1995 Ornamentals Research Report

Research Report Series No. 10 Alabama Agricultural Experiment Station Auburn University Lowell T. Frobish, Director October 1995

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INSECT, DISEASE, AND WEED CONTROL

WOODY ORNAMENTALS

FIRST PRINTING 3M, OCTOBER 1995

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GREENHOUSE CROPS

Broiler Litter Affects Growth of Annuals and Perennials

VIRGINIA V. ALLEN AND BRIDGET K. BEHE

Disposal of broiler litter, an organic waste by-product of the poultry industry, has become more challenging in light of increased scrutiny of its potential to pollute ground and surface water. Since poultry manure contains organic forms of nitrogen, it can be composted and used as a supplement in commercial fertilizers and as a substitute for peat moss in soilless growing media.

An Alabama Agricultural Experiment Station (AAES) study was conducted to determine growth effects of two annual and two perennial plant species grown in media amended with broiler litter compost. Growth of annuals was reduced when composted litter was added to the media, while growth of perennials was minimally affected.

METHODS

Media were developed to resemble a commercially available peat-lite mix by blending composted litter, peat moss, and perlite. Four media were used, each with increasing amounts of litter compost; the lowest litter concentration was in a mix with one part litter, three parts peat, and four parts perlite (1:3:4). Other litter:peat:perlite combinations were 2:2:4, 3:1:4, and 4:0:4. Plants grown in these media were compared to plants grown in a commercially prepared peat-lite medium, Fafard #2.

Plugs of annuals *Impatiens wallerana* 'Accent Lilac' and *Capsicum fruitescens* 'Bonnie Bell' and perennials *Salvia farinacea* 'Victoria' and *Coreopsis grandiflora* 'Early Sunrise' were transplanted on Feb. 15, 1994, into four-inch square plastic pots. Transplants were placed in a polyethylene-covered greenhouse, grown for six weeks using standard cultural practices, and fertilized with 27 ounces per 100 gallons of water of 20N-8.7P-16.6K Prosol at each irrigation. Plants were irrigated as needed.

RESULTS

Impatiens were smaller when grown in media containing broiler litter compost. The addition of any amount of composted litter significantly reduced the fresh and dry weight of impatiens when compared to plants grown in Fafard #2. Height of impatiens was shortest in the 2:2:4 medium (see table). Growth indices for impatiens in 2:2:4 and 4:0:4 media were smaller than those for impatiens grown in Fafard #2. Growth index is determined by adding the height, the width at the widest point, and the width perpendicular to the widest point, and then dividing that number by three. 'Bonnie Bell,' a pepper plant, showed similar reduction in growth, height, fresh, and dry weight.

Salvia was affected minimally by the addition of composted litter to the medium (see table). The growth index for salvia grown in 4:0:4 media was somewhat smaller when compared to the Fafard treatment. Height, fresh weight, and dry weight were not affected by the use of litter in the media. *Coreopsis* was not affected by the addition of composted litter to the media.

The two annual species did not grow as well in media with litter. Other annual and perennial plant species should be tested at different rates using compost prior to larger-scale production in media containing composted litter. Broiler litter could be used as an amendment in perennial plant production.

EFFECTS ON GROWTH OF TWO ANNUAL PLANTS IN MEDIA CONTAINING BROILER LITTER COMPOST WHEN COMPARED TO A COMMERCIAL MEDIUM

Medium[1]	Height[2]	Growth index[3]	Fresh wt.[4]	Dry wt.[4]
Impatiens Wallerana 'Accent Lilac'				
1:3:4	11.1	21.1	43.9	2.8
2:2:4	5.1	9.3	8.7	0.6
3:1:4	9.2	22.7	40.8	2.8
4:0:4	8.6	14.1	15.4	1.1
Fafard #2	11.8	25.4	73.8	4.7
Salvia Farinacea 'Victoria'				
1:3:4	8.5	14.2	5.8	0.7
2:2:4	9.3	14.7	6.6	1.0
3:1:4	16.0	9.7	10.4	1.6
4:0:4	11.8	14.8	11.1	1.8
Fafard #2	14.1	20.3	17.9	2.8

[1]Medium contains broiler litter:peat:perlite by volume.
[2] Height and width measurements are in centimeters. One inch equals 2.54 cm.
[3] Growth index = (height + $width_1$ + $width_2$)/3. $Width_1$ was at the widest point, and $width_2$ was perpendicular to $width_1$. It is measured in centimeters.
[4] Weight is measured in grams. One ounce equals 28.35 grams.

Landscape Performance of Fall and Summer Annuals

BRIDGET K. BEHE, CATHERINE M. WALKER, C. CHRIS MONTGOMERY, JAMES B. WITT, AND J. DAVID WILLIAMS

Approximately 120 annual plant cultivars were observed from the fall of 1993 through the spring of 1994 in the All-America Selections Display Garden at the E.V. Smith Research Center in Shorter. In summer 1994, 270 bedding plant cultivars were evaluated in the display garden. Objectives of the studies were to assist Alabama horticultural professionals and consumers in plant selection by determining the winter tolerance of fall-flowering plants and the heat tolerance of summer-flowering plants.

In the fall test, pansies performed well throughout the fall and winter. Alternatives to pansies for the fall landscape, and nice complimentary plants, include ornamental cabbage and kale. All cultivars tested performed relatively well during the coolest part of the winter. *Dianthus* cultivars tested performed well in the early spring, but not through the fall and winter months.

In the summer test, *Salvia coccinea* 'Lady in Red' was the best-performing full-sun cultivar. This exceptional plant performed well throughout the season, providing color and texture to the landscape.

METHODS

Seeds of the entries were donated by several companies and grown by a local commercial transplant producer. Beds were located in Norfolk-Orangeburg loamy sand association (fine, loamy, siliceous, thermic Typic Kandiudults) soil, tilled, and then fumigated with methyl bromide two weeks before planting. Black plastic mulch covered the beds in the fall study. In both studies, 12 plants per entry were spaced nine inches on center in a double row. Ornamental kale in the fall study was spaced 15 inches on center. Fall transplants were planted on Nov. 8, 1993; summer transplants, May 15, 1994.

Fall plants were drip irrigated with 200 parts per million of nitrogen using 20N-8.7P-16.6K Peter's fertilizer as needed until March 23, 1994. In the summer study, a commercially available controlled release fertilizer (18N-5.2P-10K) was preplant incorporated into the beds at a rate of five pounds per 100 square feet; no additional fertilizer was added during the season.

Most plants were grown in full sun. *Impatiens* were grown under aluminum hoop frames covered with 60% black shade fabric in the summer study. In the summer study, rainfall was supplemented by overhead sprinkler irrigation to provide an equivalent of one inch of water per week. In general, June and July were cloudier and rainier than normal, but August and September were sunnier and drier than normal.

Eight of twelve plants per entry were evaluated twice monthly from Dec. 6 through March 21 in the fall study and from June 23 through Sept. 29. in the summer study. The outer four plants on each side of the test plants were used as guard rows. Plants were rated by the same individual using a scale of 1-5 (see tables for definition of scale). Flowering plants were rated primarily on their floral displays, while size, shape, and freedom from insect or disease blemishes were also considered. Display was considered to be the size and color of the leaves.

FALL RESULTS

None of the 98 pansy cultivars were spectacular, although several performed respectably. 'Jewel Light Blue' performed better than other pansy cultivars tested. Yellow cultivars in general performed better than most other pansy colors; orange cultivars were second most showy. Table 1 illustrates the five highest-rated cultivars at the peak level compared to the lowest-rated entries. 'Fama See Me' and 'Accord Yellow' were the two top-performing yellow cultivars (Table 2). Many of the

TABLE 1. FIVE HIGHEST- AND LOWEST- RATED PANSY CULTIVARS

Cultivar (seed source)[1]	Rating[2]
Five highest-rated cultivars	
Jewel Light Blue (T)	4.6
Rally Orange (P)	4.4
Fama See Me (B)	4.2
Accord Clear Yellow (G)	4.0
Jewel Yellow (T)	3.9
Five lowest-rated cultivars	
Roc White (S&G)	1.9
Fama Love Me (B)	1.8
Rally White (P)	1.8
Regal White with Rose Bl. (S)	1.6
Accord Blue Blotch (G)	1.4

[1]Seed sources: Benary (B), Clause (C), Goldsmith (G), Pan American (P), American Takii (T), Sakata (S), and Sluis and Groot (S&G).
[2]Scale: 0 = dead plant; 1 = small display of foliage with no flowers present; 2 = adequate amount of foliage with no flowers or few buds showing; 3 = adequate to large amount of foliage and a relatively small floral display; 4 = sufficient foliage and floral display to be attractive in the landscape; and 5 = superior floral display and sufficient foliage display. Ratings were made in whole number units.

