throughout the season.

Results and Discussion: *Growth.* Mean plant height and width from 1989 to 1996 are shown in Table 1. In the semi-dwarf size group, Acoma, with a horizontal growth habit and white flowers, exhibited a fivefold increase in height and a threefold increase in width during the seven-year period. Tonto, a red-flowered cultivar with an upright rounded form, increased by fourfold in height and by threefold in width, attaining almost equal height and width by 1996. Apalachee, a lavender-flowered hybrid with a dense canopy and upright growth habit, and Natchez, a tall broad tree with white flowers and a landscape favorite, exhibited a six and a half and a fivefold increase in height, respectively. Sioux, with medium pink colored flowers and a tight vase-like shape, and Miami, a dark pink flowering cultivar with an upright growth habit, both grew four and a half-fold in height.

As of 1996, plant height did not differ significantly amongst cultivars in the intermediate and tree size groups with all cultivars attaining an average height of 20 ft. (Table 2). However, height differences by size group may become evident as plants reach maturity. Plant width varied greatly among cultivars and was not closely related to size group. Sioux's comparatively narrow width of just 11.2 ft in 1996 is indicative of its columnar growth habit.

Flowering. Flowering data was collected from 1991 to 1996. Figure 1 shows weekly flowering averages over the six-year period, and clearly shows the patterns of flowering for each cultivar. In all six years, flowering started in late May to mid June and ended the last week in September. Natchez flowered earliest of these cultivars and exhibited several peaks in flowering from late May through late July. Flowering of Acoma and Tonto peaked twice (late June and mid-July), while Miami, Apalachee, and Sioux each had a single peak of flowering (late June, mid-July, and late July, repectively). Mean plant height and width, flower duration and week of maximum flowering per cultivar in 1996 are shown in Table 2. Flowering duration was shortest in Sioux and Apalachee, 10.8 weeks, and longest in Natchez, 12.8 weeks. Acoma, Tonto, and Natchez exhibited the greatest peak flowering with 262, 253 and 254 maximum (peak) flowering panicles, respectively.

Significance to Industry: Information on plant height, width and flowering can be used for the marketing of these crapemyrtle cultivars by nurserymen and landscape personnel.

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Table 1. Mean growth indices of *Lagerstroemia* cultivars from 1989 to 1996 (four plants per cultivar).

Size group	Cultivar	1989	1990	1991	1992	1993	1994	1995	1996
					Height (ft)				
Semi-dwarf	Acoma	2.2	4.4	5.6	6.8	7.0	8.2	11.1	11.6
	Tonto	3.9	5.4	8.0	8.4	9.1	10.3	13.0	15.3
Intermediate	Apalachee	3.0	5.3	8.2	10.9	11.3	14.0	16.1	19.5
	Sioux	4.4	5.7	8.6	10.5	12.3	14.1	17.9	20.0
Tree	Natchez	4.2	7.7	10.7	12.0	12.7	16.2	18.3	20.2
	Miami	4.5	7.0	10.3	11.8	13.8	15.5	18.3	20.7
					Width (ft)				
Semi-dwarf	Acoma	6.5	8.3	10.5	12.0	13.8	14.4	16.0	17.5
	Tonto	5.3	7.0	9.0	9.5	11.8	12.0	14.0	15.4
Intermediate	Apalachee	3.6	5.1	7.2	11.3	11.7	13.6	15.4	18.9
	Sioux	3.6	4.8	7.0	8.2	8.9	9.5	10.6	11.2
Tree	Natchez	7.0	8.7	11.8	13.6	16.4	17.7	23.8	24.9
	Miami	4.8	6.5	8.6	11.1	13.2	12.6	16.4	16.5

Table 2. Mean plant height and width, flower duration, and maximum flowering of six *Lagerstroemia* cultivars in 1996.

Size Group	Cultivar	Heigh (ft)	tWidth (ft)	Duration of flowering (weeks)	Maximum flowers Panicles/ week	Date
Semi-dwarf	Acoma	11.6_{c} [z]	17.5_{bc} [z]	12.0	262	July 29
	Tonto	15.3_{b}	15.4_{c}	11.0	253	July 22
Intermediate	Apalachee	19.5_{a}	18.9_{b}	10.8	119	July 29
	Sioux	19.9_{a}	11.2_{d}	10.8	134	July 29
Tree	Natchez	20.2_{a}	24.9_{a}	12.8	254	July 08
	Miami	20.7_{a}	16.5_{c}	11.0	174	July 01

[z] Mean separation by Duncan's Multiple Range Test, alpha = 0.05; n = 4.

