Landscape

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Ornamental Grass Growth Responses Under Three Shade Intensities

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Index Words: *Briza media*, *Chasmanthium latifolium*, Dwarf Fountain Grass, *Imperata cylindrica*, Japanese Bloodgrass, *Liriope muscari*, Monkeygrass, *Pennisetum alopecuroides*, Perennial Quaking Grass, River Oats

Nature of Work: Growth of perennial quaking grass (*Briza media* L.), 'Red Baron' Japanese bloodgrass (*Imperata cylindrica* (L.) Beauv.), river oats (*Chasmanthium latifolium* (Michx.) Yates), 'Hameln' dwarf fountaingrass (*Pennisetum alopecuroides* (L.) Spreng.), and 'Big Blue' monkeygrass (*Lirope muscari* (Decne.) L.H. Bail.) in 0%, 30%, or 60% shade was compared in container and in-ground experiments conducted over two growing seasons.

Liners of five ornamental grasses, perennial quaking grass, 'Red Baron' Japanese bloodgrass, river oats, 'Hameln' dwarf fountaingrass and 'Big Blue' monkeygrass, were planted in containers and in the ground on June 18, 1997. The container grown plants were potted in 11.4 liter (3 gal) containers with a 3 pine bark: 1 peat: 1 sand medium (by volume) amended with 2.0 kg m^{-3} (3.3 lb yd^{-3}) 17N-3P-10K slow release fertilizer, 0.2 kg m^{-3} (0.4 lb yd^{-3}) Micromax, and 0.7 kg m^{-3} (1.1 lb yd^{-3}) dolomite. Plants were spaced on 0.61 m (2 ft) centers. The plants were grown in 0, 30, and 60% shade with maximum photosynthetically active radiation (PAR) at plant height of 1443, 1030, and 617 (mol.m^{-2}·s^{-1}. The shade treatments were created by using woven shade cloth on hoop house frames.

Plant height and width were measured at planting and just prior to dormancy. Height was measured from the medium or soil surface to the highest apparent canopy point while width was measured at crown level for the bunch type species and at ground level for the stoloniferous species. Roots and shoots of the container plants and shoots of the in-ground plants were harvested after the plants were dormant. Harvested shoots of all plants and washed roots from container plants were dried at 65OC for 7 days then weighed. Root to shoot ratio was determined by the equation: (root dry weight/shoot dry weight).

In 1998 the experiment was repeated as previously described except that the grasses were planted on 10 May 1998 and all plants were harvested just prior to dormancy. Maximum PAR at plant height was 1598, 1034, and 658 ($mol \cdot m^{-2} \cdot s^{-1}$ for the 0%, 30%, and 60% shade treatments, respectively.

Statistics. The experimental design each year was a completely random design. Analysis of variance procedures (GLM) and trend analysis by species were performed on all data using SAS Statistical Software (5).

Results and Discussion: In 1998, height of container grown perennial quaking grass, 'Hameln' dwarf fountaingrass and 'Big Blue' monkeygrass increased linearly with increasing shade intensity, while river oats had a quadratic relationship between height and shade intensity. There was a quadratic relationship for perennial quaking grass and river oats but a decreasing linear relationship for 'Big Blue' monkeygrass between height and shade intensity for plants that were planted in the ground in June 1997 and harvested five months later. There was an increasing quadratic relationship between height and shade intensity for in-ground 'Hameln' dwarf fountaingrass harvested 17 months after a June 1997 planting date. We found shade treatments did not affect height of in-ground plants that were planted and harvested in 1998. Plant height is generally assumed to increase with increased shade until production of photosynthates is limited (1, 3, 4,). Our trends toward quadratic relationships or negative linear relationships between height and shade intensity for some species planted in 1997 might, therefore, be attributed to limited photosynthates due to the increased shade.

Our results found that the width of 'Hameln' dwarf fountaingrass , a C_4 species, decreased with shade intensity. In contrast, 'Red Baron' Japanese bloodgrass, another C_4 species, was wider with increased shade intensity. Our C_3 species, perennial quaking grass, river oats and 'Big Blue' monkeygrass, in containers generally increased in width with increased shade, but few differences in plant width occurred for these species grown in the ground. Width of perennial quaking grass in containers increased linearly while width of 'Hameln' dwarf fountaingrass decreased linearly with increasing shade intensity in 1997. In 1998, container grown perennial quaking grass and 'Big Blue' monkeygrass width had a quadratic response to increasing shade intensity. In contrast, 'Red Baron' Japanese bloodgrass had a positive linear relationship while 'Hameln' dwarf fountaingrass had a negative linear relationship between plant width and shade intensity in 1998 when grown in containers. Plant width increased linearly for in-ground perennial quaking grass but decreased linearly for 'Hameln' dwarf fountaingrass with shade intensity for plants planted in June of 1997 and harvested five months

later. In contrast, 'Hameln' dwarf fountaingrass planted in the ground in June of 1997 and harvested 17 months after planting had a quadratic relationship between width and shade intensity. There were no differences in plant height or width among the various shade treatments for any species planted in May of 1998 and harvested five months later.

There were differences in our study, with a quadratic relationship between shoot dry weight and shade intensity for 'Hameln' dwarf fountaingrass and 'Big Blue' monkeygrass grown in containers in 1997, while container grown 'Hameln' dwarf fountaingrass shoot dry weight increased linearly in 1998. There was a general decrease in shoot dry weight with increased shade intensity for in-ground plants. In 1997, shoot weight of container grown perennial quaking grass increased quadratically with increasing shade intensity. There was a quadratic relationship between shoot dry weight and shade intensity for container grown 'Hameln' dwarf fountaingrass and 'Big Blue' monkeygrass in 1997, while in 1998, shoot dry weight of perennial quaking grass and 'Hameln' dwarf fountaingrass increased linearly with shade intensity. Shoot dry weight of in-ground perennial quaking grass harvested five months after being planted in June 1997 decreased quadratically with increasing shade intensity. Shoot dry weight of in-ground river oats decreased quadratically with increasing shade intensity regardless of planting and harvest dates. The in-ground 'Hameln' dwarf fountaingrass shoot dry weight decreased linearly with increased shade intensity for the harvest five months after planting in 1997, but 'Hameln' dwarf fountaingrass shoot dry weight decreased quadratically with increased shade intensity for the harvest five months after planting in 1998. Shoot dry weight of 'Big Blue' monkeygrass decreased linearly with increased shade intensity for harvests five months after planting in 1997 and 1998 in the ground.

There was a quadratic relationship between root dry weight and shade intensity for container grown perennial quaking grass, 'Hameln' dwarf fountaingrass and 'Big Blue' monkeygrass in 1997 and 1998 and for 'Hameln' dwarf fountaingrass in 1997. Root dry weight of perennial quaking grass and river oats increased linearly in 1998 with increased shade intensity. The 1998 container planting of perennial quaking grass and 'Hameln' dwarf fountaingrass had a quadratic response to shade for R/S ratio while the 1997 container grown river oats and 'Big Blue' monkeygrass R/S ratio had a negative linear response to shade. Conversely, the 1998 container grown 'Big Blue' monkeygrass had a positive linear response to shade for R/S ratio.

Significance to Industry: Turfgrass growth responses to shade have been shown to include decreased shoot dry weight, root and rhizome growth, R/S ratio, horizontal growth habit and increased plant height (2).

The response of the ornamental species in our study did not always correspond to the general findings for turfgrass species. Also, species with the same photosynthetic pathway did not always respond to shade in the same way. Growth responses of the species in this study may have been influenced by temperature and other environmental factors in addition to shade intensity. None of the ornamental grasses investigated should be eliminated for use in high shade environments without further investigation.

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Evaluation of Flower Color and Taste to Control Feeding Damage by White-tailed Deer

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Index Words: Impatiens, Putrescent Egg Solids, Repellent, Thiram, Deer Away

Nature of Work: Feeding damage by white-tailed deer to ornamental plants is a problem for nurserymen and landscape professionals in the Southeastern United States. Possible strategies to control deer are fences, scare tactics (noise, human and predator scents, etc.), and in some cases harvesting. Fences are costly and may be obtrusive additions to landscape situations. Scare tactics work only temporarily as deer become accustomed to the nuisance. Shooting is often an unacceptable alternative outside the legal hunting season and in urban and suburban environments. Chemical repellency is one of the most selective and cost effective approaches to preventing deer feeding damage on ornamental plants.

Most strategies for controlling white-tailed deer feeding damage to horticultural commodities (ornamentals and vegetables) are based on repulsion of the animal through its senses of smell, taste, and volmolfaction (a combination of taste and smell enabled by the volmolfactory gland). Deer may refuse a plant based on taste, smell, or post-ingestional side effects. Deer are known to have marked preferences for certain plant species, and lists of plant species based on deer-feeding preference are available (9). Little information, however, is available concerning deer feeding preference on the basis of color.

Several products containing thiram (a fungicide also marketed as Deer and Rabbit Repellent), garlic, putrescent egg solids, or capsaicin (pepper spray) have been shown to have deer repellent properties (1,2,3,4) and are components of several commercial products. While these products do provide some level of repellency, the protection provided by putrescent egg solids is the most promising based on efficacy and duration (7,8).

The objectives of this study were to further evaluate the efficacy of a spray containing putrescent whole egg solids as a deer feeding deterrent, and to gain a better understanding of deer feeding preference on the basis of flower color.

The study was conducted at the Auburn University Deer Research Facility. The study pen was approximately 1 acre (0.5 ha). Pine trees inside the enclosure provided approximately 60% shade. Seven deer were contained within the pen. No green vegetation was available to the deer other than that provided in the study. Water and a balanced pelleted ration were available as needed. Impatiens (Impatiens wallerana L.) were grown off site in trade gallon (2.8 L) pots. Flower color was measured with a CM-2002 Spectrophotometer (Minolta). Readings were taken using the CIELAB System of measurement (5). Deer Away® (Woodstream Corporation, PA) putrescent egg spray was applied foliarly to plants prior to placement in the pen. After being sprayed, pots were individually staked with a metal hook within the pen to prevent movement and spillage. Plants were watered daily. Pots were placed randomly inside the pen and clearly labeled according to treatment.

Flower color of impatiens was divided into 5 subjective groups: white, pink, purple, orange, and red. Three measurements were taken for each color group: L*, a*, and b*. The measure of L* relates to the scale from black to white (100 = white, 0 = black). Measurement a* covers the spectrum from green to red. A negative value for a* is more green and a more positive a* value is more red. Measurement b* covers the spectrum from blue to yellow. A negative b* is more blue and a more positive b* value is more yellow.

Feeding damage on each plant was rated daily for 7 days. A 0 - 3 rating scale was established to determine damage on impatiens (0 = no damage; 1 = 1/3 plant removed; 2 = 2/3 plant removed; 3 = plant removed to the pot line or uprooted). All feeding damage data were transformed into percent destruction (0% = no damage; 100% = plant cut at pot line or uprooted). Damage ratings were analyzed using analysis of variance (ANOVA) and means were compared using Duncan's Multiple Range Test at the 5% level (6).

Results and Discussion: There was no significant interaction between flower color and the egg-based treatment. There was a significant ($p<0.05$) difference between feeding damage on impatiens treated with putrescent egg spray versus the untreated control. Putrescent whole egg solids make for an especially effective repellent since precipitation was recorded 3 out of 7 days of the study (Table 1). No feeding damage was observed on the treated plants until Day 4, at which point the control plants were 56% destroyed. Feeding damage increased to only 19% by Day 6 possibly due to a lack of untreated plants (92% were destroyed). Although color may show an effect on feeding preference for some species, there was no significant effect of color on deer feeding preference for impatiens.

Significance to Industry: Feeding damage by white-tailed deer is of serious concern not only for growers, landscape professionals, nurserymen, and homeowners in Alabama, but also across the United States. With an estimated 25 million deer in the nation, deer feeding damage is far from being an isolated problem. With an increasing understanding of deer feeding preferences and the promise of new active ingredients such as putrescent egg solids, feeding damage by white-tailed deer may be reduced.

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Table 1. Feeding damage (%) to impatiens by white-tailed deer. Numbers followed by different letters indicate a significant difference ($p<0.05$) according to Duncan's Multiple Range Test.

Treatment	Control	Egg Spray
Day 1	11a	0b
Day 2	20a	0b
Day 3	32a	0b
Day 4	56a	9b
Day 5	84a	9b
Day 6	92a	19b
Day 7	92a	24b

Best Management Practices of Alabama Master Gardeners

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Index Words: Master Gardener, Best Management Practices

Nature of Work: Master Gardeners are delegates for extension agents to teach the general public improved gardening techniques. Their influence in the community can be significant because 650 new Master Gardeners are trained each year in Alabama. Landscape Best Management Practices (BMP's) are not currently part of the curriculum. This is alarming because many current landscape management practices are detrimental to ground and surface water resources. The objective of this survey was to determine if there is a difference in the level of awareness concerning landscape management practices and their influence on nonpoint source (NPS) pollution.

In September of 1998, 1,912 questionnaires were sent to Alabama homeowners with an interest in gardening (1,100 surveys sent to Birmingham, 812 surveys sent to Mobile). Homeowners were asked about their demographics (age, sex, education, marital status, and race), current landscape management practices and interests. Questions regarding landscape management practices were grouped in areas of fertilizer and pesticide applications, irrigation, composting, plant placement, and other practices. In January of 1999, the same questionnaire was given to Master Gardeners while attending a scheduled Master Gardener class. Our basic assumption is the current Master Gardener curriculum sufficiently prepares Master Gardeners for making landscape recommendations consistent with landscape BMP's.

Results and Discussion: These one hundred forty-four questionnaires were to be returned via their respective county agents. Alabama Master Gardeners surveyed completed and returned questionnaires for a 100% response rate (n=144). Six hundred sixty-seven homeowner questionnaires were returned to the Auburn University Horticulture Department in January of 1999 representing a 35% response rate.

A chi-square test was used to validate statistical significance at a confidence interval of .05. If the chi-square probability was below .05, the relationship between level of garden knowledge and respondent was considered inconsistent. Questions answered consistantly by the sample

poplutations of gardeners were considered significant. Fertilizer type and frequency of fertilizer applications, irrigation practices and pesticide uses and reasons for spraying were evaluated using two-way frequencies in a chi-square table.