TABLE 2. TWO HIGHEST-RATED PANSY CULTIVARS WITHIN EACH COLOR CLASSIFICATION

Variety (source)[1]	Peak Rating[2]	Ranking
Blue		
Jewel Light Blue (T)	4.6	1
Fama Silver Blue (B)	3.8	11
White		
Jewel White (T)	3.0	41
Universal White (G)	2.8	55
Purple		
Jewel Purple Face (T)	3.4	18
Clear Sky Purple (S&G)	3.2	24
Rose		
Accord Rose Blotch (G)	3.9	7
Regal Rose w/Blotch (S)	2.8	51
Red		
Universal Red (G)	3.8	12
Imperial Wine Fashion (T)	3.4	17
Orange		
Rally Orange (P)	4.4	2
Watercolor Melange	3.9	6
Yellow		
Fama See Me (B)	4.2	3
Accord Clear Yellow (G)	4.0	4
Mixed		
Imperial Antique Shades (T)	3.4	22
Accord Mix (G)	3.1	33

[1]Seed sources: Benary (B), Clause (C), Goldsmith (G), Pan American (P), American Takii (T), Sakata (S), and Sluis and Groot (S&G).
[2]Scale: 0 = dead plant; 1 = small display of foliage with no flowers present; 2 = adequate amount of foliage with no flowers or few buds showing; 3 = adequate to large amount of foliage and a relatively small floral display; 4 = sufficient foliage and floral display to be attractive in the landscape; and 5 = superior floral display and sufficient foliage display. Ratings were made in whole number units.

white cultivars had lower ratings than the other colors. Of 21 yellow cultivars, 10 were among the 25 highest rated cultivars. No white cultivars were among the top 25. Conversely, 10 of the 13 white cultivars observed were among the 25 lowest rated entries.

All of the ornamental kale entries performed generally well. 'Red Chidori' was particularly notable. 'White Kamome' was well established by Jan. 17. Other cultivars made a respectable showing with regard to peak rating on March 21. Within each variety, plants were strikingly uniform in size and color. As of the termination of the test, none of the kale cultivars had bolted.

'Princess White,' 'Pink,' and 'Purple' were the earliest of the dianthus cultivars to show significant development. Foliage was fairly uniform and healthy in appearance. These cultivars exhibited good development of foliage and floral display particularly by late March. While slower to develop in midwinter, 'Prin-

TABLE 3. FINAL HEIGHT AND WIDTH MEASUREMENTS AND SEASON-LONG AVERAGE RATING OF PLANTS IN THE 1994 SUMMER TRIAL GARDEN

Plant (source)[1]	Height[2]	Rating[3]
Achillea Summer Pastels (AAS)	32	2.5
Ageratum Blue Blanket (S&G)	45	2.9
Canna Tropical Rose (AAS)	87	3.6
Celosia Pink Candle (T)	102	3.6
Celosia Castle Pink (AAS)	0	2.5
Celosia Castle Scarlet (T)	0	2.3
Celosia Castle Yellow (T)	0	3.0
Celosia New Look (V)	60	3.9
Celosia argentea plumosa Miss Nippon Mixture (B)	0	2.3
Celosia argentea plumosa Miss Nippon Scarlet (B)	39	3.2
Coleus Vaughan's Rainbow Mix (V)	91	3.7
Gaillardia pulchella Red Plume (S&G)	35	3.3
Gazania splendens Talent Gold (B)	0	1.4
Gazania splendens Talent Mix (B)	0	0.1
Gomphrena Rainbow Orange (V)	69	4.3
Heliotrope Mini Marine (V)	0	1.2
Impatiens Impulse Lilac Blue (S&G)	58	4.4
Impatiens Blitz 2000 Formula Mix (S&G)	65	4.7
Impatiens Tango (AAS)	91	4.5
Impatiens Blitz 2000 Pink (S&G)	62	4.3
Impatiens Impulse Carmine (S&G)	62	4.3
Impatiens Accent Rose (G)	62	4.6
Impatiens Impulse Rose (S&G)	60	4.6
Impatiens Blitz 2000 Rose (S&G)	73	4.5
Impatiens Tiara Rose (C)	70	4.6
Impatiens Accent Salmon (G)	72	4.6
Impatiens Blitz 2000 Salmon (S&G)	81	4.6
Impatiens Impulse Salmon Orange (S&G)	60	4.6
Impatiens Impulse Salmon (S&G)	63	4.6
Impatiens Impulse Salmon Rose (S&G)	62	4.6
Impatiens Accent Violet Star (G)	78	4.6
Impatiens Impulse Violet (S&G)	77	4.6
Impatiens Accent Violet (G)	72	4.6
Impatiens Blitz 2000 Violet (S&G)	81	4.6
Impatiens Impulse Bright Eye (S&G)	70	4.6
Lavender Lady (AAS)	0	0.3
Lobelia erinus compacta Blue Moon (S&G)	0	2.1
Melampodium paludosum Medallion (S&G)	84	4.3
Nierembergia Mont Blanc (AAS)	15	2.0
Marigold Inca Gold (G)	0	3.7
Marigold Janie Flame (G)	34	3.2
Petunia Butter Cream Carpet (PA)	0	1.8
Petunia Celebrity Chiffon Morn (AAS)	26	2.6
Petunia Madness Rose (BA)	27	2.6
Petunia Primetime Salmon Morn (G)	0	3.3
Petunia Primetime Burgundy (G)	0	2.7
Petunia Ultra Scarlet (G)	27	2.7
Petunia Purple Wave (PA)	16	3.5
Petunia Primetime Pink (G)	22	3.7
Petunia Primetime Mixture (G)	0	2.2
Petunia Primetime Lavender (G)	0	2.0

[1](AAS) All-America Selections, (T) American Takii, (B) Benary, (BA) Ball, (C) Clause, (G) Goldsmith, (PA) Pan American, (SA) Sakata, (SN) Sandhill Nursery, (S&G) Sluis & Groot, (V) Vaughn, (W) Waller, (WR) Wright's.
[2]Height is in centimeters; 10 cm = approximately four inches.
[3]Rating: 0 = dead plant; 1 = small display of foliage with no flowers present; 2 = adequate amount of foliage with no flowers or few buds showing; 3 = adequate to large amount of foliage and a relatively small floral display; 4 = sufficient foliage and floral display to be attractive in the landscape; and 5 = superior floral display and sufficient foliage display. Ratings were made in whole number units. Ratings in this table reflect the plants' average performance throughout the season.

cess Crimson,' 'Telstar Mixture,' and 'First Love' came on strong in late February and early March to yield an adequate to attractive foliar and floral display.

SUMMER RESULTS

The few cultivars that received a 4 rating or better in full sun deserve consideration for use in Alabama gardens (Table 3). *Salvia coccinea* 'Lady in Red' was the top ranked of these cultivars, earning an average rating of 4.5. Other top performers included *Gomphrena* 'Rainbow Orange,' *Melampodium* 'Medallion,' *Verbena speciosa* 'Imagination,' and *Zinnea linearis* 'Classic.' Overall, vincas also did well, especially 'Rose Cooler' and 'Pretty in Rose.'

Although none of the 78 petunia cultivars performed as well as these top-rated plants, several did earn respectable ratings. 'Primetime Pink' and 'Purple Wave' were the two best petunias in the trial. Others in the Primetime series also performed well, including the best salmon cultivar, 'Primetime Salmon Morn'; best lavender, 'Primetime Lavender'; and best mix, 'Primetime Mix.' 'Ultra Scarlet' tied 'Primetime Burgundy' for the best red. 'Madness Rose' was the best of the rose cultivars, while 'Ultra Blue Vein' was the best blue. None of the white petunias performed well; even the best, 'Butter Cream Carpet,' had mediocre foliage and poor floral development. Also, the All-America Selections Winner 'Celebrity Chiffon Morn' had only an average rating of 2.6 in this trial.

Of the 30 marigold cultivars evaluated, the best African marigold was 'Inca Gold.' The best French marigold was 'Janie Flame.'

All 63 impatiens cultivars performed well under 60% shade. Most received a season-long average rating of 4 or higher. The Impulse series had more colors that performed well than any other series, including the top lavender impatiens, 'Impulse Lilac Blue.' The best white cultivar was 'Blitz 2000 White'; best mix, 'Blitz 2000 Formula Mix'; best orange, 'Tango'; best pink, 'Blitz 2000 Pink'; and best red, 'Impulse Carmine.' 'Blitz 2000 Rose Star,' 'Accent Rose,' 'Impulse Rose,' and 'Tiara Rose' were all equally superior among rose-colored impatiens. All violet- and salmon-colored impatiens were among the highest rated plants in the test.

TABLE 3 (CONTINUED). FINAL HEIGHT AND WIDTH MEASUREMENTS AND SEASON-LONG AVERAGE RATING OF PLANTS IN THE 1994 SUMMER TRIAL GARDEN