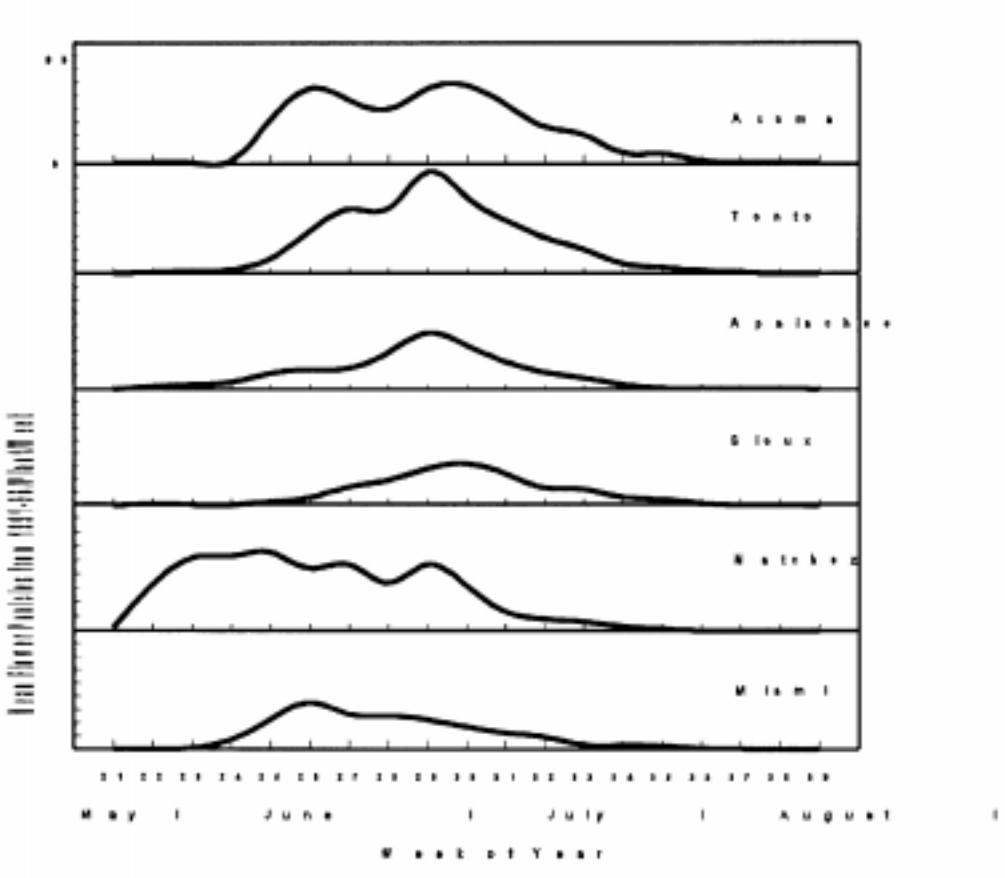

Figure 1. Comparison of seasonal flowering for six crapemyrtle cultivars averaged over 1991 through 1996.

Biostimulants and Summer Transplant Stress of Landscape Trees

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Nature of Work: Biostimulants are humate-based products which have been described as "non- nutritional products that may reduce fertilizer use and increase yield and resistence to water and temperature stress" (7). Although biostimulants have been shown to increase growth in some species (5,6,8), other researchers have reported no growth increase (1,2,4). Summer transplanting of field-grown landscape trees often results in severe transplant shock since canopies are fully developed and root systems are much reduced. The objective of this research was to test the effectiveness of biostimulant application on reduction of transplant stress of summer-transplanted landscape trees.