Several of the valid responses of home and Master Gardeners were practice related. A higher percentage of home gardeners indicated that had had a soil test with in the past five years and composted yard and garden waste. While almost 25% less master gardeners indicated participating in such practices

The evidence of similar landscape management practices involving both homeowners and Master Gardeners suggests two possible conclusions. First, the horticultural education among homeowners is thorough, and Master Gardeners and homeowners are equally as knowledgeable about landscape management practices. Secondly, Master Gardeners have not been adequately trained in landscape management practices with respect to minimizing contribution to NPS pollution. This was surprising because Master Gardener's are thought to have superior horticultural education compared to Alabama homeowners.

Further investigation will clarify weak points of the Alabama Master Gardener Program's education. We hope that through this research it will become clear that landscape BMP guidelines should be developed and implemented as part of the Master Gardener program. Addressing these weaknesses will equip Master Gardeners with sufficient knowledge to properly advise gardeners to manage the home yard and garden with as little impact on the environment as possible.

Significance to Industry: According to Alabama Cooperative Extension System, at least 2,900 potential clientele are Master Gardeners and each year the program reaches at least 30,000 homeowners potentially creating a more environmentally friendly public. Their knowledge has potential far-reaching influence on their fellow consumer. So, it is important that Master Gardeners have a higher understanding of environmentally sound landscape practices. Landscape Best management practices must be included in the Master Gardener curriculum.

The green industry has an opportunity to raise the consumer awareness and promote environmental stewardship through their landscape management practices. Landscape professionals could investigate similar ways to educate the general public. In particular, further and improved public awareness of environmental issues will all help facilitate improvement and integrity in future landscape management practices.

The Nursery Industry and Invasive Plants

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Index Words: Invasive, Pest Plant, Exotic Plant, Noxious Weed

Nature of Work: The nursery industry relies on the ability to propagate, sell, and plant exotic plants. Several Exotic Pest Plant Councils have formed in the Southeastern United States. These councils and the Department of Agriculture both have noxious weed lists or invasive exotic plant lists. Many of these lists affect the horticulture industry as they contain plants commonly used in the trade.

Results and Discussion: The horticulture industry is built on exotic plants. Using species from all over the planet we are able to grow and select from a wide array of plants to create landscapes rich with interest and diversity. Staples in the trade such as Japanese Maple [*Acer palmatum* (Thunb.)], Bradford Pear [*Pyrus calleryana* 'Bradford'(Decne.)], Japanese Barberry [*Berberis thunbergii* (DC.)], and Meserve Hybrid Hollies [*Ilex x meserveae* (S.Y. Hu)] are all of foreign origin. In addition, a strong niche market is based on the ability to import and introduce exciting, new plants. Many mail order nurseries operate on providing the next "must have" plant.

A glance into many of our natural areas demonstrates that a few species can cause problems down the road. Cultivated plants such as Purple Loosestrife [*Lythrum salicaria* (L.)], English Ivy [*Hedera helix* (L.)], Chinese Privet [*Ligustrum sinense* (Lour.)], and Japanese Honeysuckle [*Lonicera japonica* (Thunb.)], have popped up in natural areas to the attention of many conservation groups, exotic pest councils, and state governments.

The debate has escalated to the national level with the signing of the Invasive Species Executive Order in February. The Executive Order created the Invasive Species Council and armed the Council with 29 million dollars and 18 months to develop a management plan to minimize the economic, ecological, and human health impacts of invasive species (3). This throws the nurseryman, the landscape designer, and the retail garden center manager deeper into the issue as each of these industry segments could be affected, depending on what plants are identified as invasive. Councils are also playing a part on a state and regional level. Tennessee, Florida, California, and the Pacific Northwest have Exotic

Pest Councils. A Southeast Exotic Pest Plant Council was just created and Kentucky is forming a chapter from that group. In addition, some local groups have proposed or enacted laws restricting exotic plants in landscapes (5).

Written guidelines or restrictions mean definitions. What is a native plant? That question has appeared in class lectures, trade journals, industry conferences and still there is no agreed upon definition. Why? because "native and "exotic" are not indisputable facts, but rather, are opinions sometimes built on scientific findings and sometimes built on emotion. Is a plant native if it is documented to exist in America after the Pleistocene Ice Age? or before the year 1492? or when the first boat carrying Colonist families landed? At best "native" or "exotic" is a distinction, a definition that people assign a plant based on how they interpret some portion of the history of that species.

While native and exotic are arbitrary, invasive is very definable. As stated in the Executive Order "an invasive species means an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health" (3). As far as defining economic harm, purple loosestrife [*Lythrum salicaria* (L.)] is now reported to cost $45 million a year in control and lost forages (1). Florida spends a reported $14.5 million a year controlling Hydrilla [*Hydrilla verticillata* (L. f.)] (4).

No doubt there are invasive species causing disruption to plant and animal communities. The danger to the horticulture industry lies in misinformation, lack of information, and labeling plants as invasive without evaluation and documentation of the problem. Some widely used landscape plants, commonly grown and sold in the trade, are making the "Most Unwanted Lists". Listed as a Severe Threat in one Southeastern state are Wintercreeper Euonymus, [*Euonymus fortunei* (Turcz.)], Autumn Olive [*Elaeagnus umbellata* (Thunb.)], Chinese Privet [*Ligustrum sinense* (Lour.)], and Japanese Honeysuckle [*Lonicera japonica* (Thunb.)]. All of these species are in the 1998-99 Nursery Buyers Guide for that state. Listed as a Significant Threat in that same Southeastern state are: Japanese Barberry [*Berberis thunbergii* (DC.)], Burning Bush [*Euonymus alatus* (Thunb.)], English Ivy [*Hedera helix* (L.)], Winter Honeysuckle, [*Lonicera fragrantissima* (Lindl. & Paxt.)], Maidenhair Grass [*Miscanthus sinensis* (Anderss.)], Japanese Spirea [*Spirea japonica* (L. f.)], Large Periwinkle [*Vinca major* (L.)], Common Periwinkle [*Vinca minor* (L.)], Japanese Wisteria [*Wisteria floribunda* (Willd.)], and Chinese Wisteria [*Wisteria sinensis* (Sims)]. These are economically important and widely sold plants in the trade.

Complicating the situation for nurserymen, some plants may have invasive characteristics for the same reasons that they are popular in the trade. They may bear seed early and heavily, have no special germination requirements, have long flowering and fruiting periods, grow quickly, and be adaptable to a variety of soils and climates (2).

Many might argue that these plants only take advantage of disturbed areas, they simply take advantage of an ecosystem already disrupted. Will this matter? Much of our land is disturbed by urban encroachment, erosion, mining, and farming. The acres that these invasive plants are documented to cover and the millions spent on controlling them will matter to decision makers. The fact that plants widely accepted as invaders, such as Japanese Honeysuckle [*Lonicera japonica* (Thunb.)], are still being propagated and sold may compound the problem. Purple Loosestrife [*Lythrum salicaria* (L.)] is still being sold in some states although it affects many states represented in this conference and has received much negative publicity.

What is the nurseryman's role in the invasive, exotic issue?
1. Do nothing. Wait for some other group to make a decision that affects your business. The Executive Order signed by President Clinton shows the level of attention this topic is receiving. Potentially the horticulture industry could be left trying to do business without a core group of plants.
2. Be proactive. Learn about the plants that are causing problems in your area. Collaborate with researchers to find out which species are the serious invaders and why. Is the favored cultivar or the species causing the problem? Could breeding work make a difference?

The horticulture trade needs to be recognized as a significant business community to decision makers. Be active in your state, regional, and national associations so that the industry will have a strong voice about these issues. Through these associations you can educate your decision makers, as well as convey concerns to them.

The horticulture industry can be a part of the solution. The nurseryman, the retailer, the landscape maintenance crew should know the signs of a potentially invasive plant. Be observant in your fields, in display gardens, and on maintenance calls. Be aware that what makes a plant cheap to propagate may make it a strong invader. When evaluating plants look closely at those plants that are prolific and precocious seeders. Carefully select for heavy fruit bearers. Educate your customers on the reasons for choosing not to carry invasive species and offer better alternatives.

Significance to the Industry: The horticulture trade is dependent on the ability to propagate and sell plants. Many plants important to the

trade are being designated as invasive. The industry must recognize and act on the invasive plant issue to preserve not only natural ecosystems, but also, the industry's ability to introduce, propagate, and sell plants that are economically important to the trade.

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Landscape Performance of Coleus Cultivars - 1998

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Index Words: Coleus, Landscape Performance

Nature of Work: The LSU Agricultural Center has been actively involved in landscape plant performance trials over the last several years. In 1998, six-inch pots of twenty-six coleus cultivars were planted in late April at Burden Research Plantation in Baton Rouge in raised beds. Plantings were located in full sun and irrigation was provided on an as-needed basis through a drip line equipped with spray emitters. Plants were fertilized with 2 lbs N/1000 ft^2 of StaGreen Nursery Special 12-6-6 immediately after planting.

Plants were evaluated for flowering (flower spike rating) twice monthly from May through August. The measurements were based on the percentage of terminals with flowers and the measurements were averaged to determine a monthly and yearly mean. Flower spikes were removed by pinching after the June evaluation. Visual quality ratings were also determined twice monthly using a scale from 1 to 10 where 1= worst, 10=best. Included in this rating was growth habit, foliage color/ appeal, and flower spike performance.

Results and Discussion: Sun scald was significant in 1998, and previous years, on many of the lighter foliage-colored cultivars (data not shown). These included Swiss Sunshine, Grasshopper, Pineapple, Amazon, Spectrum, and Alabama.

Coleus had year-average flower spike percentages varying from 0-50%. The most flower spikes (undesirable for coleus) were observed on Grasshopper, Red Velvet, Solar Eclipse, Mardi Gras, Saturn and Thumbelina. The fewest flower spike (<10%) were found on Ducks Foot Purple, Swiss Sunshine, Spectrum, Solar Sunrise, Solar Spectrum, Solar Shadow, Solar Furnace, Sunset, New Orleans Red (Red Ruffle), and Ducks Foot Red.

Coleus had year-average visual quality ratings ranging from 4.3-8.0. Superior cultivars (>7.0) were Ducks Foot Red, Swiss Sunshine, Plum Parfait, Burgundy Sun, Solar Set, Solar Flare, New Orleans Red (Red Ruffle), Solar Shadow, Solar Furnace, Solar Sunrise, and Solar Spectrum. New Orleans Red (Red Ruffle) has been promoted in Louisiana as

a 'Louisiana Select' plant. Plum Parfait and Burgundy Sun have previously been recommended and actively promoted by the Texas Agricultural Extension Service for superior performance.

Significance to Industry: Coleus cultivar availability has greatly expanded the last several years and LSU Agricultural Center efforts have identified superior performers for recommendation and promotion to landscapers, retailers, and the gardening public.

Table 1. Flower spike percentage of coleus cultivars during 1998

Cultivar	May	June	July	August	Year Average
Ducks Foot Red	10	15	0	0	6
Ducks Foot Purple	0	0	0	0	0
Swiss Sunshine	0	0	0	0	0
Grasshopper	50	38	25	15	32
Red Velvet	50	40	40	25	39
Spectrum	0	0	0	0	0
Plum Parfait	0	0	10	30	10
Pineapple	0	0	0	15	4
Burgundy Sun	0	30	35	45	28
Solar Set	0	10	25	40	19
Solar Flare	0	0	50	55	26
Solar Eclipse	0	12	40	70	31
Mardi Gras	25	50	75	50	50
New Orleans Red	0	0	0	10	3
Brandi	0	30	35	45	28
Amazon	0	0	40	35	19
Dipt' n' Wine	0	0	50	40	23
Sunset	0	0	15	20	9
Scorpio	0	15	30	35	20
Saturn	0	25	70	50	36
Alabama	0	20	15	15	13
Solar Shadow	0	0	0	10	3
Solar Furnace	0	0	15	20	9
Solar Sunrise	0	0	0	0	0
Thumbelina	0	30	50	70	38
Solar Spectrum	0	0	10	20	8

Table 2. Visual quality ratings of coleus cultivars during 1998

Cultivar	May	June	July	August	Year Average
Ducks Foot Red	6.0	8.0	8.0	8.0	7.5
Ducks Foot Purple	5.0	7.0	7.0	7.0	6.5
Swiss Sunshine	5.0	9.0	7.5	6.5	7.0
Grasshopper	5.0	7.0	7.0	6.0	6.3
Red Velvet	5.0	6.5	6.5	5.0	5.8
Spectrum	5.0	5.5	6.5	7.0	6.0
Plum Parfait	7.0	8.0	7.0	6.0	7.0
Pineapple	6.0	6.0	5.5	3.5	5.3
Burgundy Sun	8.0	7.5	7.0	6.0	7.1
Solar Set	7.0	8.0	7.0	6.5	7.1
Solar Flare	9.0	8.0	6.5	5.5	7.3
Solar Eclipse	6.0	8.0	7.0	5.5	6.6
Mardi Gras	7.0	7.0	5.5	3.0	5.6
New Orleans Red	8.0	8.0	7.0	6.5	7.4
Brandi	8.0	7.0	5.5	4.0	6.1
Amazon	6.0	8.0	6.0	4.0	6.0
Dipt' n' Wine	6.0	6.5	5.5	4.5	5.6
Sunset	6.0	7.5	5.0	2.5	5.3
Scorpio	6.0	6.5	5.5	2.5	5.1
Saturn	7.0	7.0	5.5	4.5	6.0
Alabama	7.0	6.5	4.0	2.5	5.0
Solar Shadow	7.0	7.0	9.0	9.0	8.0
Solar Furnace	7.0	6.5	7.5	7.5	7.1
Solar Sunrise	7.0	7.0	9.0	9.0	8.0
Thumbelina	5.0	5.0	5.0	4.0	4.3
Solar Spectrum	7.0	7.5	7.0	7.5	7.3

Landscape Performance of Perennial Verbena Cultivars - 1998

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Index Words: Verbena

Nature of Work: The LSU Agricultural Center has been actively involved in landscape plant performance trials over the last several years. Perennial verbenas growing in 4" pots were transplanted on April 22, 1998 into raised landscape beds at Burden Research Plantation in Baton Rouge. Plants were spaced on 2'x 2' centers and arranged in a randomized complete block design by cultivar with six plants/cultivar. Beds were located in full sun and plants were irrigated as needed throughout the growing season. Fertilizer (StaGreen Nursery Special l 2-6-6) was applied by broadcasting 1.S Ibs N/1000 ft^2 on May 1 and 1.0 Ibs N/1000 ft^2 on July 25. Plants were deadheaded after the evaluation in July. Cultivars evaluated included Homestead Purple, Snowflurry, Blue Princess, IJpright Pink, Taylortown Red, Rose King, Aunt Bert, Tiger Rose and the Temari and Tapien series.