Plant (source)[1]	Height[2]	Rating[3]
Petunia Ultra Blue Vein (G)	0	2.7
Salvia farinacea Renaissance (S&G)	47	4.1
Salvia coccinea Lady In Red (AAS)	83	4.5
Salvia Cover Girl (B)	39	4.2
Salvia Fuego (S&G)	39	4.3
Salvia Bonfire Elite (V)	64	4.3
Salvia Rambo (V)	0	3.1
Salvia Grenadier (V)	40	3.4
Salvia Maestro (V)	0	1.8
Salvia Hot Stuff Red (V)	34	3.6
Salvia Hot Stuff Rose (V)	33	2.5
Salvia Hot Stuff Salmon (V)	29	2.6
Salvia Hot Stuff Violet (V)	45	3.4
Salvia Hot Stuff White (V)	38	2.6
Rudbeckia hirta Toto (B)	0	0.8
Rudbeckia hirta Indian Summer (AAS)	46	3.5
Rudbeckia Becky Mix (T)	0	1.2
Sunflower Sunrich Lemon (T)	0	0.3
Sunflower Sonja (B)	0	0.3
Verbena Amour Mixture (G)	0	1.7
Verbena Valentine Light Blue (BA)	14	2.2
Verbena Exp. Lit. Pink (BA)	9	1.3
Verbena Royal Valentine (BA)	11	1.5
Verbena Peaches & Cream (AAS)	0	0.8
Verbena hybrida Novalis Deep Blue With Eye (B)	14	1.6
Verbena hybrida Novalis Mix (B)	0	1.4
Verbena hybrida Romance Formula Mix (S&G)	8	1.2
Verbena hybrida Novalis Rosyred With Eye (B)	0	0.7
Verbena hybrida Novalis Rose With Eye (B)	0	1.1
Verbena hybrida Novalis Brilliant Rose (B)	0	1.3
Verbena hybrida Novalis Bright Scarlet (B)	0	1.1
Verbena hybrida Novalis White (B)	16	1.9
Verbena x speciosa Imagination (AAS)	37	4.2
Vinca Parasol (AAS)	59	3.6
Vinca Apricot Delight (W)	34	3.4
Vinca Topicana White (W)	33	3.8
Vinca Pacifica Red (W)	38	3.6
Vinca Pacifica Punch (W)	51	3.8
Vinca Pacifica Polka Dot (W)	46	3.7
Vinca Icy Pink Cooler (PA)	56	3.7
Vinca Pink Cooler (PA)	56	3.5
Vinca Rose Cooler (PA)	48	4.3
Vinca Pretty In Rose (AAS)	58	4.3
Zinnia Dreamland Mix (T)	0	2.7
Zinnia Peter Pan Mixture (G)	0	2.5
Zinnia Short Stuff Mixture (G)	0	2.0
Zinnia Scarlet Splendor (AAS)	0	1.7
Zinnia Short Stuff Deep Red (BA)	0	0.8
Zinnia Short Stuff Scarlet (BA)	0	1.2
Zinnia Short Stuff Gold (BA)	0	2.2
Zinnia Short Stuff White (BA)	0	1.8
Zinnia White Star (V)	48	3.8
Zinnia Short Stuff Coral (BA)	25	2.6
Zinnia Short Stuff Orange (BA)	0	2.1
Zinnia Linearis Classic (V)	51	4.1

[1](AAS) All-America Selections, (T) American Takii, (B) Benary, (BA) Ball, (C) Clause, (G) Goldsmith, (PA) Pan American, (SA) Sakata, (SN) Sandhill Nursery, (S&G) Sluis & Groot, (V) Vaughn, (W) Waller, (WR) Wright's.
[2]Height is in centimeters.
[3]Rating: 1 = small foliar display, no flowers; 2 = adequate foliage, no flowers or few buds; 3 = adequate to large amount of foliage, relatively small floral display; 4 = sufficient foliage and floral display; and 5 = superior floral display and sufficient foliage display.

National Bedding Plant Production Increasing

BRIDGET K. BEHE AND CATHERINE M. WALKER

Nationally, the bedding plant market has been expanding over the last 20 years with increases more evident in production units rather than prices. The objective of this study was to quantify changes in production units and prices from 1993 to 1994 for both annual and perennial plants.

Plant producers were asked to compare the 1993 and 1994 seasons in terms of numbers grown, prices, and total sales. A large majority reported increases in gross sales for 1994, and half of those who reported increases had growth of more than 6%. However, prices changed less than 1% for most producers over the last five years. Since sales increased more than prices, producers experienced an increase in units sold.

METHODS

Questionnaires were mailed to members of the Professional Plant Growers Association in 1993 and 1994. This organization had approximately 1,400 members in 1993; 1,169 in 1994. Twenty-two percent of the members participated in the study each year.

Members from 41 states and four Canadian provinces responded. The greatest number of responses came from Michigan (49), which accounted for 19% of the total. Respondents from several states in the Northeast accounted for 38% of the total: Michigan, Ohio, New York, and Pennsylvania.

RESULTS

Eighty percent of the members surveyed experienced an increase in gross sales, while 9% reported a decrease. Eleven percent reported that their gross sales had changed less than 1%. Thirty-one percent reported a 1-5% increase in gross sales, 24% reported a 6-10% increase, and 25% reported an increase of more than 10%. Four percent of members reported a decrease of 1-5% in gross sales, 3% indicated a decrease of 6-10%, and 2% indicated a decrease of more than 10%.

Small changes in flat and pack prices were made from 1993 to 1994. Forty-four percent of the respondents changed prices by less than 1%. Forty-nine percent of the respondents raised prices, while 7% of the respondents lowered prices. Forty-one percent of respondents raised prices 1-5%, 6% raised prices 6-10%, and 2% raised prices more than 10%. Six percent of respondents lowered prices 1-5%, 1% lowered prices 6-10%, and 0.4% lowered prices more than 10%. These price changes were very similar to changes made from 1992 to 1993.

TABLE 1. OVERVIEW OF BEDDING PLANT PRODUCTION IN 1994

Crop	Pct. growers selling crop	Avg. grade[1]	Pct. rating excellent[2]	Pct. of total sales	Own seedlings[3]	Own plugs[3]	Bought plugs[3]
Ageratum	75	2.5	13	2.1	35	40	25
Alyssum	73	3.1	35	3.1	40	41	19
Asters	57	2.1	6	0.7	41	41	18
Begonias	77	3.1	38	7.3	19	36	45
Browallia	52	2.0	5	0.9	34	41	25
Celosia	72	2.3	4	1.9	33	43	24
Dahlias	71	2.7	16	1.9	40	41	19
Dianthus	75	3.0	30	2.6	33	42	25
Dusty Miller	77	2.9	26	2.8	32	40	28
Geranium (s)	57	2.9	31	6.3	25	42	33
Geranium (c)	68	3.5	62	15.0	15	27	58
New Guinea Impatiens	70	3.3	53	4.2	14	26	60
Impatiens	77	3.5	63	14.8	22	41	37
Lobelia	69	3.1	39	2.0	36	40	24
Marigolds	76	2.9	25	6.9	47	37	16
Pansies	75	3.4	55	6.2	34	36	30
Petunias	77	3.1	38	9.1	31	39	30
Phlox	46	2.1	10	4.4	42	41	17
Portulaca	73	2.8	24	2.2	35	40	25
Salvia	75	2.7	13	2.7	35	41	24
Snapdragon	72	2.8	19	2.3	35	40	25
Verbena	67	2.6	15	1.4	33	39	28
Vinca	70	2.9	34	3.0	27	40	33
Zinnias	64	2.6	18	1.4	48	41	11
Cabbage	61	2.0	6	1.0	52	38	10
Peppers	66	2.7	19	2.0	46	41	13
Tomatoes	68	3.0	37	3.9	50	39	11
Other Bedding Plants	40	2.8	14	6.9	41	38	21
All Perennials	55	3.3	47	15.3	32	25	43

[1]Survey respondents used a scale of 1-4 to rate the market for each plant; 1 = poor, 2 = fair, 3 = good, and 4 = excellent.
[2]The percentage of respondents who rated the sales trend of each crop as a 4.
[3]Plants were either produced from seedlings or plugs that producers grew themselves or from plugs they purchased from outside sources. These columns in the table show the percentage of growers using each propagation method.

Solid increases were reported in the number of units (flats and packs) marketed in 1994, with 39% of the participants reporting increases of 6% or more. Seventy percent of the respondents sold more units, while only 10% sold fewer flats and packs. Twenty percent of the growers sold the same number of units as in 1993 (+/- 1%). A greater percentage of firms increased marketing more than 10% than were predicted in 1993. Thirty-two percent of respondents increased units sold 1-5% (30% projected increases in 1993); 23% increased units sold 6-10% (15% projected increases in 1993); and 16% increased units sold more than 10% (11% projected increases in 1993). Six percent of respondents decreased units sold 1-5%, 3% decreased units sold 6-10%, and 0.4% decreased units sold more than 10%.

In order to determine some specifics in production and marketing of annuals, respondents were asked a series of questions pertaining to individual crops (Table 1). Nearly all respondents reported marketing several types of annuals. Plants marketed by the greatest percentage of respondents were impatiens, petunia, begonia, dusty miller, and marigold. Plants marketed by the fewest respondents were phlox, browallia, and seed geranium. Nearly half of all respondents reported growing each annual species listed.

Members also were asked to rate sales trends for each of the annuals. The average rating was highest for impatiens. Other annuals rated as having good or better sales trends were alyssum, begonia, dianthus, geranium from cutting, New Guinea impatiens, lobelia, pansies, petunia, and tomato. Sales trends for perennials as a whole were rated as slightly better than good. Four substantial changes over the 1993 season were noted in 1994. First, 30% of respondents rated dianthus sales as excellent in 1994, as compared to 25% in 1993. Second, only 63% rated impatiens sales as excellent in 1994, down from 71% in 1993. Third, pansy sales appeared to be improving; 55% of respondents rated their sales as excellent in 1994, compared to 45% in 1993. Fourth, 34% rated vinca sales excellent in 1994, compared to 24% in 1993.

Some annual plants accounted for a large amount of the average respondent's crop. Impatiens and cutting geraniums were leaders, accounting for an average 15% of the crop.

Significant percentages of respondents used their own plugs or seedlings to produce alyssum, aster, dahlia, marigold, zinnia, cabbage, pepper, and tomato. However, more than 40% of respondents reported propagating begonia, perennials, New Guinea impatiens, marigold, pansy, verbena, cabbage, and peppers from purchased plants or plugs.