We tested the effectiveness of a biostimulant (Bio-Plex®, Turf Chemicals Plus, Inc., Manheim, Penn.) in two experiments. This product is a mixture of humic acid, seaweed extracts, vitamins, hormones, and micronutrients. In experiment one, we used *Acer rubrum* (red maple) and *Acer X freemanii* (Freeman maple). Average height and caliper were 16.2 feet and 2.8 inches, respectively, for Freeman maple and 14.1 feet and 2.9 inches, respectively, for red maple. All trees were in established nursery rows in a Groseclose silt loam soil (pH = 6.2), and were six feet apart within rows which were 12 feet apart. Treatments (biostimulant or no biostimulant) were assigned to both species as a randomized complete block with one replication per block. Each replication consisted of two adjacent trees (two subsamples per replication). Treatments were at least 12 feet apart. There were four blocks of Freeman maple and three blocks of red maple, and each species was analyzed separately. Treatments were applied on 23 July 1996. The biostimulant was applied as a root zone soak (2 oz. in 10 gal. water) with a container that wraps around the tree and delivers water to the root zone at approximately 2 gal. per hour (Tree Collars®, Turf Chemicals Plus, Inc., Manheim, Penn.) and sprayed on foliage to runoff. Control trees were soaked and sprayed with water only. All trees were dug with a 36-inch diameter rootball with a tree spade (Vermeer Manufacturing Co., Pella, Ia.), lifted so as to sever all roots, and placed back in the original position on 25 July. Pre-dawn water potentials were taken periodically with a pressure bomb (Soilmoisture Equip. Corp., Santa Barbara, Calif.), and leaf conductance was measured with a null balance porometer (LI-1600, LICOR, Lincoln, Neb.). Height and caliper were taken again one year later on 19 July 1997.

In experiment two, similar treatments (6 replications of each treatment) were assigned to another block of red maple (mean height = 5.0 feet; caliper = 0.9 inch) in a completely random design on 21 August 1996. The biostimulant was applied as 1 oz. biostimulant in 5 gal. water. All trees were hand dug with a 13-inch rootball on 22 August and left exposed until transplanted on 5 September 1996. Rootballs were watered on 30 August 1996. Pre-dawn water potentials and leaf conductance were measured periodically. All trees were dug on 25 - 28 October, and all roots outside of the original rootball were collected for root length analysis (Delta-T SCAN, Delt-T Devices, Cambridge, England).

Results and Discussion: *Experiment one.* One year after treatment, red maple grew an average of 0.4 and 0.6 feet in height and 0.07 and 0.05 inches in caliper for biostimulant-treated trees and controls, respectively. Differences were insignificant for both height growth ($p>F=0.34$) and caliper growth ($p>F=0.63$). Freeman maple grew an average of 0.4 and 0.9 feet in height and 0.1 and 0.07 inches in caliper for biostimulant-treated trees and controls, respectively. Although caliper growth was statistically similar ($p>F=0.44$), controls grew more in height than biostimulant-treated trees ($p>F=0.033$). Pre-dawn water potential data for both species showed a typical pattern of low stress before transplanting (on 7/24), an increased stress immediately after transplanting (on 7/26) and a subsequent return to pre-transplant levels in subsequent measurements (on 7/29 and 8/05) (data not shown). No statistical differences existed between treatments for any date for either species for water potential. Maximum stress levels attained (-0.15 MPa) were relatively benign compared to severely stressed trees (3), indicating that trees from both treatments were able to ameliorate water stress during the night. Leaf conductance, measured in early afternoon, indicated low conductances for both species immediately after transplanting (on 7/26) and on the 8/06 measurement (data not shown). No differences were apparent between treatments for either species or measurement date.

Experiment two. Pre-dawn water potentials indicated a typical low water stress immediately before transplanting (on 8/22), with much increased stress immediately after (on 8/23) and four days after transplanting (on 8/26) (data not shown). A lack of return to pre-transplant levels as was seen in experiment one may be due to the exposure of the rootballs after digging or the fact that a larger-than-standard rootball was used in experiment one (36-inch actual vs. 30-inch standard). No differences were apparent between treatments for any measurement date. Leaf conductance was low for all dates measured, although data were similar for treatments and not-dug trees on the 8/26 and 8/28 dates (light levels were relatively low on these days) (data not shown). Leaf conductance for treatments were statistically lower than for not-dug trees on the 8/29

and 9/15 measurement dates. Total new root length averaged 258 feet for controls and 120 feet for biostimulant-treated trees. A statistical difference did not exist (p>F=0.24).

Significance to the industry: Under the conditions of these experiments, we found no evidence of a benefit to the application of the biostimulant as an aid to summer transplanting of red or Freeman maple. However, these species are relatively easy to transplant. This was evident from the fact that no appreciable flagging or leaf drop occurred in experiment one, possibly aided by unusually good transplanting weather (relatively cool and cloudy). Sound horticultural practices, such as the thorough rootball soak, are always desirable. In experiment two, wilting and leaf drop occurred, but recovery was sufficient to result in considerable new root growth just two months after harvest. Different results may have been obtained for more difficult-to-transplant species.

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Use of trade names does not imply endorsement or criticism of the products named or similar ones not named.