Flowering percentage, expressed as a visual estimate of the percentage of the plant covered by open blossom, was determined twice monthly from May through September. These measurements were averaged to determine a monthly and yearly mean. Visual quality ratings were also determined twice monthly using a scale from 1 to 10 with 1=worst, 1 0=best. Included in this rating was growth habit, foliage color/appeal, and flower quality. Visual quality ratings were also averaged to determine a monthly and yearly mean. Plants were evaluated for resistance/susceptibility to an *Alternaria* sp. leaf spot mid-summer using a disease rating scale of 1 to 6 where 1=no leaf spots/defoliation, and 6=76-100% leaves with leaf spots/ defoliation.

Results and Discussion: Flowering percentages for perennial verbena cultivars in 1998 averaged from 26-55% (Table 1). Homestead Purple, a Louisiana Select recipient in 1996 and the most popular cultivar used by Louisiana landscapers, did not perform as well in 1998 as in previous years. Rose King, Tiger Rose, and Taylortown Red were good performers; Snowflurry was also impressive (Tables 1 and 2). The fine textured Tapien series of verbena from Proven Winners were acceptable perform-

ers with Tapien Lavender and Tapien Blue Violet being the best of the series.
Homestead Purple was the least susceptible to *Alternaria* leaf spot, while Snowflurry and Aunt Bert were the most susceptible (Table 3). Aunt Bert, based on performance evaluations and disease problems, should not be recommended for use in Louisiana.

Significance to Industry: Perennial verbenas continue to be popular in Louisiana for landscape use. Good performance is obtained in late winter through late spring and in the fall. Summer performance is questionable. Superior performers have been identified for recommendation. New cultivars of perennial verbenas currently being released and soon to be released in 2000 ill be evaluated over the next several years.

Table 1. Flowering percentage of perennial verbena cultivars during 1998

Cultivar	May	June	July	Aug	Sept	Year Average
Homestead Purple	35	35	30	32	10	26
Snowflurry	65	65	32	35	20	40
Blue Princess	35	62	30	30	25	36
Upright Pink	75	75	25	37	40	42
Taylortown Red	60	70	40	55	40	45
Rose King	60	80	40	50	45	55
Aunt Bert	40	50	20	10	10	26
Tiger Rose	45	80	55	30	35	42
Temari Bright Red	25	45	45	35	15	33
Temari Violet	20	55	55	30	20	36
Temari Blue	55	55	20	15	10	31
Tapien Soft Pink	30	35	50	50	30	39
Tapien Pink	25	25	60	50	40	40
Tapien Lavender	30	40	55	60	50	47
Tapien Blue Violet	30	40	55	35	30	38
Tapien Powder Blue	40	45	60	50	30	45

NOTE: Flowering percentage expressed as a visual estimate of the percentage of the plant covered by open blossoms. ‘Snowflurry’ also sold in Louisiana as ‘White’, ‘Trailing White’, and ‘Upright White’; ‘Blue

Princess' sold in Mississippi as 'Biloxi Blue'; 'Upright Pink' also sold in Louisiana as 'Pink' and 'Feliciana Pink'.

Table 2. Visual quality ratings of perennial verbena cultivars during 1998

Cultivar	May	June	July	Aug	Sept	Year Average
Homestead Purple	6.0	6.5	6.5	6.5	5.0	6.1
Snowflurry	8.0	8.5	7.0	6.5	6.0	7.2
Blue Princess	7.0	8.5	7.0	7.0	6.0	7.1
Upright Pink	9.0	8.5	7.0	7.0	7.0	7.7
Taylortown Red	9.0	9.0	8.5	8.0	7.0	8.3
Rose King	8.0	8.5	7.5	7.5	7.0	7.7
Aunt Bert	6.0	8.0	5.5	5.0	4.0	5.7
Tiger Rose	7.0	8.5	7.0	6.5	7.0	7.2
Temari Bright Red	6.5	7.0	7.5	6.0	4.0	6.1
Temari Violet	5.0	7.5	7.5	6.5	6.0	6.5
Temari Blue	7.0	8.0	6.5	5.0	2.0	5.7
Tapien Soft Pink	5.0	5.5	7.0	7.0	6.0	6.1
Tapien Pink	5.0	5.5	7.5	7.5	4.0	5.9
Tapien Lavender	5.0	5.5	7.5	8.0	7.0	6.6
Tapien Blue Violet	5.0	6.0	7.5	7.0	6.0	6.3
Tapien Powder Blue	5.0	6.5	8.0	7.0	6.0	6.5

NOTE: Visual quality rating based on a scale from 1 to 10 with 10=est, 1=worst. Included in this evaluation was growth habit, foliage color/ appeal, and flower quality. 'Snowflurry' also sold in Louisiana as 'White', 'Trailing White', and 'Upright White'; 'Blue Princess' sold in Mississippi as 'Biloxi Blue'; 'Upright Pink' also sold in Louisiana as 'Pink' and 'Feliciana Pink'.

Table 3. Reaction of perennial verbenas to *Alternaria* leaf spot during 1998

Cultivar	Disease Rating	Cultivar	Disease Rating
Aunt Bert	5.7	Tapien Pink	2.0
Snowflurry	5.0	Tapien Powder Blue	2.0
Blue Princess'	2.0	Tapien Lavender	2.0
Rose King	2.0	Temari Bright Red	2.0
Taylortown Red	2.0	Temari Blue	2.0
Upright Pink	2.0	Temari Violet	2.0
Tapien Blue Violet	2.0	Tiger Rose	2.0
Tapien Soft Pink	2.0	Homestead Purple	1.5

NOTE: Disease rating based on a scale from1 to 6 where 1=no spots/defoliation, 2=1-10%, 3=11-25%, 4=26-50%, 5=51-75%, and 6=76-100% leaves with leaf spots/defoliation.

Landscape Performance of Lantana Cultivars - 1998

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Index Words: Lantana, Landscape Performance, Mycovellosiella

Nature of Work: A landscape trial evaluating the performance of lantana cultivars has been conducted annually by the LSU Agricultural Center since 1995. The primary criteria in these trials has included evaluation of lantana cultivars for floral impact, growth habit, and pest resistance (lantana lace bug, aphids, white flies, fungal leaf spots).

Cultivars evaluated in 1998 landscape trials included Samantha, Trailing Purple, New Gold, Weeping White, Spreading Sunset, Lemon Drop, Gold Mound, Golden King, Irene, LSG Red-Orange, Marshall's Red, Pink Caprice, Golden Plume, Sonrise, Silver Mound, Patriot Firewagon, Lemon Swirl, American Red Bush, Imperial Purple, Radiation, Dallas Red, Confetti, White Lightnin', Patriot Cherry, Cream, Patriot Desert, Sunset, Lady Olivia, Dwarf Pink, New Bronze, Patriot Dovewings, Patriot Sunburst, Patriot Tangerine, and Patriot Honeylove. Most of these cultivars were established in landscape beds during the spring of 1996, but several cultivars were added to the planting in April 1998. Plants remaining from previous years were pruned to 46 inches above the soil line in early March and re-mulched with 2 inches of pine straw.

The raised landscape beds were composed of an Olivier silt loam amended with composted rice hulls and aged pine bark. The beds were located in full sun and plants received irrigation as needed throughout the growing season. Plants were spaced on 2.S foot centers in single rows and received a top dressing of StaGreen Nursery Special 12-6-6 at the rate of 1 lb N/1000 ft^2 in late March and early July. Plants were not dead headed or pruned during the growing season and no pesticides were applied for insect or disease control.

Flowering percentage was determined for each cultivar twice monthly from May through September by visually estimating the percentage of the plant canopy covered by open blossoms. Ratings for each month were averaged to determine a monthly flower percentage. Monthly ratings were averaged to determine a yearly average.

Visual quality ratings were taken twice monthly from May through September and were based on a scale from 1 to 10 where 10=best, 1=worst.

Included in this evaluation was growth habit, foliage color/appeal and flower quality. Ratings for each month were averaged to determine a monthly visual quality rating. Monthly visual quality ratings were averaged to determine a yearly average.

Reaction of lantana cultivars to leaf spot caused by the fungus *Mycovellosiella lantanae* was estimated on October 30. Disease ratings were based on a scale from 1 to 6 where 1=0% foliage with leaf spots, 2=1-10%, 3=1] -25%, 4=26-50%, 5-51-75%, and 6=76-100% foliage with leaf spots.

Results and Discussion: Leaf spot was first observed on lantana in 1998 (Table 3). Most cultivars were only slightly susceptible. Cultivars Golden Plume, American Red Bush, Golden King, and New Gold were moderately susceptible to leaf spot. Lemon Swirl and Samantha (the same plant sold under different cultivar names by different nurseries) was highly susceptible to leaf spot. This cultivar has variegated foliage.

Year-average flowering percentage for lantana cultivars ranged from 13-66% (Table 1). Poorest flowering performance was observed for Samantha, Lemon Swirl, Radiation, Patriot Firewagon, Marshall's Red, Golden King, Dwarf Pink, Lady Olivia, Cream, Patriot Cherry, and Patriot Desert Sunset. Best flowering performance was observed for Patriot Dovewings, Patriot Sunburst, Patriot Tangerine, Patriot Honeylove, Lemon Drop, New Gold, Gold Mound, Sonrise, Silver Mound, Imperial Purple, Dallas Red and White Lightnin'. Trailing lantanas typically have the best flowering, followed by mounding types and upright types, respectively.

Year-average visual quality ratings for lantana cultivars ranged from 3.9-8.2 (Table 2). The best visual quality ratings (7.8 or better) were found for Lemon Drop, Gold Mound, Silver Mound, White Lightnin', Patriot Dovewings, Patriot Sunburst, Patriot Tangerine, and Patriot Honeylove. The worst visual quality ratings (6. 5 or worse) were found for Patriot Cherry, Cream, DwarfPink, New Bronze, Golden King, Irene, Marshall's Red, Pink Caprice, Golden Plume, and Patriot Firewagon.

Significance to Industry: Lantanas continue to be one of the most popular flowering perennials for use in southeastern United States landscapes. The introduction of new cultivars made it necessary to evaluate performance of these cultivars in landscape settings. This research has identified superior performing cultivars and these are being promoted to landscapers, retail garden centers, and gardening consumers.

Table 1. Flowering percentage of lantana cultivars during 1998

Cultivar	May	June	July	August	Sept	Year Average
Samantha	25	30	30	25	30	28
Trailing Purple	20	50	55	40	45	42
New Gold	40	60	60	60	40	52
Weeping White	25	45	55	50	50	45
Spreading Sunset	70	40	35	40	60	49
Lemon Drop	30	50	65	60	60	53
Gold Mound	80	65	65	60	60	66
Golden King	25	55	50	25	35	38
Irene	10	60	50	35	50	41
LSG Red-Orange	25	65	55	60	50	51
Marshall's Red	40	40	30	30	50	38
Pink Caprice	70	30	25	35	50	42
Golden Plume	60	45	40	40	55	48
Sonrise	60	65	55	50	70	60
Silver Mound	60	85	70	60	50	65
Patriot Firewagon	5	60	45	35	50	39
Lemon Swirl	15	30	45	35	35	31
American Red Bush	10	50	60	45	50	43
Imperial Purple	10	65	70	70	65	56
Radiation	10	65	65	35	20	39
Dallas Red	15	70	60	40	60	49
White Lightnin'	15	45	70	50	65	49
Confetti	10	50	50	40	55	41
Patriot Cherry	0	30	55	40	55	36
Patriot Desert Sunset	30	45	40	40	15	34
Cream	10	50	30	35	35	32
Patriot Dovewings	75	55	60	70	70	66
Patriot Sunburst	80	65	60	50	50	61
Patriot Tangerine	65	75	60	60	50	62
Lady Olivia	50	55	35	25	25	38
Patriot Honeylove	55	70	60	25	50	52
Dwarf Pink	10	20	10	15	10	13
New Bronze	15	50	45	40	50	40

NOTE: Flowering percentage expressed as a visual estimate of the percentage of the plant covered by open blossoms.