Table 2. Overview of the Market for Perennials in 1994

Crop	Pct. growers selling crop	Avg. grade[1]	Pct. rating excellent[2]	Pct. of total sales
Achillea	48	2.4	12	2.7
Aquilegia	48	2.8	27	3.8
Chrysanthemum	48	3.0	34	12.0
Dianthus	50	3.0	33	4.7
Hemerocallis	45	2.9	34	5.1
Hosta	48	3.0	50	8.0
Orn. Grasses	40	2.2	18	2.0
Phlox	45	2.7	23	4.8
Primula	43	2.5	19	4.0
Salvia	42	2.5	16	2.3

[1]Survey respondents used a scale of 1-4 to rate the market for each plant; 1 = poor, 2 = fair, 3 = good, and 4 = excellent.
[2]The percentage of respondents who rated the sales trend of each crop as a 4.

Perennial plant sales were as strong as annual plant sales in 1994 with an estimated 5.3% growth in the numbers of units produced. Seventy-four percent of respondents reported an increase in 1994 perennial sales, while only 11% experienced a decrease. Sixteen percent had a change in sales of less than 1%. Twenty-three percent of respondents had an increase of 1-5%, 23% had an increase of 6-10%, and 28% had an increase of more than 10%. Four percent of respondents had a decrease of 1-5%, 3% had a decrease of 5-10%, and 3% had a decrease of more than 10%. Perennial plant sales continue to grow significantly as more participants reported increases of 10% or more.

Perennial sales accounted for an average 15.3% of the total crop. They had a very good overall rating in terms of the future sales outlook. Twenty-three percent of the study's participants did not market perennial plants. On the average, a higher percentage of 1994's respondents marketed perennials.

The mix of perennial species produced by commercial growers is relatively large (Table 2). This is reflected in the low percentage of sales accounted for by any one perennial type. Chrysanthemum accounted for the largest percentage of the average of any producer's perennial crop, followed by hosta, hemerocallis, phlox, and dianthus.

Fifty percent of the respondents rated hosta as having excellent sales in 1994. This was up from 37% in 1993. Significant improvement was also seen in sales of dianthus; 33% of respondents reported excellent sales in 1994, compared to 23% in 1993. Hemerocallis sales were slightly better in 1994, but sales of primula and salvia decreased to some extent. Increases were planned for individual types of perennials in 1995, although no one perennial was due to be increased more than 12%.

Consumer Preferences for Geranium Flower Color, Leaf Variegation, and Price

BRIDGET K. BEHE AND ROBERT G. NELSON

Previous research highlighted a strong preference for red flowers among many customers, but there is no information on preferences for leaf type. An AAES study was conducted to determine consumer preferences for geranium flower color, leaf variegation, and price.

There were differences in consumer preferences for these factors in geraniums. However, flower color was the most important factor, comprising nearly half of the purchase decision for all gender and age groups. As one might expect, consumers preferred lower prices. Leaf variegation had little effect on the purchase decision.

METHODS

Five flower colors were used: red, pink, white, coral, and lavender. Variegation is a band or stripe on the leaf; it can be dark or white. Three leaf patterns were used: plain green leaf (no zone), green leaf with white zone, and green leaf with dark zone. Prices varied from \$1.39 to \$2.79 in increments of 20 cents. Researchers developed composite photographs to represent each of the 25 possible combinations of these factors. Consumers shopping at two Montgomery garden centers were asked to rate each photograph. The rating scale was from 1 (not likely to buy) to 10 (likely to buy). "Conjoint analysis" allowed simultaneous determination of the importance of each factor and selection of the most preferred product.

Of the 204 respondents, 79% were female, and 21% were male. The mean age was 48 years, and the median household income was \$50,000 to \$54,999. Thirty percent had completed some high school, 48% had completed college, and 22% had completed advanced degrees.

RESULTS

Conjoint analysis was used to determine the highest- and lowest-rated plants (Table 1). 'Danielle,' a lavender geranium with green leaves surrounded by a white zone, priced at \$1.39, was most preferred. 'Snow White,' a white flower with plain green leaves, priced at \$2.39, was least preferred. Contrary to previous studies, red geraniums were not most preferred.

Conjoint analysis also revealed the relative importance of each factor when consumers were making purchase decisions (Table 2). For the sample as a whole, flower color was most important, followed by price. Leaf variegation was relatively unimportant in the purchase decision. For men, flower color and leaf variegation were more important in the purchase decision than for women. Retail price was more important to women. Consumers older than 60 used flower color and leaf variegation more than the group overall in making their decisions.

Since flower color was found to be such a major factor in purchase decisions, plant breeders and marketers should focus more on developing and selling different colors of geraniums rather than different leaf variegation patterns.

TABLE 1. THREE HIGHEST- AND LOWEST-RATED GERANIUMS

Rating	Flower[1]	Leaf	Price
Highest-rated			
6.56[2]	Lavender	Var[3]	\$1.39[4]
6.39	Dark Red	None	\$1.39
6.36	Lavender	None	\$1.59
Lowest-rated			
4.66	Pink	None	\$2.39
4.27	White	None	\$2.79
4.21	White	None	\$2.39

[1]Varieties: lavender = Danielle; dark red = Flame; Pink = Mrs. Parker; and white = Show White. Other flower colors were coral and red.
[2]Average rating on a scale from 1 (definitely would not buy this plant) to 10 (definitely would buy this plant).
[3]Leaf variegation was none (none), green leaf with white zone (var), or green leaf with dark zone (zone).
[4]Prices were: \$1.39, \$1.59, \$1.79, \$1.99, \$2.39, or \$2.79.

TABLE 2. RELATIVE IMPORTANCE OF FLOWER COLOR, LEAF VARIEGATION, AND PRICE TO CONSUMERS [1]

Group	Color	Variegation	Price
Overall (191)	52.05	3.38	44.57
Male (35)	67.74	10.59	21.67
Female (140)	48.70	3.13	48.18
60 or less (134)	44.84	5.09	50.07
61 or more (37)	61.82	7.51	30.67

[1]This table shows the percentage each attribute was weighted in the purchase decision as calculated by conjoint analysis. The number of respondents is shown in parentheses.

INSECT, DISEASE, AND WEED CONTROL

Crapemyrtle Cultivars Resistant to Powdery Mildew

AUSTIN K. HAGAN, GARY J. KEEVER, CHARLES H. GILLIAM, AND J. DAVID WILLIAMS

Powdery mildew, which is caused by *Erysiphe lagerstroemiae*, is a common and sometimes damaging disease of crapemyrtle. Although severe mildew infections have little visible impact on tree vigor, the off-color, distorted foliage on heavily diseased crapemyrtle detracts from this tree's ornamental value. Powdery mildew often is most noticeable on the "seedling" or volunteer crapemyrtles, which are found in the landscapes of many older Alabama homes.

Establishment of mildew-resistant crapemyrtle cultivars has been recommended for years as an alternative to costly, time-consuming, and sometimes ineffective fungicide spray programs. In 1994, the severity of powdery mildew was evaluated in a field planting of crapemyrtle. Of the 45 crapemyrtle cultivars evaluated, the majority demonstrated good to excellent resistance to powdery mildew.

METHODS

Bare-root crapemyrtle (*Lagerstroemia* spp.) was planted March 3, 1993, into a Marvyn loamy sand soil on 20-foot centers in rows spaced 25 feet apart. Planting holes were dug to a depth of 24 inches. A trickle irrigation system was installed shortly after tree establishment. Trees were grown in full sun and irrigated as needed. Each tree was topdressed with 3.2 ounces of fertilizer (13-13-13) on May 26 and June 24, 1994. Weeds around the base of each tree were controlled with a weed trimmer and applications of Roundup. Alleys between rows were periodically mowed. Disease severity was rated on Aug. 4, 1994.

RESULTS

The highest disease ratings were noted on the cultivar Gray's Red. Extensive powdery mildew development also was observed on the cultivars Orbin's Adkin, Carolina Beauty, PI6789220 White, Byers Wonderful White, and Potomac. Light colonization and distortion of the leaves was seen on an additional 22 cultivars. However, 17 cultivars were entirely free of powdery mildew symptoms.

REACTION OF CRAPEMYRTLE CULTIVARS TO POWDERY MILDEW

Cultivar	Disease rating[1]
Gray's Red	2.3
Orbin's Adkin	1.8
Carolina Beauty	1.7
PI6789220 White	1.7
Byers Wonderful White	1.6
Potomac	1.5
Zuni	0.9
Country Red	0.9
Hardy Lavender	0.6
Pecos	0.6
Seminole	0.6
Raspberry Sundae	0.5
Yuma	0.5
William Toovey	0.4
Majestic Beauty	0.4
Caddo	0.3
Natchez	0.3
Velma's Royal Delight	0.3
Glendora White	0.3
Powhatan	0.3
Regal Red	0.3
Wichita	0.3
Centennial Spirit	0.2
Basham's Party Pink	0.2
Cherokee	0.1
Hopi	0.1
Near East	0.1
Catawba	0.1
Choctaw	0.0
Sioux	0.0
Apalachee	0.0
Tuscarora	0.0
Acoma	0.0
Muskogee	0.0
Miami	0.0
Peppermint Lace	0.0
Comanche	0.0
Fantasy	0.0
Osage	0.0
Biloxi	0.0
Sarah's Favorite	0.0
Lipan	0.0
PI6789713	0.0
Tuskegee	0.0
Tonto	0.0

[1]Scale of 0-4, with 0 = no disease; 1 = 1-25% of the leaves damaged or extensively colonized by the powdery mildew fungus; 2 = 25-50%; 3 = 50-75%; and 4 = 75-100%.

Application of Pesticides and Pesticide Combinations for Control of Liriope Scale on Container-Grown Liriope

William H. Reynolds, Michael L. Williams, and Gregory S. Hodges

Liriope scale insects, among the most frequently encountered pests of commercially grown liriope, ophiopogon (mondo), rhodea, and related turf plants, reduce the health and vigor of infested plants by sucking out plant juices. An AAES study showed that several pesticides provide excellent control of these insects.

Figure 1. These container-grown liriope plants show mild chlorosis and foliar die back caused by moderate infestation of liriope scale.

The scale cover is tan to brown, oyster-shaped and one to two millimeters long. Only the immature scale is mobile; once settled on the foliage, it remains attached for the remainder of its life. Scale insects often go unnoticed until populations have reached high levels, at which time the chlorotic spotting produced by feeding becomes evident. Although liriope plants in outdoor plantings may become infested, container-grown plants are at greatest risk. When infestations become heavy on containerized plants, rapid decline in plant health and death may result.

Control of Liriope Scale on Container-Grown Liriope

Treatment[1]	Rate[2]	No. living insects[3] 7 DAT[4]	28 DAT	56 DAT
Orthene 15G	0.05 g/pot	2.75	1.75	0.50
Orthene 15G	0.10 g/pot	3.75	2.00	0.00
Orthene 15G	0.20 g/pot	1.25	0.75	0.00
Orthene 15G	0.30 g/pot	0.75	0.00	0.00
Sunspray 6E	2 gal./100 gal.	0.50	0.00	0.00
Cygon 2E	0.5 lb./100 gal.	1.50	0.00	0.00
Merit 2.5% G	0.025 g/pot	1.75	0.50	0.00
Control	--	9.75	8.50	5.00

[1]Treatments were applied Aug. 30, 1993. Granular material were scattered on the soil surface; Cygon 2E and Sunspray 6E applied as foliar sprays to runoff.
[2]Rate of active ingredient used in each treatment.
[3]Mean number of living insects per four blades.
[4]DAT = days after treatment.

METHODS

In 1993, seven pesticides were evaluated for control of liriope scale (*Pinnaspis caricis*) on containerized liriope, *Liriope spicata*. Thirty-two scale-infested liriope plants in trade gallon containers were selected for treatment. Pesticide tests were initiated Aug. 30, 1993, using both foliar sprays and granular materials. Foliar sprays were applied to runoff using hand-held compressed air sprayers. Care was taken to thoroughly wet all plant surfaces. After treatment, all sprayed plants were allowed to air dry. Granular materials were sprinkled di-

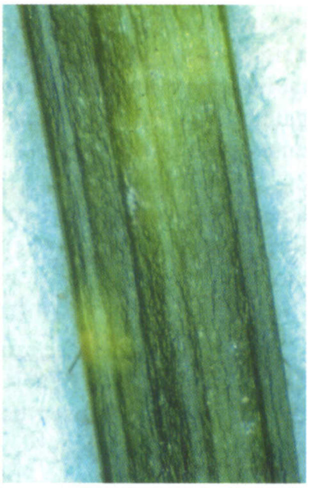


Figure 2. Characteristic chlorotic spotting caused by feeding of liriope scale.

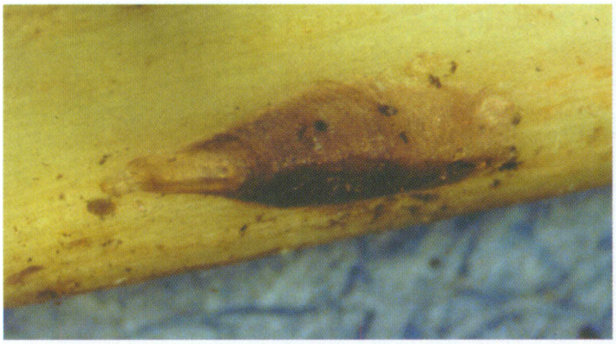


Figure 3. Scale cover of adult female insect on leaf.

rectly on the soil surface. Plants were placed under an overhead sprinkler system within a shadehouse at the Auburn University Pesticide Research Facility. Plants were then watered for one hour. After the initial watering, plants were watered as needed.

RESULTS

Several pesticides evaluated in this test provided excellent control, offering growers new materials to be used to combat scale insect infestations. After 56 days, 100% control of liriope scale was obtained from the following pesticides: Orthene 15G at rates greater than 0.05 gram of active ingredient per pot, Sunspray 6E, Cygon 2E, and Merit 2.5% G (see table). Of the seven pesticides tested in 1993, only plants treated with Orthene 15G at the 0.05-gram per pot rate had living insects after 56 days. Phytotoxicity was not observed in any of the treatments. Early recognition of infestations coupled with pesticide application may help in the management of liriope scale.

Figure 4. Liriope scale infestations are often overlooked because of the insects' habit of clustering at the bases of the leaf sheaths and blade axils.

Managing Boxwood Leafminer in Containerized Boxwood

Michael L. Williams, William H. Reynolds, and Greg S. Hodges

The boxwood leafminer, *Monarthropalpus buxi* (Laboulbene), is considered by many to be the most serious insect pest of boxwood, and is found from the Atlantic to the Pacific wherever boxwood grows. An AAES study identified several insecticide treatments to control the leafminer.

Eleven cultivars of *Buxus sempervirens*, as well as *Buxus microphylla* and *B. harlandi,* may become heavily infested with boxwood leafminer. Dwarf English boxwood, var. *suffruticosa* is rarely infested, and the varieties *pendula* and *argenteo-variegata* appear to be immune to attack.

In Alabama, boxwood leafminer has a single generation each year, passing the winter as partly grown larvae in the leaves. In early spring (March-April), the larvae develop rapidly, pupate within the mine in the leaf, and emerge as small orange flies. The adult flies mate and begin laying eggs within two to three hours after emergence. Eggs hatch in about 19 days, and the larvae develop slowly until fall when they begin to increase considerably in size.

Figure 1. Boxwood leafminer damage.

The effect of an occasional boxwood leafminer in a leaf is not significant, but in heavy infestations five or more larvae may develop in a single leaf. In this situation, the larval mining activity severely weakens the plant, making it more susceptible to attack by disease and winter kill in colder areas.

METHODS

Six pesticide treatments were evaluated for control of boxwood leafminer infesting outdoor, container-grown boxwood. Test materials were applied Aug. 30, 1993, to two-foot-tall boxwoods growing in three-gallon containers. All plants were heavily infested with boxwood leafminer larvae. Pretreatment counts of ten leaves averaged 9.7 larvae per leaf. Granular formulations were scattered over the soil surface in the container, and Cygon was applied as a foliar spray using a hand-held compressed-air sprayer. Care was taken to cover undersides of leaves with the Cygon spray. After treatment application, foliar-sprayed plants were allowed to dry, and all plants were randomized in a block under an overhead sprinkler system. Plants were then irrigated for one hour. After the initial irrigation, plants were watered as needed. Efficacy of materials was determined by dissecting 40 leaves from each treatment and counting the number of living larvae.

RESULTS

A summary of results is presented in the table. Excellent reduction of the leafminer population was obtained at the 56-day post-treatment period with the higher rates of Orthene 15G, Merit 2.5% G, and Cygon 2E. No phytotoxicity was observed with any treatment. The success of the granular pesticides in controlling boxwood leafminer in container plants provides another approach to managing this pest in the nursery or landscape.

Figure 2. Adult boxwood leafminer.

CONTROL OF BOXWOOD LEAF MINER ON CONTAINERIZED BOXWOOD

Treatment[1]	Rate[2]	No. larvae[3] 7 DAT[4]	28 DAT	56 DAT
Orthene 15 G	.05 g	63.50	65.50	41.00
Orthene 15 G	.10 g	58.25	44.80	34.75
Orthene 15 G	.20 g	53.50	23.30	5.00
Orthene 15 G	.30 g	45.00	10.50	0
Merit 2.5% G	.04 g	59.25	10.00	0
Cygon 2E	0.5 lb.	49.00	8.30	0
Control	--	70.50	64.80	74.50

[1]Treatments were applied Aug. 30, 1993; granular materials were scattered on soil surface in pot, while Cygon was applied as a foliar spray.
[2]Rate is the amount of active ingredient applied to each pot for the granular materials. For Cygon, rate is the amount of active ingredient per 100 gallons of water.
[3]This is the mean number of living larvae per 10 leaves. Treatments evaluated Sept. 6, Sept. 27, and Oct. 25, 1993.
[4]DAT = days after treatment.

Figure 3. Boxwood leafminer larvae.

Fireblight-Resistant Crabapple Cultivars

AUSTIN K. HAGAN, KENNETH M. TILT , J. DAVID WILLIAMS, AND JAMES R. AKRIDGE

Diseases have greatly limited the use of flowering crabapple in residential and commercial landscapes across the South. In Alabama, fireblight, cedar-apple rust, and apple scab are the most prevalent diseases on flowering crabapple. Use of disease-resistant cultivars, the preferred method of controlling these diseases, greatly simplifies tree maintenance by virtually eliminating costly and time-consuming pesticide applications.

As part of the National Crabapple Evaluation Program, an AAES field trial was initiated in 1992 to assess the adaptability of 60 crabapple cultivars to the Deep South. A number of crabapple cultivars demonstrated moderate to excellent resistance to fireblight.