Table 2. Visual quality ratings of lantana cultivars during 1998

Cultivar	May	June	July	August	Sept	Year Average
Samantha	6.0	7.0	7.5	7.0	7.0	6.9
Trailing Purple	5.0	8.0	8.0	7.5	7.0	7.1
New Gold	8.0	7.5	7.5	7.0	7.0	7.4
Weeping White	7.0	7.0	8.0	8.0	7.0	7.4
Spreading Sunset	8.0	7.0	7.0	7.0	7.0	7.2
Lemon Drop	7.0	7.5	8.5	8.0	8.0	7.8
Gold Mound	9.0	8.5	7.5	7.5	7.0	7.9
Golden King	7.0	7.0	6.5	6.0	5.0	6.3
Irene	.0	7.0	7.0	7.0	6.0	6.4
LSG Red-Orange	7.0	8.5	7.5	7.0	6.0	7.2
Marshall's Red	6.0	6.5	6.5	6.5	6.0	6.3
Pink Caprice	7.0	6.0	6.0	6.0	7.0	6.4
Golden Plume	7.0	7.0	6.5	6.0	5.0	6.3
Sonrise	8.0	7.5	7.5	7.0	7.0	7.4
Silver Mound	9.0	8.5	8.5	8.0	7.0	8.2
Patriot Firewagon	5.0	7.0	6.5	6.5	6.0	6.2
Lemon Swirl	6.0	7.5	7.5	7.0	7.0	7.0
American Red Bush	6.0	7.0	7.5	7.0	7.0	6.9
Imperial Purple	6.0	7.0	9.0	8.5	7.0	7.5
Radiation	6.0	7.5	7.5	7.0	6.0	6.8
Dallas Red	6.0	7.5	7.5	7.0	7.0	7.0
White Lightnin'	7.0	8.0	9.0	8.0	8.0	8.0
Confetti	5.0	7.0	7.0	7.0	7.0	6.6
Patriot Cherry	4.0	6.0	6.0	6.5	6.5	5.8
Patriot Desert Sunset	7.0	7.0	7.0	7.0	6.0	6.8
Cream	5.0	7.0	6.5	6.0	5.0	5.9
Patriot Dovewings	9.0	8.0	8.0	8.0	8.0	8.2
Patriot Sunburst	9.0	8.0	8.0	7.5	7.0	7.9
Patriot Tangerine	8.0	8.5	8.0	7.5	7.0	7.8
Lady Olivia	9.0	7.0	7.0	6.0	5.0	6.8
Patriot Honeylove	9.0	8.5	8.0	7.0	7.0	7.9
Dwarf Pink	3.0	4.5	4.5	4.5	3.0	3.9
New Bronze	5.0	7.0	6.5	7.0	6.0	6.3

NOTE: Visual quality ratings based on 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. Reaction of lantana cultivars to *Mycovellosiella* leaf spot during 1998

Cultivar	Disease Rating	Cultivar	Disease Rating
New Bronze	2.0 a	Silver Mound	2.0 a
Dwarf Pink	2.0 a	Patriot Firewagon	2.0 a
Patriot Honeylove	2.0 a	Irene	2.0 a
Lady Olivia	2.0 a	Pink Caprice	2.0 a
Patriot Tangerine	2.0 a	Spreading Sunset	2.0 a
Patriot Sunburst	2.0 a	Lemon Drop	2.0 a
Patriot Dovewings	2.0 a	Trailing Purple	2.0 a
Cream	2.0 a	Patriot Desert Sunset	2.3 a
Gold Mound	2.0 a	Weeping White	2.3 a
Patriot Cherry	2.0 a	Golden Plume	3.0 b
Confetti	2.0 a	American Red Bush	3.0 b
White Lightnin'	2.0 a	Golden King	3.0 b
Dallas Red	2.0 a	New Gold	3.3 b
Radiation	2.0 a	Lemon Swirl	6.0 c
Imperial Purple	2.0 a	Samantha	6.0 c
Sonrise	2.0 a		

NOTE: Disease ratings based on a scale from 1-6 where 1=no leaf spots present, 2 = 1-10%, 3-11-25%, 4=26-50%, 5=51-75%, and 6= 76-100% of leaves with spots. Means within columns are not significantly different when followed by the same letter (SNK test, P=0.05).

Powdery Mildew Resistance in Monarda

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Index Words: Bee Balm, Monarda, Powdery Mildew.

Nature of Work: In an allegedly humorous mailing from a major wholesale herbaceous perennials grower, it was suggested that the industry use “Honest Abe” labels that accurately describe plants at point of sale. One of their suggestions was as follows: “*Monarda didyma* ‘Cambridge Scarlet.’ BEEBALM. 4-5' stems bear red flowers in summer. Must be sprayed often with highly toxic fungicides to prevent ugly, disfiguring powdery mildew on the foliage. Plants kept healthy in this way are very invasive and may take over the world.”

Because growing conditions favoring powdery mildew exist in much of the U. S., studies evaluating powdery mildew resistance in Monarda cultivars have been conducted in IL and VT (1, 2). However, interpreting these results for the often warmer, more humid, rainier landscapes of the southeastern U.S. can lead to problems with cultivars that are not able to withstand severe southern disease pressures. Therefore, a trial was established in a simulated landscape bed at MHCREC, Fletcher, NC in spring 1997.
Clay loam soil was limited to a ph of 6.2 and tilled to a depth of 8 inches prior to planting liners which were obtained from commercial nurseries. Three replicates of 23 Monarda cultivars plus the wild type, *Monarda didyma*, were planted in rows 3 ft apart with plants 1.25 ft apart within rows in a randomized complete block design. Fertilizer was applied as one-half ounce of nitrogen per plant from 10-10-10 in 1997 and one ounce of nitrogen per plant in 1998 as new vegetative growth became visible in spring.

Even during a “drought” year like 1998, MHCREC Fletcher is a rainy place with 46.2 in. rainfall in 1998, 15.8 in. of which fell May through July. In addition, morning fog is present most days in June, July and August. It is hard to imagine landscape conditions more favorable to powdery mildew than those at MHCREC in 1997 and 1998. Mildew evaluations were developed based on percent defoliation of cultivars during the growing season. Percentage defoliation was calculated by measuring height to which all foliage had abscised, dividing by total plant height, then multiplying by 100. The 1998 results are shown both from the beginning of the flowering season (Table 1) and near the end of the

flowering season (Table 2).

Results and Discussion: None of the cultivars nor *Monarda didyma* were immune to powdery mildew under our conditions. In fact, none had less than 45% defoliation on June 8, 1998 or less than 65% defoliation by July 27, 1998. Therefore, even the most resistant of these cultivars should be reserved for the back of the border unless landscapers wish to display leafless stems along with bee balm flowers. Flowering was normal in all test plants but less prolific in those exhibiting severe powdery mildew symptoms.

Significance to Industry: Resistance to powdery mildew defoliation under SEVERE disease pressure existed. Cultivars 'Claire Grace,' 'Marshall's Delight' and 'Stone's Throw Pink' were most resistant early in the flowering season while 'Beauty of Cobham,' 'Blue Stocking,' 'Cambridge Scarlet,' 'Elsie's Lavender,' 'Mahogany,' 'Marshall's Delight' and 'Vintage Wine' were most resistant late in the season.

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Table 1. Early Bloom Season (June 8, 1998) Randing of Monarda.

HIGHLY RESISTANT (40-50% DEFOLIATION)		
Claire Grace	Marshall's Delight	Stone's Throw Pink
MODERATELY RESISTANT (50-60% DEFOLIATION)		
Beauty of Cobham	Blue Stocking	Cambridge Scarlet
Comanche	Mahogany	Vintage Wine
POORLY RESISTANT (over 60% DEFOLIATION)		
Cerise	Cherokee	Colrain Red
Croftway Pink	Elsie's Lavender	Garden View Scarlet
Jacob Cline	Jean Stewart	Loddon Crown
Monarda didyma	Raspberry Wine	Sagittarius
Scorpio (Scorpion)	Snow White	Violet Queen

Table 2. Late Bloom Season (July 27, 1998) Ranking of Monarda.

HIGHLY RESISTANT (60-70% DEFOLIATION)		
Beauty of Cobham	Blue Stocking	Cambridge Scarlet
Elsie's Lavender	Mahogany	Marshall's Delight
Vintage Wine		
MODERATELY RESISTANT (70-80% DEFOLIATION)		
Cerise	Cherokee	Claire Grace
Colrain Red	Comanche	Croftway Pink
Garden View Scarlet	Jacob Cline	Jean Stewart
Loddon Crown	Raspberry Wine	Sagittarius
Scorpio (Scorpion)	Stone's Throw Pink	Violet Queen
POORLY RESISTANT (over 80% DEFOLIATION)		
Monarda didyma	Snow White	

Effect of Compost and Fertilizer on Establishment of Annual Color Beds

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Index Words: Cotton Boll Compost Yard Waste Compost, Turkey/yard waste compost, Petunia, Melampodium, Fertilizer Effect

Nature of Work: Recent legislation has made it difficult to dispose of organic waste materials (Saarela, 1998). A number of companies have been established to manufacture composted organic waste products. While a great deal of research has been conducted on the use of composted organic products for container media (Mcconnell and Shlaralipour, 1991; Purman and Gouin, 1992), very little has been done on the establishment of annual color beds.

The experiment was conducted to evaluate the effect of bed preparation, compost, and fertilizer, on the establishment of annual color beds. All treatments were applied to an undisturbed site in Little Rock, AR. The soil is classified as a Carnasaw-Mountainburg Association with a pH of 6.2. All plots except for the control were cultivated with a rototiller to a depth of 6". For treatments including a composted product the tilled plot received a 2" layer of compost that was tilled in lightly. Three compost products were evaluated in the trial (Table 1). Products include: cotton boll compost (CBC: Back to Earth Resources, Inc. Slaton, TX), composted municipal yard waste (YWC: American Composting, Little Rock, AR) and composted turkey/yard waste compost (TYWC: Earth Care Technologies, Inc. Lincoln, AR). Fertilizer treatments include a soluble fertilizer 13-13-13 applied at the rate of 1.8 lb N/1,000 ft^2 at planting (April 16, 1999). A single application of slow-release fertilizer (Scotts Osmocote â 14-14-14) was applied at planting at a rate of 3.6 lb N/1,000 ft^2 . Fertilizers were applied as a topdress after planting the annuals but before the plots were mulched with a 2" layer of pine bark mulch. Plots were treated with Pendulum 2G (pendimethalin) at 200 lb/ A. Treatments were replicated 3 times in a block design amenable to spatial analysis by PROC MIXED (SAS Institute). Treatment plots were 3' x 3'. Annuals used in this study were Wave Petunias and Showstar Melampodium. Only data for petunia will be reported in this paper. Data collected during the study includes number of flowers, a growth index (height x average radius squared x pi), and shoot fresh weight(one-third of the Petunia plants were harvested on June 18). Data were analyzed using the spatial model of PROC MIXED with variances modeled as varying anisotropically with distance.

Results and Discussion: Significant treatments effects were noticeable by the third week with the petunia plots (Table 2, 3). While both soluble and slow-release fertilizer resulted in increased growth of petunias, soluble fertilizer was the most effective treatment (Table 3). Petunia plants treated with soluble fertilizer were three times as large as non fertilized plants. Data (not shown) for Melampodium suggest that slow-release fertilizer was more effective in the establishment period than soluble fertilizer. The difference likely reflects the fertilizer requirement for these different plants during the establishment period. Based on these data, petunia appears to require a higher amount of quickly available nutrients during the establishment period.

The use of cotton boll compost (CBC) delayed the growth of Petunia during the first few weeks of establishment (Table 2). The mean growth index for the CBC plants was almost 70% less than the rototilled with no compost treatment. The dramatic reduction in growth may be a result of the high salt content (Table 1) of the CBC compost. Growth of Petunia plants in plots tilled but without compost, or the use of yard waste based compost products (TYWC and YWC), was not significantly different than the no till plots during the first 3 weeks of establishment.

After two months the trends for bed preparation/compost type treatments changed for the Petunia plots (Table 4). While the benefit of tilling plots at planting was still the same as using a compost product from a statistical standpoint, the benefit of simply tilling a bed was decreasing from the third to ninth week. Petunia plants grown in the CBC treated plots were recovering well from their initial slow start. By the ninth week Petunia plants in the no till plots were significantly smaller than other bed preparation treatments. No till plants were one-half the size of plants grown in plots using yard waste based compost products (TYWC and YWC). The best treatments continued to be those plots using a yard waste based compost product (TYWC and YWC).

The benefit of using either a soluble or slow-release fertilizer product was still measured after 9 weeks (Table 5).

Significance to Industry: Data indicate that the use of fertilizer and compost can have a significant effect on the establishment of annual bedding.

Based on the results, initial growth of annual plants is greatly enhanced by the use of soluble or slow-release fertilizer. While the use of some types of compost may be beneficial in the early stages of bedding plant establishment, compost based on cotton boll material does not appear to

be recommended. Rototilling an annual bed prior to planting increases the growth of annuals during the early stages of establishment but the benefit may not be long term.

Table 1. Chemical properties of compost products.

Compost	PH	EC	P	K	Ca	Mg	Na
		(mmho/com)		ppm			
CBC	8.4	5.6	850	23225	4650	1850	525
YWC	7.7	0.8	325	4375	6500	1100	350
TYWC	4.9	1.7	475	550	4050	325	200

Table 2. Effect of bed preparation/compost type on the growth of Wave Petunia on May 11 (3.5 weeks).

Bed preparation/compost	Mean Growth Index (cm^3)
Rototilled	2856 a
CBC	892 b
YWC	2417 a
TYWC	3128 a
No till	1894 b

Mean separation by Tukey LSD (P=0.05)

Table 3. Effect of fertilizer on the growth of Wave Petunia on May 11 (3.5 weeks).

Fertilizer	Mean Growth Index (cm^3)
None	1044 c
Soluble	3416 a
Slow-release	2252 b

Mean separation by Tukey LSD (P=0.05)

Table 4. Effect of bed preparation/compost type on the growth of Wave Petunia on June 18 (9 weeks).

Bed preparation/compost	Shoot Fresh Weight (gms)
Rototilled	331ab
CBC	388 ab
YWC	511 a
TYWC	488 ab
No till	240 b

Mean separation by Tukey LSD (P=0.05)

Table 5. Effect of fertilizer on the growth of Wave Petunia on June 18 (9 weeks).

Fertilizer	Shoot Fresh Weight (gms)
None	282 b
Soluble	498 a
Slow-release	396 ab

Mean separation by Tukey LSD (P=0.05)

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University of Arkansas Plant Evaluation Program

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Arkansas

Index Words: Plant Evaluation

Nature of Work: A statewide plant evaluation program was initiated in the spring of 1999. The program is designed to evaluate the performance of woody and herbaceous ornamental plants at three locations across Arkansas over a 3 to 5-year period. The three evaluation sites represent three USDA Plant Hardiness Zones: Fayetteville zone 6, Little Rock zone 7, and Hope zone 8. Plants will be evaluated for resistance to insect and disease problems and for ornamental characteristics. Plant growth will be measured and compared between testing sites. The program objective is to evaluate plant material on a statewide basis and to provide the nursery industry with a propagation source for non patented and trademarked plants. The Arkansas program embodies components from other states programs (Flanagan *et al* 1993). Trial sites typically consist of 3 foot wide rows separated by a grassy 7 foot alley. Plant groups are planted together (i.e. trees are planted together). Spacing between plants is determined by plant type. Trees are spaced10 feet apart, shrubs 6 feet apart, and herbaceous perennials 4 feet apart. Plants are irrigated as needed by drip irrigation. Plants are fertilized and mulched after planting. Disease and insect control measures are used when the problem is determined to exceed a threshold level.

Results and Discussion: Woody plants established in the spring of 1999 include: *Styrax japonicum, Quercus hybrid, Loropetalum* Plum Delight®, *Rhaphiolepis indica* Bay Breeze®, *Itea virginica* 'Henry's Garnet', *Abelia x grandiflora* 'Sunrise', *Ligustrum* 'Green Meatball', *Ilex x* Dixie Dream®, *Lagerstroemia indica* 'Velma's Royal Delight', *Lagerstroemia x* 'Pocomoke', *Ilex x* Oakleaf®, *Lagerstroemia x* 'Chickasaw', *Ilex x* Little Red®, *Camellia sasanqua* Hot Flash®, *Rhododendron* Autumn Amethyst® , *Rhododendron* Autumn Coralä® and *Rhododendron* Autumn Embers ®. Perennials established in the 1999 include: *Agastache rupestris, Salvia uliginosa, Salvia greggii,* and *Gaura lindheimer*i. A tentative list of plants to be established in 2000 include: *Rhus aromatica* 'Gro-low', *Eucommia ulmoides*, *Abelia chinensis*, *Viburnum x* 'Conoy', *Ilex verticillata* Winter Red®, I*llicium henryi, Diervilla lonicera* 'Copper', *Deutzia gracilis* 'Nikko', and *Acer palmatum* var. *dissectum* 'Seiryu'.

Plants are measured following planting and then measured again in the fall. Plant measurements include a spread, height, and caliper. Data is also recorded on ornamental characteristics such as flowering, fruiting, and insect and disease problems. Woody ornamentals are evaluated for 5 years while herbaceous plants 3 years. Plants are planted using a completely randomized design with 4 replications per testing site.

Significance to Industry: The program is designed to evaluate and promote new or underused plants in the Arkansas ornamentals industry. Plants that are identified as growing successfully at all three testing sites may prove worthy candidates for nomination to the 'Arkansas Select' program.

Results from the testing program will be reported to the ornamentals industry at annual meetings and in trade publications. Data will be published in the Journal of Arboriculture, HortScience, or Journal of Environmental Horticulture.

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Deer Problems in Landscapes and Nurseries

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Index Words: Dear Feeding Perferences, Deer Habits

Nature of Work: Deer are among the most graceful, majestic, and troublesome of wildlife. Over the past decade, damage to ornamental plants in landscapes and nurseries, by white-tailed deer (Odocoileus virginanus) has increased dramatically. This situation has become a problem due to the increase in the deer population in N.C. (currently estimated at nearly one million) and to the urbanization of rural areas. Conflicts between deer and the human population will only increase as more urban areas are developed. Over 295,000 acres were lost to urbanization since 1987 in North Carolina. The solution is to eliminate the deer or improve deer management strategies in the areas that are experiencing damage. The solution is complicated, and it involves a combination of management strategies, such as selecting plants that deer do not prefer, discouraging deer from entering the property, applying materials to the plants periodically that discourage deer from browsing, or eliminating the problem deer.

Results and Discussion: Deer can damage plants in an assortment of ways. The buck deer can damage trees and shrubs by rubbing his antlers in the late summer, fall, and early winter. The rubbing can cause the bark, and lower limbs of small trees and shrubs to be disfigured. This problem leads to considerable aesthetic damage and sometimes death of an ornamental.

Deer are most active around dawn and dusk. Deer foraging behaviors vary seasonally and annually, like most animals. Factors that affect their feeding behavior include — population, weather, food availability/attraction, and distance from cover. They are browsers, often consuming their total food intake for the day in many different locations. It is estimated that deer can eat up to 6-8 lbs. of plant material per day. They seem to prefer lush foliage such as leaves, stems, and buds of woody plants. They feed regularly on fertilized plantings and managed croplands. Nurseries seem to be at the beginning of the buffet line in the winter when natural food is hard to come by. However, many plant species are resistant to this possible browsing problem. When thinking about plant selection in areas with a high deer population, it is advisable to select plants that are ‘non-preferred’ by deer. Table 1 lists ornamental woody plants according to the severity of deer damage (Fargione et al., 1991).

Significance to Industry: The elimination of deer by increasing hunting quotas and reducing hunting restrictions will help, but it is not practical to use shooting devices in areas that are highly populated by humans. There are many methods that can be used to discourage deer from damaging plants. Plant selection is vital, but not a 100% guarantee. There are numerous chemical and organic repellents, scare tactics, and fencing methods being explored and used in areas with extreme damage. Several commercial spray repellents are available that are specifically designed with an offending scent or taste to keep deer from foraging on plants. Some sprays are applied directly to the foliage and some are not: Deer Off; Hinder (Consists of Ammonium Soap; EPA approved on vegetable crops) Tree Guard; Deer Away; Plant Protec (Garlic odor); Predator Urine (Coyote urine); and Hot Sauce. The main problem with repellents is that they are dependent on the deer population, the weather, and the availability of other food choices. No repellent is 100% effective due to the fact that deer may become accustomed to the repellent.

There are several home remedies that have been proven somewhat effective. Hanging soap or human hair on trees at 3-foot intervals, or mixing egg or hot sauce repellent deters deer. Trap crops such as corn, soybeans, alfalfa, and clover have been known to lure deer to other areas for foraging.

Scare tactics are another way of attempting to prevent deer from foraging on ornamentals. Some have tried leaving the radio on in the yard or using ultrasonic sound units that only animals can hear. Deer will eventually decide to withstand the noise in order to tackle their hunger. Motion detectors can be used on these devices as well as on sprinklers and floodlights. Some have even recommended using heavy, deep-sea fishing line run three feet above the ground around the perimeter of the planting area. Dogs are another deterrent that have been found to be very valuable.

If sprays and scare tactics are one's only option, it is best to rotate the tactics regularly to keep these foraging animals off balance. Unfortunately, fencing is the only foolproof option of stopping the deer damage. The key is to put the fence up before deer start to damage the plants. There are a few different designs of fencing that have been found to be useful: Upright (7 feet tall); Slanted (Facing outward; 5-foot-tall; confuses deer's depth of vision); Double (Two shorter fences placed 5 feet apart; this provides no place for the deer to land when jumping the first fence); Electric (Run an electric fence wire 30 inches off the ground and mark it with strips every 10 feet so the deer can see it; then bait the wire with peanut butter and wait for the deer to take a lick and scurry); Black

& Green Mesh (This 8-foot-tall invisible fence is supported by trees or posts).

The battle between deer and humans is unlikely to disappear in the near future. A strategy should be selected to accommodate the size and needs of the desired landscape.

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Table 1. Woody plants listed by severity of deer damage (Fargione et al., 1991).

Plants Seldom Damaged

Botanical Name	Common Name
Berberis sp.	Barberry
Betula	Birch
Buddleia davidii	Butterfly bush
Buxus spp.	Boxwood
Cotinus coggygria	Smoketree
Cytisus scoparius	Scotch Broom
Elaeagnus angustifolia	Russian Olive
Ilex opaca	American Holly
Leucothoe sp.	Leucothoe
Picea pungens	Norway Spruce
Pieris japonica	Japanese Pieris
Cornus florida	Flowering Dogwood
Cornus kousa	Kousa Dogwood
Crataegus spp.	Hawthorne
Forsythia spp.	Forsythia
Gleditsia triacanthus	Honey Locust
Ilex cornuta	Chinese Holly
Ilex glabra	Inkberry
Juniperus spp.	Juniper and Cedar
Kalmia latifolia	Mt. Laurel
Kerria japonica	Japanese Kerria
Ligustrum spp.	Privet
Mahonia spp.	Mahonia
Myrica cerifera	Wax Myrtle
Nandina domestica	Nandina
Nerium oleander	Oleander
Pinus spp.	Pine

Pittosporum tobira	Pittosporum
Podocarpus macrophyllus	Podocarpus
Pyracantha spp.	Firethorn
Robinia pseudoacacia	Black Locust
Sassafras albidum	Sassafras
Syringa vulgaris	Lilac
Taxodium distichum	Bald Cypress
Thuja spp.	Arborvitae
Vinca minor	Periwinkle
Yucca spp.	Yucca
Vitex agnus-castus	Chastetree
Wisteria floribunda	Japanese Wisteria
Plants Occasionally Damaged	
Acer griseum	Paperbark Maple
Acer rubrum	Red Maple
Acer saccharinum	Silver Maple
Acer saccharum	Sugar Maple
Amelanchier arborea	Downy Serviceberry
Campsis radicans	Trumpet Creeper
Chaenomeles speciosa	Flowering Quince
Cotinus coggyrria	Smoketree
Cotoneaster spp.	Cotoneaster
Cryptomeria japonica	Japanese Cedar
Hibiscus syriacus	Rose of Sharon
Hydrangea paniculata	Panicle Hydrangea
Ilex crenata	Japanese Holly
Magnolia soulangiana	Saucer Magnolia
Parthenocissus quinquefolia	Virginia Creeper
Quercus spp.	Oak
Salix spp.	Willow
Spirea x bumalda	‘Anthony Waterer’ Spirea
Tsuga canadensis	Eastern Hemlock
Viburnum rhytidophyllum	Leatherleaf Viburnum
Weigela florida	Old Fashioned Weigela
Plants Frequently Damaged	
Abies fraseri	Fraser Fir
Acer platanoides	Norway Maple
Cercis canadensis	Redbud
Clematis spp.	Clematis
Cornus mas	Cornelian Cherry Dogwood
Euonymus alatus	Winged Euonymus
Euonymus fortunei	Wintercreeper
Hedera helix	English Ivy
Malus spp.	Apple
Prunus spp.	Cherries, Peaches

Pyrus calleryana 'Bradford'	Bradford Pear
Rhododendron spp.	Rhododendron/Azalea
Rosa x hybrida	Rose
Sorbus aucuparia	Mountain Ash
Taxus cuspidata	Japanese Yew
Thuja occidentalis	American Arborvitae

Effect of Nitrogen and Potassium and Mowing Height on 'Raleigh' St. Augustinegrass

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Index Words: St. Augustine Grass, *Stenotaphrum secundatum*, Nitrogen, Potassium, Mowing

Nature of Work: St. Augustinegrass [*Stenotaphrum secundatum* (Walt.) Kuntze] is widely utilized as a lawn turfgrass from the Carolinas to Florida and along the Gulf Coast into Texas (1). It is adapted to areas with mild winter temperatures and is tolerant of high summer temperatures (1, 3). St. Augustinegrass has a coarse leaf texture, large stolons, and good to excellent shade tolerance. It is utilized primarily for home and commercial lawns and provides an adequate stand of turf at moderate maintenance levels but it will provide a more dense and greener stand of turf when maintained at a higher level of maintenance (3).

The most commonly utilized cultivar of St. Augustinegrass in Louisiana is 'Raleigh'. It has excellent cold tolerance and good shade tolerance. 'Raleigh' spreads rapidly, is medium green in color, has a medium to coarse leaf texture, and has good shoot density (2). It is susceptible to chinch bugs and brown patch disease. Since 'Raleigh' has such good cold tolerance and is readily available from nurseries, it has been utilized throughout the state. There has been limited research done on the effects of fertility and mowing on 'Raleigh' St. Augustinegrass in Louisiana. The objective of this study was to evaluate the effects of nitrogen, potassium, and mowing on 'Raleigh' St. Augustinegrass.

A study was initiated on established turfgrass plots of 'Raleigh' St. Augustinegrass in May of 1997 at the Burden Research Center in Baton Rouge, LA. The treatment combinations consisted of high (H) and low (L) mowing heights; high (H) and low (L) rates of nitrogen (N); and high (H) and low (L) rates of potassium (K) at the following levels: mowing heights of 5 cm (2 inches) and 7.5 cm (3 inches); N rates of 454 and 227 g N/93 m^2/month (1.0 and 0.5 lb N/1000 ft^2/month); and K rates of 454 and 227 g K/93 m^2/month (1.0 and 0.5 lb K/1000 ft^2/month). The treatment combinations were (mowing, N, and K): HHH, HHL, HLH, HLL, LHH, LHL, LLH, and LLL. Half of each of three replications were cut twice a week at the two mowing heights in order to maintain the proper heights. Nitrogen applications were made in one direction and K applications made in the perpendicular direction across the plots monthly. All

plots received applications of a micronutrient fertilizer (June and August) and were irrigated as needed. The study was a randomized complete block design with 3 replications and data analysis utilized the GLM procedure of SAS (4).

Color, density, texture, uniformity, and quality were determined visually on a monthly basis from May through December (only data for June - August is presented). Each of these parameters 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. The quality rating takes into account the color, density, and uniformity of the turfgrass stand and provides an indication of the overall appeal of the stand of turf (5).

Results and Discussion: There were significant differences for color, density, and quality for 'Raleigh' St. Augustinegrass from June through August, with the only exception being no differences for quality in July (Table 1). There were differences for uniformity for June only (data not shown). The HHH and HHL treatments (uniformity of 8.3) were different from the LLH and LLL treatments (7.3) with all other uniformity ratings being 8.0. Texture ratings were 4.0 for all four of the low mowed treatments (LHH, LHL, LLH, LLL) for each month and were different from the high mowed treatments which were 3.3 for the HLH and HLL treatments and 3. 0 for the HHH and HHL treatments for each of the three months (data not shown).

Both the high and low mowing height and high N rate treatments (HHH, HHL, LHH, and LHL) had the highest color ratings for all months and were different from those treatments with the low N rate (Table 1). Therefore, mowing height did not affect color since both heights under the high N rate resulted in similar color. The four treatments with low N (HLH, HLL, LLH, and LLL) had color ratings above 5.0 for all months. This would be considered acceptable color as far as being aesthetically pleasing.

The LHH and LHL treatments had the highest density for all months and was not different from the HHH and HHL treatments which were not different from the other four treatments in June and July (Table 1). The HLH and HLL treatments had the lowest density ratings (6.0) of any treatments during August. A lower mowing height can affect shoot density and help increase it (1). Thus, the low mowing height in combination with the high N rate resulted in the highest shoot density ratings

since the high N would provide more growth.

Turfgrass quality was the best under both the high and low mowing and high N rate (HHH, HHL, LHH, and LHL) during June (Table 1). Quality was lowest under the LLH and LLL treatments for June. There were no differences in quality for July as all treatments except the LLH and LLL ones resulted in a decrease in quality ratings. In August, the HHH and HHL treatments had the best quality followed by the LHH and LHL treatments. Since quality ratings of 5.0 are considered acceptable, even the lowest quality ratings for any treatment in any given month of 6.0 would be considered adequate.