METHODS

Bare-root crabapples (*Malus* spp.) were planted in May 1992 on 18-foot centers in a Benndale (A) fine sandy loam at the Brewton Experiment Field. Before planting, soil fertility and pH were adjusted according to soil test recommendations. Approximately three pounds fertilizer (5-10-15) were evenly distributed annually around the base of each tree. The trees were not irrigated. Weeds were controlled with directed applications of recommended rates of a tank-mix of Gallery + Surflan or Roundup herbicide. Visual ratings of disease ratings were made on May 28, 1993, and May 24, 1994.

RESULTS

In 1993 and 1994, fireblight outbreaks were noted in the flowering crabapples. Each year, extensive blossom blight, dieback of numerous shoots, and canker development on the limbs was observed on the most heavily damaged cultivars.

Only a single crabapple selection, *M. baccata* Jackii, was free both years of fireblight symptoms. Over that same time period, very minor and unobtrusive fireblight damage was noted on the cultivars Coral Burst, Pink Princess, Spring Snow Dwarf, Jewelberry, Robinson Dwarf, Adams Dwarf, Radiant, Velvet Pillars, Adams, Pink Spires, and Dolgo. An additional 17 crabapple cultivars suffered moderate and unsightly damage in 1993, but disease severity in 1994 was lighter. Extensive fireblight-incited shoot and limb dieback consistently occurred on the cultivars Mary Potter, Sentinel, Siani Fire, Snowdrift Dwarf, Silver Moon, Snowdrift, Golden Raindrops, Klehm's Imperial Bechtel, Brandywine, and Hopa.

In 1994, observations were made on the severity of other diseases. Symptoms of apple scab appeared on the leaves of five crabapple cultivars. Significant disease development occurred only on the cultivars Radiant and Eleya. The occurrence of cedar rust disease was limited to light fruit infections on a few scattered trees. The leaf spot phase of cedar apple rust was not observed, nor was powdery mildew.

Thirteen cultivars of flowering crabapple with good fireblight resistance have been identified. Of these fireblight-resistant cultivars, only Radiant was damaged by apple scab, a disease most likely to occur on trees in the northern third of Alabama. With the exception of Radiant, the fireblight-resistant cultivars would be the best choices for use in Alabama landscapes. Shoot blight and limb dieback was so extensive on 17 crabapple cultivars that they cannot be recommended for use in Alabama landscapes.

FIREBLIGHT SEVERITY ON CRABAPPLE, 1993-1994

Cultivar	Severity[1] 93	94
Mary Potter	2.5	2.2
Red Jade Dwarf	2.5	0.8
Purple Prince	2.3	0.7
Sentinel	2.3	1.7
Siani Fire	2.3	1.6
Snowdrift Dwarf	2.2	1.8
Indian Magic	2.1	0.7
Professor Sprenger	2.0	0.8
Silver Moon	2.0	2.4
Snowdrift	2.0	1.9
Doublooms	1.9	1.4
Golden Raindrops	1.8	2.0
Red Jade	1.8	0.3
Ormiston Roy	1.7	0.9
Klehm's Imperial	1.7	3.3
Bechtel Profusion	0.6	0.1
Sugar Tyme	1.6	0.8
Floribunda	1.6	1.0
Selkirk	1.5	0.5
Candied Apple	1.5	0.1
Winter Gold	1.5	2.0
Brandywine	1.5	2.7
Hopa	1.5	2.0
Royalty Dwarf	1.5	0.1
Tea	1.4	0.3
Red Baron	1.4	1.1
Red Jewel	1.3	1.1
Baskatong	1.3	0.1
Adirondak	1.3	1.1
Red Splendor Dwarf	1.3	0.2
Strawberry Parfait	1.2	0.0
Beverly	1.2	0.1
Donald Wyman	1.2	0.0
Floribunda Dwarf	1.2	0.4
Eleya	1.1	0.7
Prairefire	1.0	0.1
Centurion	1.0	0.1
Louisa	1.0	0.1
Velvet Pillar (tree)	0.9	0.1
White Angel	0.8	0.5
Zumi var. Calocarpa	0.8	0.3
Sargentii	0.8	1.9
Sargentii Dwarf	0.7	1.6
Indian Summer	0.7	0.0
David	0.7	0.5
Bob White	0.7	0.1
Liset Dwarf	0.6	0.0
Liset	0.4	0.1
Dolgo	0.3	0.0
Pink Spires	0.2	0.1
Adams	0.2	0.0
Velvet Pillar (bush)	0.2	0.3
Radiant	0.2	0.0
Adams Dwarf	0.2	0.0
Robinson Dwarf	0.1	0.0
Jewelberry	0.1	0.2
Spring Snow Dwarf	0.1	0.1
Pink Princess	0.0	0.1
M. baccata Jackii	0.0	0.0
Coral Burst	0.0	0.1

[1]Scale: 0 = no disease symptoms; 1 = one or few branch tips showing symptoms; 2 = numerous brach tips showing symptoms, few major branches infected; 3 = several major branches infected, considerable dieback; and 4 = major portion of tree was damaged or the tree died.

Evaluation of Selected Herbicides on Field-Grown Woody Plants

JESSE A. REEDER, CHARLES H. GILLIAM, KEVIN R. KEEL, GLENN R. WEHTJE, DAVID B. SOUTH, PATRICK PACE, AND GARY J. KEEVER

A greater diversity of difficult-to-control broadleaf weeds, along with crop sensitivity to herbicides, make weed control more of a problem in field-grown nursery crops than in container production. For many years, the most common and widely used broadleaf-active herbicides for field-grown plants were Goal (oxyfluorfen) and Princep (simazine), both of which can injure some landscape species.

Recently, Predict (norflurazon) and Pendulum (pendimethalin) were registered for use in field-grown nursery crops. Previously, Predict use was limited to cotton, cranberries, and various fruit and nut trees. Pendimethalin has been available for use in container nursery crops for several years as Southern Weedgrass Control, a granular formulation. However, Pendulum is a water dispersible granule.

An AAES test showed that Pendulum is harmless to field-grown woody plants and provides adequate weed control in field-grown nursery crops. Predict provided almost total weed control but caused temporary foliar damage. One of the primary herbicide treatments used in field production in the Southeast -- Surflan applied in combination with Princep -- was among the least effective at controlling sicklepod in this study.

METHODS

Liners of 'Acoma' crapemyrtle, 'Chesapeake' viburnum, live oak, and 'Mary Nell' holly were planted on April 12, 1991. Granular fertilizer, 13N-5P-11K (13-13-13), was applied preplant at the rate of 52 pounds of nitrogen per acre, and annually thereafter at 120 pounds per acre. Irrigation was provided as needed with Chapin twin-wall VI irrigation hoses containing holes every foot. Plots were 12x16 feet with plants spaced 3x3.6 feet.

One week after planting, herbicides were applied with a CO_2 backpack sprayer equipped with a 8004 flat fan nozzle at 28 pounds per square inch, in a spray volume of 20 gallons per acre. Pendulum 60 WDG, Predict 80 DF, and Surflan 4 AS were applied alone or in combination with either Gallery, Goal, or Princep. Herbicides were applied on April 17 and July 22, 1991, and March 17 and June 23, 1992. Weeded and nonweeded control plots were maintained. The test area was overseeded with sicklepod and goosegrass. The test area contained an erratic population of yellow nutsedge. Consequently, the entire area was treated with Pennant (metolachlor) 7.8E before application of the other treatments to suppress yellow nutsedge as a confounding variable.

RESULTS

Crapemyrtle. Injury following the first application in 1991 was caused primarily by Goal. Goal in combination with other herbicides produced 92% average injury at 30 days after treatment (DAT) and 86% at 60 DAT (Table 1). Injury was restricted to new growth. Crapemytrle was not obviously injured by Goal in the second application. There was no crapemyrtle injury from the first application of Pen-

TABLE 1. EFFECTS OF SELECTED HERBICIDES ON INJURY AND GROWTH OF FIELD-GROWN 'ACOMA' CRAPEMYRTLE

Treatment[1]	Injury[2]				Growth index[3]	
	4/17/91[4]		7/22/91		1991	1992
	30	60	30	60		
Predict	13	13	0	0	69	101
Predict+Princep	29	29	37	25	73	102
Predict+Goal	95	93	0	19	65	93
Predict+Gallery	8	6	0	28	71	99
Surflan	5	6	6	0	77	102
Surflan+Princep	0	0	5	5	63	101
Surflan+Goal	94	88	0	0	66	93
Surflan+Gallery	13	13	0	0	89	111
Pendulum	0	0	0	0	80	102
Pendulum+Princep	38	38	0	0	75	86
Pendulum+Goal	88	78	5	5	51	91
Pendulum+Gallery	18	23	0	0	73	88
Weeded	15	13	0	0	73	99
Unweeded	0	8	0	0	46	80

[1]Predict, Surflan, and Pendulum were applied at three pounds per acre, whether applied alone or in combination with other chemicals. In the combination treatments, Princep, Goal, and Gallery were applied at one pound per acre. The weeded and unweeded controls received no chemical treatment.
[2]Injury rating scale: 0% = no injury and 100% = death.
[3]Growth index = (height + $width_1$ + $width_2$)/3. $Width_1$ was at the widest point, and $width_2$ was perpendicular to $width_1$. It is measured in centimeters (one inch equals 2.54 cm). Measurements were taken in October 1991 and 1992.
[4]Applications were made April 17 and July 22, 1991, and March 17 and June 23, 1992. Injury ratings were made 30 and 60 days after treatment. This table shows only the 1991 injury ratings.

dulum, Predict, or Surflan. After the first application, only Predict or Predict combinations caused crapemyrtle injury. The injury, characterized by bleaching of the older foliage, dissipated by 90 DAT. There was no injury in 1992 (data not shown). By October 1992, all herbicide-treated plants were similar in size to the hand-weeded plants.