Significance to Industry: Nitrogen at the high rate in combination with either mowing height provided the best color, density, and quality for 'Raleigh' St. Augustinegrass. There did not seem to be any trend regarding potassium rates. Although the rates of K did not show any visual differences as did the N rates, proper amounts of K are important to the overall health and quality of the turfgrass stand since potassium is important in relation to stress tolerance and water relations of the plant. This study indicated that 'Raleigh' provided a very good to excellent stand of turf with very good color during the months of June, July, and August in southern Louisiana. In this study, the high rate of N (1.0 lb N/ 1000 ft^2/month) under either mowing height resulted in the best color, density, and quality. Therefore, proper N fertility and adequate K along with the appropriate mowing height will result in good quality 'Raleigh' turf that has acceptable color.

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Table 1. Visual color, density, and quality for 'Raleigh' St. Augustine grass under different mowing height, N rate, and K rate treatment combinations for June, July, and August 1997.

			June			July			August		
Mowing	N	K	Color	Density	Quality	Color	Density	Quality	Color	Density	Quality
H	H	H	8.3 a[1]	7.3 ab	8.0 a	7.0 a	7.3 ab	6.7	8.0 a	7.0 ab	8.0 a
H	H	L	8.3 a	7.3 ab	8.0 a	7.0 a	7.3 ab	6.7	8.0 a	7.0 ab	8.0 a
H	L	H	6.0 b	7.0 b	7.0 b	6.0 b	7.0 b	6.0	6.0 b	6.0 c	6.0 c
H	L	L	6.0 b	7.0 b	7.0 b	6.0 b	7.0 b	6.0	6.0 b	6.0 c	6.0 c
L	H	H	8.0 a	8.0 a	8.0 a	7.0 a	8.0 a	6.7	7.3 a	7.3 a	7.3 b
L	H	L	8.0 a	8.0 a	8.0 a	7.0 a	8.0 a	6.3	7.3 a	7.3 a	7.3 b
L	L	H	5.6 b	6.6 b	6.0 c	6.0 b	6.7 b	6.0	5.6 b	6.3 bc	6.0 c
L	L	L	5.6 b	6.6 b	6.0 c	6.0 b	6.7 b	6.0	5.6 b	6.3 bc	6.0 c
		LSD	0.7	0.7	0.5	0.6	0.7	NS	0.7	0.7	0.5

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

Nutrient Concentration of Zoysiagrass Cultivars

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Index Words: Zoysiagrass, *Zoysia japonica, Z. matrella*, Nutrient Concentration

Nature of Work: Zoysiagrasses are warm season turfgrasses that are native to China, Japan, and Southeast Asia. They are well adapted to the very warm humid, warm humid, warm arid to semiarid, and transitional regions of the United States (1). When maintained under the proper cultural and climatic conditions, zoysiagrass forms a uniform, dense, and high quality turfgrass. Zoysiagrasses are utilized as a home lawn turfgrass and may be used on golf course tees and fairways, athletic fields, and parks.

There are three zoysiagrass species that are utilized as turfgrasses. Japanese lawngrass (*Zoysia japonica* Steud.) has a coarser leaf texture, lower shoot density, and better low temperature tolerance than the other two species. *Zoysia matrella* (L.) Merr. is intermediate in leaf texture, shoot density, and low temperature tolerance. Korean velvetgrass (*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* while 'Emerald' is a hybrid between *Z. tenuifolia* and *Z. japonica* and is somewhat similar in appearance to *Z. matrella* (3). Although not utilized as much as some other warm season turfgrasses, zoysiagrass has great potential for use in the Gulf Coast states (2). There has been minimal research performed relating to the fertility requirements and responses of zoysiagrass and the effects on the nutrient concentration in the plant. The objective of this study was to evaluate the effects of nitrogen and potassium fertility on the macronutrient concentrations of several zoysiagrasses.

Fertility studies were initiated on established turfgrass plots of 'Emerald', 'Meyer', and *Z. matrella* in July of 1996 at the Burden Research Center 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/93 m^2/month (1.0 and 0.5 lb N/1000 ft^2/month) and K levels of 454 and 227 g K/93 m^2/month. The treatment combinations were (N and K): HH, HL, LH, and LL. Fertility treatments were

applied in 2 split applications monthly in order to provide half of the total N and K rate for each treatment at any one application. The study was a randomized complete block design with 3 replications. The individual plots were divided into four sub-plots with N applied in one direction across the plots and K applications made in the perpendicular direction. All plots received a micronutrient fertilizer (June and August), were irrigated as needed, and mowed at a height of 3.8 cm (1.5 inch). In late August of 1996, plant tissue samples were collected, dried, and ground for nutrient analysis. The samples were analyzed for the concentrations of nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), and sulfur (S).

Results and Discussion: There were significant differences for N, P, K, Ca, Mg, and S for the different cultivars under the different N and K rate treatment combinations as shown in Table 1. The N concentrations for all cultivars under all treatment combinations were within the sufficiency range for N (2.00 - 6.00%), although they tended to be toward the low end of the range. 'Emerald' and 'Meyer' under the HH treatment had higher N concentrations when compared to both the LH and LL treatments. This was not the case for *Z. matrella* in which both the high N rates were not different from the low N rates.

The P concentrations for all cultivars under all treatment were within the sufficiency range for P of 0.20 to 0.60% (Table 1). There were few differences among the cultivars under the N and K treatment combinations. 'Meyer' under the HH treatment was different from 'Emerald' under the HL and LL treatments. All other cultivars and treatment combinations resulted in no differences for P.

The concentrations of K for all cultivars under all treatments resulted in values lower than the sufficiency range for K (2.00 - 5.00%). 'Meyer' under the HH treatment resulted in the highest K concentration (1.86%) and was different from all other cultivars and treatments except for 'Emerald' under the HH treatment (Table 1). In many cases, the treatment combinations with the high K rate were not different from those with the low K rate.

Calcium concentrations for all cultivars under all treatments (Table 1) were lower than the sufficiency range for Ca (0.50 - 1.50%). Although Ca is very rarely deficient in turfgrasses, it is important to have adequate levels in the plant since calcium is a component of cell walls and is important in the mechanical strength of the tissues (4). The highest Ca concentration was for 'Emerald' under the HH treatment (0.30%). In general, 'Emerald' under the HH and LH treatments had higher Ca levels compared to the other cultivars under other treatments.

All cultivars under all treatments resulted in Mg concentrations under the sufficiency range of 0.20 to 0.50% (Table 1). There were few differences among the treatments for any cultivar with 'Emerald' under the HH treatment having the highest Mg concentration (0.15%). Magnesium is a component of the chlorophyll molecule and is important for turfgrass color. Therefore, low levels of Mg in the turfgrass plant could affect color and the overall quality of the stand of turf. This is one nutrient that requires further research in turfgrass.

Sulfur concentrations were within the sufficiency range (0.20 - 0.50%) for all cultivars under all treatments (Table 1). 'Meyer' under the HH treatment had the highest S concentration (0.43%) while 'Emerald' under the LL treatment had the lowest (0.28%). With the increased use of sulfur coated urea (SCU) fertilizers in turf, there generally are not many instances in which S is deficient.

Significance to Industry: Cultivars of zoysiagrass have very good potential to be utilized more as a turfgrass in the Gulf Coast states including Louisiana. Appropriate concentrations of N, P, K, Ca, Mg, and S in the turfgrass plant is important in helping the plant carry out numerous physiological processes that help provide a good quality stand of turf. This study indicated that all three of the zoysiagrass cultivars under the treatment combinations imposed upon them had adequate concentrations of N, P, and S. Although N concentrations were sufficient, they tended to be toward the low end of the range. Additional potassium may be needed to provide sufficient levels of K. Calcium and magnesium were two nutrients that were present in deficient amounts in this study, and further research is needed to ascertain if fertilizers that contain these nutrients would improve the overall turf quality.

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Table 1. Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, and Sulfur Concentrations for 'Emerald', *Z. matrella*, and 'Meyer' zoysiagrasses at various N and K rate treatment combinations.

Cultivar	N	K	Macronutrient Concentration (%)					
			N	P	K	Ca	Mg	S
'Emerald'	H	H	3.15 a[1]	0.34 ab	1.76 ab	0.30 a	0.15 a	0.36 bc
	H	L	2.89 ab	0.30 b	1.50 bc	0.21 bc	0.13 ab	0.29 cd
	L	H	2.58 bcd	0.35 ab	1.57 bc	0.29 ab	0.13 ab	0.33 bcd
	L	L	2.64 bcd	0.31 b	1.46 c	0.23 abc	0.13 ab	0.28 d
Z. matrella	H	H	2.70 bc	0.35 ab	1.49 bc	0.21 bc	0.14 ab	0.36 bc
	H	L	2.60 bcd	0.33 ab	1.50 bc	0.19 c	0.12 b	0.36 bc
	L	H	2.38 cd	0.36 ab	1.44 c	0.21 bc	0.13 ab	0.37 ab
	L	L	2.36 d	0.36 ab	1.41 c	0.21 bc	0.13 ab	0.35 bcd
'Meyer'	H	H	2.84 ab	0.39 a	1.86 a	0.18 c	0.14 ab	0.43 a
	H	L	2.35 d	0.37 ab	1.52 bc	0.20 bc	0.14 ab	0.36 bc
	L	H	2.39 cd	0.33 ab	1.39 c	0.21 bc	0.13 ab	0.32 bcd
	L	L	2.34 d	0.35 ab	1.50 bc	0.19 c	0.14 ab	0.35 bcd
LSD		0.33	0.07	0.28	0.08	0.02	0.06	

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

Potential Uses of Mycorrhizal Fungi in Nursery Production and Landscape Management

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I**ndex Words:** *Acer rubrum, Betula nigra*, Colonization, Inoculation, Mycorrhizae, *Nyssa sylvatica, Pinus taeda, Pisolithus tinctorius, Pistacia chinensis, Quercus acutissima, Q. palustris, Q. phellos, Taxodium distichum*

Nature of Work: Mycorrhizal fungi are highly specialized organisms that commonly inhabit or colonize the fine, non-woody roots of most landscape plants. The root structures that form on or in plant roots as a result of colonization are called mycorrhizae, and act as extensions of the colonized plant's roots. By extending the roots the plant's absorptive surface is increased by as much as 700 percent (2) thereby allowing additional uptake of water and nutrients.

The relationship is not one-sided, but symbiotic. In exchange for extending plant roots the mycorrhizal fungi obtain carbohydrates, vitamins and amino acids from their host plants. This beneficial relationship has been well researched and documented in forest ecosystems and regeneration (3), but any research relating to nursery production and landscape management with landscape species has been limited until recently by the lack of commercially-available mycorrhizal inoculants. Methods for rapid, bulk commercial production of inoculum have now been developed, and several mycorrhizal inoculant products introduced. The efficacy and economic feasibility of these products for nursery production and landscape management have not been widely researched (1). The purpose of this research, therefore, was to begin to evaluate the potential uses for mycorrhizal fungi in the above applications. For these studies five potential uses were identified: inoculation of container-grown plants during production; inoculation of field-grown plants during production; inoculation of field-grown plants during postharvest and prelandscape during holding; inoculation of field-grown plants during landscape installation; and inoculation of established landscape plants.

Inoculation of container-grown plants during production. On April 16, 1998, Cellugro-grown seedlings of four species of ectomycorrhizal trees (*Betula nigra* (river birch), *Pinus taeda* (loblolly pine), *Quercus acutissima*

(sawtooth oak), *Q. phellos* (willow oak)) and three species of endomycorrhizal trees (*Nyssa sylvatica* (black gum), *Pistacia chinensis* (Chinese pistache), *Taxodium distichum* (bald cypress)) were potted into 3-gal containers in a 6:1 bark:sand (v:v) medium, half with Mycor Nursery/Media Mix (Plant Health Care, Pittsburgh, PA) with added Scleroderma spores incorporated into the medium, and half with no inoculant. Trees were topdressed with 1.4 oz of 15-9-12 Osmocote Plus (The Scotts Company, Marysville, OH) and grown on a conventional gravel-covered bed under overhead irrigation. Treatments were replicated seven times in a completely randomized block design.

Inoculation of field-grown plants during production/Inoculation of field-grown plants during landscape installation. Three treatments, a preharvest inoculation, a postharvest/at transplant inoculation, and a no inoculation control, were applied to one ectomycorrhizal (river birch) and one endomycorrhizal species (*Acer rubrum* (red maple)) on October 21 and 23, 1997 (pre), and on March 16 and 17, 1998 (post), respectively. The preharvest treatment was MycorTree Tree Saver Injectable (Plant Health Care) at the rate of 15 oz/100 gal water applied at 2 gal/tree in 4 injections approximately 8" deep and 12" from the trunk. The postharvest treatment was MycorTree Tree Saver Transplant (Plant Health Care) at the rate of 3 oz/1" caliper incorporated into the upper 10" of backfill at planting. Treatments were replicated five times in a completely randomized block design.

Inoculation of field-grown plants during postharvest/prelandscape holding. Two types of treatments, with or without mycorrhizal inoculation, and with or without shrink wrap root ball holding covering, were applied to two ectomycorrhizal species (river birch and willow oak). Freshly harvested tree root balls were treated on March 24 and 25, 1998 at the rate of 1 oz of MycorTree Tree Saver Injectable (dissolved in _ gal water) injected into 10-12 sites approximately 8" deep and 12" from the trunk. Half of the root balls were then covered with white shrink wrap, and half were left with the balling burlap exposed. All trees received drip irrigation as needed, and were held on a gravel-covered bed until transplanting on July 15, 1998.

Inoculation of established landscape plants. Three groups of established trees, two ectomycorrhizal (*Q. palustris* (pin oak) and willow oak) and one endomycorrhizal (red maple), growing in disturbed soils on three urban landscape sites were selected for treatment. Four treatments consisting of a water control, Peter's 9-45-15 (The Scotts Company) at a rate of 3lb N/100 gal water, MycorTree Injectable at $^1/_4$ lb/100 gal, and a fertilizer-mycorrhizal combination were injected on a grid pattern within tree drip lines with equal numbers of injections of all treatments based on

the manufacturer's mycorrhizal product rate per inch of tree caliper. Pin oaks (in Richmond, VA) were inoculated on May 19, 1998, and willow oaks and red maples (in Chesapeake, VA) were inoculated on May 29, 1998. Treatments were replicated four times for pin oak and red maple, and three times for willow oak, in a randomized complete block design. For the field and landscape studies, evaluation of mycorrhizal development and root dry weight was accomplished by removing soil cores with a golf cup cutter or by use of "RIC's" (Root-Ingrowth Cores, Plant Health Care, Frogmore, SC).

Results and Discussion: Inoculation of container-grown plants during production. On October 13, 1998 three replications of each species were harvested to determine mycorrhizal development and root and shoot dry weights. The remaining four replications were transplanted to the field on November 7 and 8 for one additional year of growth prior to evaluation. *Pisolithus tinctorius* colonization of the ectomycorrhizal species, and VAM (vesicular-arbuscular mycorrhizae) colonization of the endomycorrhizal species, was significant at the 0.05 level for treatments, species and treatment/species interaction. Top dry weight was not significant for the ectomycorrhizal species, but was significant at the 0.05 level for the endomycorrhizal species by species. Root dry weight was significant at the 0.05 level for the ectomycorrhizal trees by species, and for the endomycorrhizal trees by treatment and species.

Inoculation of field-grown plants during production/Inoculation of field-grown plants during landscape installation. No significant increase in mycorrhizal development occurred for either species, and for river birch, no significant increase in root dry weight. For red maple both preharvest and postharvest inoculation resulted in significantly increased root dry weight at the 0.05 level compared to the uninoculated control.

Inoculation of field-grown plants during postharvest/prelandscape holding. For both species, mycorrhizal inoculation resulted in significantly increased levels of *P. tinctorius* colonization and increased root dry weight, both at the 0.05 level. There was no significant effect from root ball covering, and no significant inoculation/covering interaction.

Inoculation of established landscape plants. There was no significant increase in mycorrhizal development of the two ectomycorrhizal species, but there was a significant increase in mycorrhizal development for the endomycorrhizal red maple at the 0.05 level with the mycorrhizal and mycorrhizal+fertilizer treatments. There was likewise no significant increase in root dry weight for the two ectomycorrhizal species, but there was a significant increase at the 0.05 level for the red maple with the fertilizer and mycorrhizal+fertilizer treatments. The fact that the two

ectomycorrhizal species showed no increase in mycorrhizal development might be a reflection of an adequate native population of mycorrhizal fungi at the landscape sites.

Significance to Industry: These preliminary studies suggest that where native mycorrhizal populations are nonexistent (in soilless media) or in low concentrations, mycorrhizal development can be easily promoted by the introduction of fungal inoculant. Because two biological organisms are involved in this relationship (the mycorrhizal fungus and its host plant), it is probable that a considerable lag time exists after both inoculation and mycorrhizal development before any measurable response occurs in the host plant. The fact that root dry weight did increase for some trees, in particular the endomycorrhizal tree species whose corresponding fungi's large spores cannot blow in for recolonization as can those of ectomycorrhizal fungi, is encouraging. Growth measurements to be taken later this year, and additional studies being conducted, may confirm the suspected "colonization-to-measurable-response" lag time and substantiate whether inoculation during certain phases of nursery production and landscape management would be beneficial.

(Greater detail on the materials and methods and results of these studies will be forthcoming in the Journal of Environmental Horticulture and the Journal of Arboriculture.)

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Crapemyrtle Cultivar Performance in Alabama

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Index Words: *Lagerstroemia*, Crapemyrtle, Flowering

Nature of Work: Crapemyrtle (*Lagerstroemia* spp.) is a shrub or small tree that has been found to satisfy a number of landscape needs. Valued for its summer flowers, ex-foliating bark, and autumn color, crapemyrtles are widely used. However, with so many cultivars available, making the best choice could prove difficult. Long-term studies that document flowering and growth would be a valuable resource in cultivar selection (1,2,4).

A study to determine bloom duration and intensity was undertaken on 45 crapemyrtle selections. Trees, 24 to 30 inches tall and bare root stock, were planted March 3, 1993 into 24 inch augered holes. Crapemyrtles were planted on a 20 x 25 foot spacing. There were six replications per cultivar with 2 trees in each replication. Soil throughout the 6-acre site was Marvyn loamy sand. Drip emitters (2 emitters/tree) were installed May, 1993 and plants were irrigated as needed (3). Trees were fertilized on May 26, 1993 with Polyon 24-6-16, 12 month formulation. Thereafter, they were fertilized annually with 6 ounces per tree in February of each year. Princep 4L and Surflan A.S. were applied every year during the first week of March for preemergent weed control. Post-emergence weed control was accomplished as needed with Roundup. Data collection included: growth index, which was taken after each growing season [GI = (height + width at widest point + width perpendicular to first width)/3]; flowering, which was rated weekly on a scale of 0 to 10, where 0 = no blooms and 10 = full bloom; bloom duration, which was determined from weekly flowering data; and, disease presence, which was noted in 1995, 1996, and 1997 when plants were evaluated for powdery mildew (June) and cercospora leaf spot (September) (5).

Results and Discussion: Growth index is presented only for the tall crapemyrtles. Among the white flowering cultivars, Natchez, Fantasy and Sara's Favorite were the larger plants with flowering duration of 85, 56, and 78 days, respectively (Table 1). When rated for powdery mildew and cercospora leaf spot, Fantasy and Sara's Favorite were the only tall white cultivars with little or no disease problems over the three year evaluation. There were nine pink crapemyrtle cultivars in the tall category. Basham's Party Pink, Tuscarora, and Tuskegee were all vigorous

growers with flowering duration of 94, 88, and 78 days, respectively. There were little or no disease problems with these three cultivars. Between the two lavender cultivars, Muskogee and Hardy Lavender, Muskogee was the more vigorous; flowering duration was similar, and both were susceptible to cercospora leaf spot. Carolina Beauty was the only red in this group. It was one of the smaller plants in this group and had powdery mildew in 2 of 3 years and cercospora leaf spot each year.

Significance to Industry: While there are many crapemyrtle cultivars on the market, this study shows that superior cultivars are available for the landscape industry. Superior white cultivars are Natchez, Sarah's Favorite, and Fantasy; superior pink cultivars are Baham's Party Pink, Tuscarora, and Tuskegee. There is a need in the industry for improved lavender and red crapemyrtle cultivars.

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Table 1. Growth and flowering of 17 tall crapemyrtles.

Cultivar	Species	Flower Color	Growth index (ft)			Bloom time (3 yr average)			Disease Problems	
			1996	1997	1998	Start	Finish	Duration (days)	Powdery Mildew	Cercospora Leaf Spot
Byers W. White	indica	White	6.6	8.5	9.2	7 / 01	10 / 02	93	yes	yes
Natchez	indicaxfauriei	White	9.4	12.5	15.7	6 / 26	9 / 19	85	no	yes
Fantasy	fauriei	White	9.0	11.2	14.1	6 / 29	8 / 24	56	no	no
Sara's Favorite	indicaxfauriei	White	10.0	12.7	15.8	7 / 01	9 / 17	78	no	no
Miami	indicaxfauriei	Pink	7.4	10.5	12.5	6 / 29	9 / 22	85	no	yes
Potomac	indica	Pink	7.2	8.9	10.1	7 / 01	10 / 07	98	no	yes
Tuscarora	indicaxfauriei	Pink	9.4	11.5	13.3	6 / 30	9 / 26	88	no	no
Choctaw	indicaxfauriei	Pink	10.0	12.1	15.2	6 / 27	9 / 14	79	no	yes
Biloxi	indicaxfauriei	Pink	10.8	13.5	16.2	7 / 07	9 / 14	69	no	yes
Basham's Pink	indicaxfauriei	Pink	9.4	12.2	14.6	6 / 29	10 / 01	94	no	no
Comanche	indicaxfauriei	Pink	9.1	11.6	13.3	6 / 30	9 / 08	70	no	yes
Osage	indicaxfauriei	Pink	8.3	10.2	13.3	6 / 27	10 / 01	96	no	yes
Tuskegee	indicaxfauriei	Pink	10.5	12.6	14.1	7 / 06	9 / 22	78	no	no
H. Lavendar	indica	Lavender	7.9	10.5	13.3	7 / 04	10 / 02	90	no	yes
Muskogee	indicaxfauriei	Lavender	11.4	13.9	17.2	6 / 29	9 / 13	77	no	yes
Wichita	indicaxfauriei	Lavender	6.1	8.7	10.9	6 / 30	9 / 24	86	no	no
Carolina Beauty	indica	Red	6.9	9.0	10.5	7 / 04	9 / 28	86	yes	yes

Research & Education Garden: Consumer Education Programs

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Index Words: Educational Programs, Research Garden, Educational Garden

Nature of Work: The Georgia Station Research & Education Garden is a 65-acre tract containing research plots and a Demonstration Area which lies adjacent to the University of Georgia - Griffin Campus. It serves as a vehicle to transfer research results and good gardening practices to industry professionals and the general public. Fifty percent of Georgia's population lives within 60 miles of the Garden. According to a National Gardening Association survey, 84% of homeowners do their own lawn maintenance and pest control. These homeowners spend more than $400/year for pesticides and less than 50% of them read the label.

The northeast Georgia Piedmont is one of the fastest growing areas in the United States. By the year 2010, this area will expand by 1.5 million new residents, pushing the population of the greater Atlanta area to 5 million. Nonpoint source pollution from pesticide and nutrient loading in urban areas has increased with increasing development. As a result, the Georgia Station Research & Education Garden conducts educational programs based on sound gardening practices that promote a quality landscape without degrading the environment.

Results and Discussion: Consumer Education Programs consist of quarterly Community Seminars and Workshops, student educational programs, bi-annual newsletters, *The Georgia Gardener* television show, and a Landscape Management Manual for the Homeowner.

Community Seminars & Workshops are conducted quarterly by University of Georgia scientists and renowned state gardening experts who present a variety of topics of interest to homeowners. They include A Walk Through the Butterfly Garden, Using Herbs in the Landscape, Top Ten Myths of Gardening, and Wildflowers: Low Maintenance Gardens. Workshops provide hands-on opportunities for home gardeners to learn proper gardening techniques such as bed preparation, propagation, and pruning.

Student Educational Programs consist of tours of the Research &

Education Garden, the “Learn & Serve Garden”, 4-H summer camp, and Farm City Day. Teachers may take their classes to view the research plots and Demonstration Area, permitting students to examine ongoing scientific studies and see how they are conducted. The Demonstration Area consists of 15 theme gardens each providing educational opportunities. For example, in the Butterfly Garden students can learn the life cycle of a butterfly by observing its various stages of development. In the Herb Garden, different herbs can be seen and their value in cooking, perfumes, and deodorants discovered. The Xeriscape Garden emphasizes the importance of placing plants with similar water needs together in a landscape to maintain their health as well as to reduce water usage.

The “Learn & Serve Garden” is a project funded by the state Department of Education in which local middle school students learn math and science skills by planning, planting, maintaining and harvesting a vegetable garden. Students’ academic achievement in the outdoor classroom is compared to a control group of students learning the same information in a traditional academic setting. Produce harvested from the garden is donated to the local food pantry. Teachers also assess how service learning affects student academic performance and behavior.

4-H day camp at the Research & Education Garden was offered to 5th and 6th grade children in Henry and Spalding Counties. They spent two half-days in the Research & Education Garden in July 1999 as part of a pilot program to teach students basic horticulture and provide hands-on opportunities for them to practice what they learn. This pilot program sets the stage for several thousand 4-H students to use the Garden each summer for day camp programs.

Farm City Day - All Spalding County second graders take a class trip to the Spalding County Fair Grounds each April for Farm City Day. Research & Education Garden staff and volunteers host a booth to teach children basic plant health needs and provide them a opportunity to plant a flower plug or vegetable seed.

The *Georgia Station Research & Education Garden Newsletter* contains an update of activities and programs in the Research & Education Garden including research projects. In addition, it offers IPM Notes, a discussion of Integrated Pest Management strategies for the garden during this season. The newsletter is being enhanced to include more practical gardening tips based on current research.

The Georgia Gardener television show will film segments from its permanent set based in the Garden. The show airs each Thursday evening on

GPTV at 7:30 p.m. for 30 minutes and Saturday morning at 10:00 a.m. University of Georgia horticultural educator, Walter Reeves, hosts this unique show that is both hands-in-the-dirt and cutting-edge research being carried on at the University of Georgia. The Georgia Gardener transfers research results to the general public in a timely fashion through the media of television. It has received excellent viewer ratings thus far.

Landscape Management Manual for Homeowners - To accurately assess homeowner gardening needs, their knowledge of sound gardening practices, and to learn the profile of those who do their own landscape management, a survey has been developed and administered to the general population of Georgia. Results are being tabulated. A Landscape Management Manual for the Homeowner has been adapted from an Industry IPM Manual currently used in educating landscape professionals. This information will be used to educate homeowners throughout the state, particularly in urban areas. Advanced Master Gardeners will be trained to teach the program to homeowners. Teaching will take place at the Research & Education Garden as well as at locations suggested by the survey results.

Significance to Industry: Promoting proper gardening through educational programs will stimulate interest in gardening and create a demand for both plants, turf and products needed to maintain the landscape. Transferring research results through Research & Education Garden programs gives the public access to the latest gardening information that will not only allow them to maintain a healthy landscape but protect the environment as well.

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Herbaceous Perennial Field Trials in Central Alabama, 1996-1997

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Index Words: Trial Gardens, Crop Production, Flower Cultivars, Varieties, Perennials

Nature of Work: Fifty-seven full-sun herbaceous perennials were evaluated from July 1996 - Oct. 1997 for overall performance in south-central Alabama (USDA Hardiness Zone 8; AHS Heat Zone 8). Results generated from the study will assist horticultural professionals and consumers in similar climates with selection of flowering perennials for landscape use. Selections included in the trials were based on plants landscapers and homeowners might find available in local nursery or retail garden centers.

The need for new varieties of plants and an increased interest in perennials were the trends most frequently identified in a recent Georgia survey of retail garden center outlets (2). Garden center respondents projected strongest future demand for perennials and groundcovers among eight plant categories during the next five years (2). While herbaceous perennials continue to gain popularity (4,5), many field trials continue to lump annuals and perennials together for evaluation (1). When asked to rate projects at public institutions, research and demonstration stations, growers generally put variety trials at the top of the list (3). Growers are aware that new varieties and cultivars have a profound influence on their industry and want to be the first in line when something new comes out.