Viburnum. Predict, applied alone and in combination treatments, caused bleaching of 'Chesapeake' foliage 30 DAT in 1991 (data not shown). Injury symptoms were similar to those observed on crapemyrtle, and they dissipated by 90 DAT. There was no observed bleaching from 1992 applications of Predict. Generally, the Predict-induced injury did not reduce growth indices, reflecting the temporary nature of this injury.

Live Oak. Maximum herbicide injury occurred at 30 DAT in 1991 with all herbicide treatments (data not shown). However, it was difficult to distinguish between herbicide injury and transplant shock after field planting. Nonweeded plants experienced 29% injury at 30 DAT, providing evidence of post-transplant shock. By 90 DAT, plants had generally grown past injury symptoms or transplant shock. With the July 1991 application, plant injury was generally greatest when Predict or Predict combinations were applied. Predict symptoms were similar to those observed on crapemyrtle and viburnum. Growth indices of live oak in all herbicides treatments were similar to the hand-weeded plants both years.

Mary Nell holly. None of the herbicide treatments resulted in visible plant injury in excess of 10% (data not shown). Injury was restricted to Predict. Growth indices were not influenced by any herbicide treatment.

Weed Control. Control of sicklepod, a major weed pest in field-grown nursery crops in the Southeast, was consistently enhanced when Predict was applied (Table 2). In 1992, Predict treatments provided almost total sicklepod control. Pendulum and Surflan provided about the same level of weed control after the first two applications. Thereafter, Pendulum generally provided greater sicklepod control than Surflan. The relatively poor performance of Surflan + Princep may explain why sicklepod is often a troublesome weed.

In summary, Pendulum is safe on field-grown woody plants and provides weed control similar to existing programs. Predict provided the best weed control, but it caused foliar injury; however, plants generally grew past injury symptoms within 60 DAT. Current registration recommends delaying Predict application until one full growing season after planting. Data from the AAES study support this recommendation; most Predict-caused injury occurred with the first application after planting.

TABLE 2. EFFECTS OF SELECTED HERBICIDES ON SICKLEPOD CONTROL

Treatment[1]	Pct. sicklepod control[2]									Weed fresh weight[3]		
	4/17/91[4]			7/22/91			6/23/92			4/17/91	7/22/91	6/23/92
	30	60	90	30	60	90	30	60	90			
Predict	75	78	58	96	81	89	98	96	93	4.4	4.4	0.0
Predict+Princep	90	81	86	99	90	94	71	99	93	2.2	0.0	0.0
Predict+Goal	98	96	91	98	89	90	96	96	94	0.0	2.2	0.0
Predict+Gallery	83	83	71	98	90	90	91	93	95	2.2	2.2	0.0
Surflan	48	43	13	70	35	28	48	18	25	11.0	28.7	48.51
Surflan+Princep	53	33	28	86	38	33	70	45	40	15.4	19.9	30.9
Surflan+Goal	75	95	48	74	38	30	80	60	30	0.0	30.9	39.7
Surflan+Gallery	63	60	25	78	55	35	83	53	38	6.6	24.3	22.1
Pendulum	40	58	30	90	48	50	78	65	50	2.2	13.2	17.6
Pendulum+Princep	43	60	28	88	43	40	70	43	28	4.4	17.6	33.1
Pendulum+Goal	70	88	53	88	55	38	86	79	55	0.0	15.4	17.6
Pendulum+Gallery	63	73	66	84	33	25	83	73	58	2.2	24.3	11.0
Weeded	25	30	8	63	25	93	71	93	88	97.0	0.0	0.0
Unweeded	23	0	0	0	0	0	0	0	0	101.4	44.1	64.0

[1]Predict, Surflan, and Pendulum were applied at three pounds per acre, whether applied alone or in combination with other chemicals. In the combination treatments, Princep, Goal, and Gallery were applied at one pound per acre. The weeded and unweeded controls received no chemical treatment.
[2]Weed control rating: 0% = no weed control and 100% = complete weed control. Control ratings were made 30, 60, and 90 days after treatment.
[3]Fresh weight is measured in pounds of weeds per plot. These measurements reflect the amount of weeds removed from plots during the study periods that began on April 17 and July 22, 1991, and June 23, 1992.
[4]Applications were made April 17 and July 22, 1991 and March 17 and June 23, 1992. Sicklepod control was not rated following the March 17 application due to limited germination.

Adsorption, Desorption, and Leaching of Oryzalin in Container Media and Soil

GLENN R. WEHTJE, CHARLES H. GILLIAM, AND BEN F. HAJEK

Irrigation runoff from landscape plant production areas and established landscapes has been suggested as a source of pesticide contamination for local water supplies or surrounding bodies of water. Studies have been conducted on the leachability of some herbicides, but there was no similar research on oryzalin (Surflan).

A recent AAES study evaluated the adsorption, desorption, and mobility of oryzalin in soil and soilless container media. Data indicated that oryzalin movement in media is limited and would not likely be displaced out of the container via irrigation runoff.

METHODS

Oryzalin sorption was evaluated in soil (Marvyn sandy loam, Typic Kanhapaludults) and three media: rice hulls:peat:pinebark:wood shavings (1:1:1:2) (R-P-PB-W); pine bark:sand (7:1) (PB-S); pine bark:peat (3:1) (PB-P). Application rates ranged from 0.01-100 parts per million (ppm). Desorption was measured in the soil and R-P-PB-W, at the treatment rate of 10 ppm oryzalin, by a series of water extractions. Additional water was added to replace that extracted from the soil and media. Equilibration time between each extraction was 24 hours. Oryzalin mobility was evaluated in each medium and the soil by use of a column leaching technique.

RESULTS

Oryzalin adsorption (attachment to media particles) by the three media ranged from 93% to 95%, regardless of oryzalin concentration (Table 1). At concentrations between 0.01 and 10 ppm, adsorption by the soil and by all media was statistically the same. At 100 ppm, adsorption by R-P-PB-W and PB-S was greater than by soil. In contrast to the media, the proportion of oryzalin adsorbed by soil was inversely related to the concentration: 96% at 0.01 ppm and 90% at 100 ppm.

TABLE 1. PERCENT ORYZALIN ADSORBED IN MEDIA AND SOIL AS INFLUENCED BY ORYZALIN CONCENTRATION

Media[1]	Oryzalin concentration (ppm)				
	.01	.10	1	10	100
#1	95	94	94	93	94
#2	95	95	94	94	94
#3	95	94	95	94	93
Soil	96	95	94	92	90

[1]Medium #1 = rice hulls:peat:pinebark:wood shavings (1:1:1:2). Medium #2 = pinebark:sand (7:1). Medium #3 = pinebark:peat (3:1). Soil = Marvyn sandy loam, Typic Kanhapludults.

TABLE 2. RELATIVE MOBILITY OF ORYZALIN IN SOILLESS MEDIA AND SOIL AS DETERMINED BY COLUMN LEACHING

Depth[1]	Pct. oryzalin recovered			
	Medium #1[2]	Medium #2	Medium #3	Soil
0-2	92	91	99	85
3-4	6	6	1	11
5-10	1	3	< 1	3

[1]Distance from the surface is measured in centimeters. One inch equals 2.54 cm.
[2]Medium #1 = rice hulls:peat:pinebark:wood shavings (1:1:1:2). Medium #2 = pinebark:sand (7:1). Medium #3 = pinebark:peat (3:1). Soil = Marvyn sandy loam, Typic Kanhapaludults.

The amount of oryzalin removed from R-P-PB-W with each of five consecutive extractions was 7.4%, 4.2%, 2.6%, 2.7%, and 2.8%, resulting in 19.7% cumulative extraction. The amount recovered decreased by 43% between the first and second extractions, and by 38% between the second and third. Analogous values with the soil were 8.9%, 5.6%, 4.2%, 4%, and 3%, totaling 25.7%; the decrease was substantial (37%) only between the first and second extractions. Oryzalin adsorptivity by the soil and R-P-PB-W were identical based upon a simple one-time equilibration and extraction experiment. The medium had a slightly greater resistance to desorption over repeated cycles of rewetting, equilibration, and extraction than the soil.

The leachability of oryzalin in R-P-PB-W and PB-S was identical (Table 2). Nearly all the applied oryzalin was retained within 1.6 inches of the soil surface, with a minimum of 91% held in the top .75 inch. Oryzalin was least mobile in PB-P, with 99% being retained in the top .75 inch. With the soil, less was retained in the top .75 inch and correspondingly more was retained between 1.2 and 1.6 inches.

For both media and soil, oryzalin adsorption and resistance to leaching was high, and adsorption was somewhat reversible. Weed control activity in nursery and landscape situations probably depends on this desorption. Each rewetting of the medium through either irrigation or rainfall results in a portion of the applied oryzalin reentering the soil solution, where it can be adsorbed by germinating weed seeds.

Evaluation of Selected Fungicides for Control of Southern Blight on Aucuba

JOHN W. OLIVE AND AUSTIN K. HAGAN

Southern blight, a common disease of aucuba, ajuga, and other woody ornamentals, causes problems both in the landscape and nursery. In an AAES evaluation of selected fungicides, Prostar 50W, ASC66825, and a high rate of Folicur 3.6F proved to be effective in controlling the disease on aucuba in container production.