In the spring of 1996, 57 herbaceous perennial varieties/cultivars were planted at the E.V. Smith Research Center (EVSRC) located in Shorter, Ala. (latitude 32°30'N, longitude 85°40'W). Raised beds of Norfolk-Orangeburg loamy sand soil (fine, loamy, siliceous, thermic Typic Kandiudults) were tilled and fumigated with methyl bromide two weeks before planting. No other fungicides or insecticides were applied during the trial period. Commercially available controlled-release fertilizer (18-6-12) was pre-plant incorporated into the beds as per soil test recommendations and then side-dressed again in the following spring (1997). No additional fertilizer was applied during the growing seasons. Six beds, each 6' (80', were prepared for planting on April 11, 1996. Three plants per entry were grown in three separate beds (a total of nine plants per

entry) in full sun in a randomized complete block design. Plants were allowed to adjust to transplanting and evaluations began July 3, 1996. Rainfall was supplemented by overhead sprinkler irrigation to provide an equivalent of one inch of water per week. Minimum deadheading of spent flowers, weeding by hand, and cutting back as needed to prevent breakage was the only other maintenance performed during the trial.

Plants were evaluated every two weeks from July 3, 1996 through Oct., 1997. Plants were rated by the same individual using a 0-5 scale in three categories: flowering, foliage and overall appearance. Plants were rated primarily on floral displays, while size, shape and freedom from insect or disease blemishes were also considered. A rating of 0 indicated the absence of a desired characteristic; 1—indicated a minimal amount of the characteristic; 2—indicated a small amount of the characteristic; 3—sufficient display to be attractive in the landscape; 4—above average display and quite beneficial in the landscape; and 5—superior display and extremely showy in the landscape. Ratings were made in whole number units.

Results and Discussion: The highest overall rating was for Lythrum virgatum 'Mordens Pink' with a rating of 4.9 for July, 1996 (Table 1). The Coreopsis rosea and Coreopsis verticillata 'Moonbeam' had second highest overall rating at 4.8. 'Moonbeam' also rated of 4.2 for Aug. 1996. Verbena bonariensis rated 4.2 and 4.0 for July and Aug. 1996, respectively. The only selection to rate of 4.0 or higher for two months in 1996 and one month in 1997, was Salvia leucantha. A plant with an overall rating of 2.5 or higher was considered a good performing plant and adequate for a full sun garden located in USDA Hardiness Zone 8 and AHS Heat Zone 8. Only the very best overall performers were highlighted, therefore only selections with an overall rating of 4.0 or higher are listed in Table 1.

Helianthus angustifolius and *Salvia uliginosa* responded well to pruning once or twice in the middle of the growing season to maintain a manageable height and prevent plants from falling over. *Artemisia* x 'Powis Castle' responded better to early spring pruning than fall or winter pruning, due to a tendency to die from winter injury if pruned too early. *Dictamnus albus* 'Purpureus', known for it's slow development, gradually increased in size each year and should be given a few years to mature. Another slow starter, *Baptisia alba* 'Pendula', had attractive, graceful arching limbs with rounded leaflets on pinnately compound leaves, with or without flowers.

Among the most impressive performers were *Scabiosa columbaria* 'Butterfly Blue' and 'Pink Mist'. Once blooming, flowers were present on

one or more plants even through the winter. *Scabiosas* had a tendency to re-seed in the immediate vicinity, providing enough additional plants for transplanting. *Verbena tenuisecta* had a moss-like carpet of foliage, which almost always had a few flowers and sometimes was covered with dark purple blooms. *V. tenuisecta* 'Alba' also performed well, but produced fewer flowers. *Verbena canadensis* 'Homestead Purple' was a similar ground cover producing purple flowers in mass but had a tendency to flower only along the edges of the spreading plant, leaving the center without blooms. *Verbena bonariensis* had a tall, open, airy growth habit and small purple flowers. *Geranium sanguineum* 'Album' produced delicate flowers on interesting palmate foliage and spread slowly, making a nice ground cover. *Rudbeckia fulgida* 'Goldsturm' was a very good performer, with large, golden color ray flowers that attracted butterflies. *Salvia leucantha* was magnificent during its long bloom season (close to three months), the grey pubescent leaves provided a good back drop for earlier flowering plants.

Several plants performed well the first year, but did not over-winter. These could be treated as annuals and still be valuable additions to the landscape if replaced every year. One such selection was *Salvia van houttie* a very showy plant reaching approximately 3' tall x 2' wide and completely covered with dark maroon flowers that attracted hummingbirds. Once the flowers fell, the dark maroon calyx remained, extending the "effective" period for several weeks. *Boltonia* selections produced seedlings to replace the mother plant, but *Boltonia asteroides* var. *latisquama* 'Nana', *B. asteroides* 'Pink Beauty' and 'Snow Bank', and *Gallardia* x *grandiflora* 'Goblin' could also be treated as annuals. In general, *Coreopsis* selections ('Moonbeam', 'Zagreb', and rosea) were disappointing, performing beautifully the first year, but, although alive, not blooming well in the second year.

Artemisia ludoviciana 'Silver King' became so invasive, it had to be removed from the trial. Therefore, we would not recommend planting it in a mixed border due to it's aggressiveness. While *Lythrum* species are often considered invasive, we had very few seedlings germinate and no colonizing through underground stolons. Caution should be used when planting this perennial, and it should not be introduced to native wetland areas.

Significance to Industry: The perennials evaluated in this study generally performed better the first year of planting than the second year. Several varieties did not return the second year, though some natural reseeding occurred. Plants that maintained attractive foliage while not in bloom and had highly rated bloom displays during the bloom season are worth incorporating into a full sun perennial or mixed border. Gardeners

and growers are encouraged to try plants in several locations to determine suitability for particular locations. Plants that received high ratings in this study appear to be tolerant of a full sun environment with little care and still perform well. Landscape performance however, may vary from year to year as climatic conditions affect performance. Results from more than one variety trial should be compared to increase the reliability of recommendations because weather, soil type, exposure, cultural practices, and other variables can greatly affect plant performance. Horticulturists are urged to visit several trial gardens to gain a better understanding of variety performance throughout a region or market area.

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Table 1. Average overall rating for best performing perennials in the 1996-97 trial garden[z].

Variety	Date	Overall
Achillea x 'Moonshine'	5/97	4.3
Artemisia x 'Powis Castle'	7/96	4.0
Aster x *frikarkii* 'Monch'	7/96	4.2
Boltonia asteroides 'Pink Beauty'	7/96	4.1
Boltonia asteroides 'Snowbank'	8/96	4.1
Coreopsis rosea	7/96	4.8
Coreopsis verticillata 'Moonbeam'	7/96	4.8
	8/96	4.2
Coreopsis verticillata 'Zagreb'	7/96	4.4
Gaura lindheimeri	5/97	4.3
Lythrum virgatum 'Mordens Pink'	7/96	4.9
Lythrum salicaria 'Robert'	7/96	4.5
Rudbeckia fulgida 'Goldsturm'	8/96	4.0
Salvia leucantha	9/96	4.4
	10/96	4.7
	10/97	4.5
Scabiosa columbaria 'Butterfly Blue'	4/97	4.2
Verbena canadensis 'Homestead Purple'	4/97	4.2
Verbena bonariensis	7/96	4.2
	8/96	4.0
Verbena canadensis 'Alba'	4/97	4.4

[z] Study conducted at the E.V.Smith Research Center of the Alabama Agricultural Experiment Station in Shorter, Alabama from Jan., 1996 through Dec., 1997. Ratings of 4.0 or higher presented. Plants rated using a 0-5 scale.

Alternative Weed Control Options for Large Container Production

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Nature of Work: Despite new herbicides and formulations, hand-weeding in the nursery is still necessary resulting in an additional $607-1400/hectare (3). Nurseries generally apply herbicides at 3-4 month intervals, and non-target herbicide losses from those applications pose environmental concerns as they enter nearby surface water. Gilliam et al. (2) reported non-target herbicide losses of 23-83% for 3 quart pots depending on spacing. Herbicide losses of 76% were reported when 4 quart containers were placed on 26.4 cm centers (7). Keese et al.(4) reported granular herbicide residues moving from application sites via runoff water into containment ponds. Potential for surface water contamination from non-target herbicide losses, coupled with the possibility of crop damage from high levels of herbicides in recycled run-off water, necessitates the investigation of alternative weed control methods such as recycled newspaper pellets, waste tires, and straw (1,5,6). Therefore the objective of this study was to determine the relative ability of non-chemical methods to suppress weed growth compared to traditional chemical methods.

Uniform quart liners of *Lagersroemia indica x faurei* 'Natchez', Natches crape myrtle, were grown in 57 liters containers form June 13 until December 15, 1997, on a gravel container pad using overhead irrigation. Growing medium was 100% pine back amended with 2.27 kg of dolomitic limestone and 0.68 kg of Micromax (The Scotts Co., Marysville, OH), per m^3. Twenty-five prostrate spurge seed were seeded onto each container after treatment to ensure uniform weed pressure. Data collected included: plant growth, weed number per container, and a weed control rating (expressed based on % of container covered by weeds). Treatments included Rout 3 G (3.27 kg ai/ha),Regal 0-0 (3.27 kg ai/ha), recycled newspaper pellets (2.2 cm thick), geotextile disks (Spin-out coated), kenaf mulch, pole shavings (4.4 cm thick) and a hand-weeded control. Treatments include Rout 3 G (3.27 kg ai/ha), Regal 0-0 (3.27 kg ai/ha), recycled newspaper pellets (2.2 cm thick), geotextile disks (Spin-out coated), kenaf mulch, pole shavings (4.4 cm thick), and a hand-weeded control. Herbicide treatments were reapplied at 90 day inter-

vals. Treatments were organized in a randomized complete block design consisting of 8 single replications.

Results and Discussion: Hand-weeded plants were almost 40% shorter than plants using Regal 0-0 or recycled newspaper pellet as a weed control technique (Table 1). Plants grown using Rout, geotextile disks, kenaf mulch, or pole shavings had similar heights compared to all other treatments. While growth was similar between some weed control treatments and the hand-weeded control, unchecked weed growth can lead to reduced plant growth due to competition for nutrients and water and is unsightly in the retail market. Crape mytrle, and aggressive species rotted into the underlying container pad, possibly moderating the competitive weed influence.

No weed were present in any weed control treatments 30 days after treatment (DAT) (Table 2). Weed numbers were higher n the hand-weeded control 90, 150, and 180 DAT. Weed numbers in pole shavings and kenaf mulch increased 90 DAT and by 180 DAT poor weed control existed. Weed numbers 120 DAT were lowest in containers with geotexitle disks. Although all treatments had fewer weds compared to the hand-weeded control 180 DAT, containers mulched with kenaf had more weeds than any other alternative weed control method except pole shavings.

Significance to Industry: Production of landscape plants in larger container sizes represents an increasing market share; however non-target losses are excessive with current herbicide practices. Increased value of crops grown in larger container sizes allows for consideration of alternative non-chemical weed control methods applied on a per-container basis. Development of a production system that includes an economically feasible non-chemical alternative would address a major environmental concern while allowing nursery producers to reduce herbicide use. With the exception of pole shavings and kenaf mulch alternative non-chemical weed control methods provided weed control comparable to chemical methods and superior to the hand-weeded control 180 DAT. Use of alternative weed control strategies merits further attention for weed control in larger containers sizes.

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Table 1. Influence of weed control methods on plant growth

Treatment	Δ Height[y](cm)[z]
Rout 3G 3.27 kg ai/ha	129.5 ab
Regal 0-0 3 kg ai/ha	166.1 a
Recycled newspaper pellets 2.2 cm thick	168.9 a
Geotextile disk + spinout	121.7 ab
Kenaf mulch 4.4 cm thick	143.5 ab
Pole shavings 4.4 cm thick	127.0 ab
Hand-weeded control	103.9 b

[x] Means followed by the same letter within a column are not different according to LSD ($p<0.05$).
[y] 150 DAT
[z] Data collected December 15, 1997

Table 2. Influence of various weed control methods on weed number for crape myrtles.

	Weed Number/Container					
	DAT					
Treatment	30	60	90	120	150	180
Rout 3G 3.27 kg ai/ha	0.0 b	0.1 b	2.4 b	2.0 ab	1.4 b	2.4 c
Regal 0-0 3.27 kg ai/ha	0.0 b	1.3 b	1.3 b	1.5 ab	2.1 b	1.8 c
Recycled newspaper pellets 2.2 cm thick	0.0 b	0.4 b	0.9 b	1.6 ab	2.5 b	2.6 c
Geotextile disk + spinout	0.0 b	0.0 b	0.0 b	0.1 b	0.3 b	0.1 c
Kenaf mulch 4.4 cm thick	0.0 b	0.8 b	2.1 b	2.5 ab	6.5 b	16.5 b
Pole shavings 4.4 cm thick	0.0 b	2.6 ab	1.5 b	12.9 ab	6.6 b	9.4 bc
Hand-weeded control	0.3 a	4.9 a	11.9 a	17.4 a	28.1 a	29.0 a

[a]Means followed by the same letter within a column are not different according to LSD (p≤0.05).

Table 3. Influence of various weed control methods on weed ratings for crape myrtles.

	Weed Ratings					
	DAT					
Treatment	30	60	90	120	150	180
	%					
Rout 3G 3.27 kg ai/ha	100.0 a	99.8 a	93.9 a	78.8 ab	85.5 ab	88.9 ab
Regal 0-0 3.27 kg ai/ha	100.0 a	98.1 a	92.5 a	98.1 a	96.3 ab	95.9 a
Recycled newspaper pellets 2.2 cm thick	100.0 a	99.5 a	97.0 a	93.9 a	87.6 ab	86.9 ab
Geotextile disk + spinout	100.0 a	100.0 a	100.0 a	99.4 a	98.5 a	99.4 a
Kenaf mulch 4.4 cm thick	100.0 a	98.3 a	92.5 a	81.3 ab	77.5 b	67.5 c
Pole shavings 4.4 cm thick	100.0 a	96.4 a	90.4 a	81.9 ab	77.5 b	79.4 bc
Handweeded	99.1 b	87.4 a	71.3 b	62.5 b	41.9 c	38.1 d

[a]Means followed by the same letter within a column are not different according to LSD (p≤0.05).