The disease, caused by the fungus *Sclerotium rolfsii*, is characterized by profuse white mycelial growth on the lower stem of infected plants. This growth results in a sudden wilt or a slow decline of the infected plant. Small oblong to round structures known as sclerotia are often present in association with the disease.

TABLE 1. EFFECT OF A SINGLE DRENCH APPLICATION OF SELECTED FUNGICIDES ON PLANT DEATH OF AUCUBA

Treatment	Rate/100 gal.	Pct. dead plants 1993	1994
Prostar 50W	2 lb.	0	0
ASC66825 500F	32 fl. oz.	0	0
Folicur 3.6 F	8 fl. oz.	10	63.5
Terraclor 75W	1.25 lb.	0	63.5
Terraguard 50W	1 lb.	20	100
Curalan 50 DF	.5 lb.	100	100
Inoculated Control	--	80	100
Uninoculated Control	--	0	0

METHODS

Aucuba japonica liners were potted in a 3:1 pine bark-peat moss medium in trade-gallon containers. The medium was amended with 14 pounds of Osmocote 17-7-12, six pounds of dolomitic limestone, two pounds of gypsum, and 1.5 pounds of micromax per cubic yard. Plants were grown in an open, plastic-covered greenhouse and watered daily. Fungicides were applied as a spray/drench using a CO_2-pressurized sprayer. Approximately five gallons total liquid volume per 100 square feet were applied to each treatment. All treatments, except for the uninoculated control, were inoculated with *S. rolfsii*-infested wheat seed 24 hours after fungicide applications. Plant death was determined 60 days after inoculation. An initial experiment provided a general fungicide screening. A second study focused on determining the optimum rates of chemicals that proved effective in screening.

Southern blight is characterized by profuse white growth on the lower stems of infected plants.

RESULTS

In the fungicide screening, plants treated with ASC66825 (Fluazinam) or Prostar 50W exhibited no disease symptoms 60 days after treatment in either year. Terraclor 75W, Folicur 3.6F, and Terraguard 50W provided control in 1993; however, in 1994, all three failed to provide satisfactory control. Curalan provided no control in either year (Table 1).

Results of the rate-use evaluations were similar in both years and indicated that, at 60 days after treatment, both Prostar 50W and ASC66825 protected aucuba from *S. rolfsii* at all rates tested. Folicur 3.6F was not effective at lower rates but provided excellent control at the highest rate tested (Table 2).

TABLE 2. EFFECT OF APPLICATION RATES OF THREE FUNGICIDES ON PLANTS INOCULATED WITH *S. ROLFSII*

Treatment	Rate/100 gal.	Pct. dead plants 1993	1994
Folicur 3.6F	4 fl. oz.	80	100
	8 fl. oz.	70	87.5
	16 fl. oz.	0	0
Prostar 50W	0.5 lb.	0	0
	1.0 lb.	0	0
	2.0 lb.	0	0
ASC66825	8 fl. oz.	0	0
	16 fl. oz.	0	0
	32 fl. oz.	0	0
Inoculated Control	--	100	100
Uninoculated Control	--	0	0

Evaluating Phytotoxicity of Insecticidal Oil Sprays on Selected Container-Grown Plants

Charles P. Hesselein and Frederick W. Engle

Figure 1. Flowerwood Nursery personnel spraying plants in oil phytotoxicity trial.

Increased government regulation, concern for workplace safety, environmental issues, and the need for economically effective methods of pest management are compelling ornamental plant growers to seek novel and more benign methods of pest control. While petroleum oil has been used in insect control for over 100 years, producers traditionally have avoided using it due to its reputation for damaging growing plants

Recent technology has resulted in narrow range, highly refined, "summer oil." Despite the fact that this oil can be safely sprayed on most actively growing crops, many ornamental producers are still apprehensive about its use. However, an AAES study confirmed the relative safety of insecticidal oil use over a wide range of plant species. It is effective, safe for the environment and human health, and compatible with other pest management tactics.

Insecticidal oil has a wide range of activity against common ornamental pests, such as aphids, scales, mealybugs, immature whiteflies, and all stages of mites. Target pests have shown little or no resistance to insecticidal oil. Short residual activity makes the oil sprays less harmful to beneficial insects. Low mammalian toxicity and residues that are readily metabolized by bacteria make insecticidal oil very safe for humans and the environment. These positive attributes make insecticidal oil a good candidate for use in IPM programs, as well as in labor-intensive situations such as those found at most nurseries.

Plants Used in Oil Phytotoxicity Trial

Dwarf Burford Holly	'Fire power' Nandina
'Centennial Spirit' Crapemyrtle	'Scarlet Leader' Cotoneaster
Dwarf Yaupon Holly	Japanese Boxwood
Camellia.	'Hinode Giri' Azalea
'Judge Solomon' Azalea	'René Michelle' Azalea
'Helleri' Holly	Golden Euonymus
Spiraea	'Crimson Pigmy' Barberry
Chinese Privet	'Big Blue' Liriope
Rose[1]	Carissa Holly[1]
Pink Gumpo Azalea[1]	Compacta Holly[2]

[1]Phytotoxicity observed 9/9/94.
[2]Phytotoxicity observed 9/9/94 and 9/23/94.

METHODS

Twenty different ornamental plants were used in a summer 1994 demonstration trial at Flowerwood Nursery in Loxley, Ala., to determine the phytotoxicity of insecticide oil (see table). These plants were chosen because they are preferred hosts of the types of insects that oil sprays are know to control. Two oil products -- Sunspray Ultra Fine Spray Oil and Target Oil -- were tested at the rate of one gallon of oil per 100 gallons of spray solution. Six treatments were tested: a morning spray of each oil product, an afternoon spray of each, and two water controls. Morning is the recommended time to spray, because afternoon is when phytotoxicity is most likely to occur. All plant surfaces were sprayed until runoff. Spraying was conducted by Flowerwood Nursery (Figure 1). Plants were sprayed using a hand-held Green Garde JD9-C spray gun at approximately 200 psi at the bypass valve.

Plants were sprayed on Aug. 9 and Sept. 6. The temperature was 78°F and the relative humidity 83% on the morning of Aug. 8; 87°F and 67% on the afternoon of Aug. 8; 84°F and 80% on the morning of Sept. 6; and 91°F and 71% on the afternoon of Sept. 6. Weather on both dates was partly cloudy. Plants were evaluated for signs of phytotoxicity three and seven days after the first spray and three and 17 days after the second spray.

RESULTS

No phytotoxicity was observed following the first spray. On Sept. 9, the first observation date after the second spray application, phytotoxicity was observed on rose, compacta holly (Figure 2), carissa holly, and gumpo azalea (Figure 3). Symptoms included water-soaked spotting on a few leaves of carissa holly, faint water spotting on leaves of compacta holly, chlorosis of growing tips of gumpo azaleas, and marginal burn and curling on rose leaves. Due to an oversight, roses were sprayed while under considerable water stress; this may explain the observed phytotoxicity.

On Sept. 23, following the second spray, phytotoxicity could only be discerned on the compacta holly. As with observations made Sept. 12, symptoms consisted of water spotting on leaves.

While the oils proved to be relatively safe to use, they should be sprayed in the morning or evening and should not be sprayed on wilted plants. Producers should avoid spraying when temperatures are above 90°F or below 40°F or when relative humidity will remain above 90% for over 36 hours. Also, oils are not compatible with sulfur-based products, foliar nutrient applications, and several insecticides and fungicides; oil labels contain specific compatibility precautions. Spray tanks and lines must be rinsed before and after oil sprays.

Figure 2. Damaged compacta holly branch (right), compared to branch in control group.

Growers are advised to test a small number of plants before spraying large numbers of plants of unknown sensitivity; phytotoxicity should appear within 48 hours. Oil sprays kill by contact; thorough coverage of all infested plant surfaces is necessary for satisfactory results. As with any pesticide, one must read and follow all label recommendations and precautions.

The authors wish to thank Flowerwood Nursery, Inc.; Florikan E.S.A., Inc.; and Sun Company, Inc. for their assistance with this project.

Figure 3. Gumpo azaleas; comparison of chlorotic growing tips (four treated rows in the right of the photo) to water sprayed control plants (two rows in the left of the photo).

Granular Preemergence Herbicides Influence Annual Bedding Plant Growth

MACK THETFORD, CHARLES H. GILLIAM, AND GREG CREECH

Freshly tilled soils provide an ideal environment for weed seed germination, making the unwanted vegetation a serious pest in beds of newly transplanted annuals. To control weeds, landscape contractors prefer granular preemergence herbicides for their ease of application. While these herbicides can control a variety of weeds, they can also injure young transplants. AAES studies found varying degrees of herbicide sensitivity among annual bedding plants.

In the past few years, several herbicides have been developed for landscape use. Two recently registered herbicides for turf or landscape use are Snapshot 2.5TG (trifluralin + isoxaben) and Stakeout 0.1G (dithiopyr). Since application of these herbicides to turf or woody species may impact nearby annual bedding plants, more data are needed concerning the effects of the chemicals. Objectives of this study were to (1) evaluate the effectiveness of Snapshot and Stakeout and (2) assess their phytotoxicity as compared to Ronstar 2G (oxadiazon), Rout 3G (oxyfluorfen + oryzalin), and Southern Weedgrass Control (SWGC) (pendimethalin) on some popular annual bedding plants.

METHODS

On June 1, 6.9-square-foot plots consisting of a sandy loam soil amended with two inches of pine bark were further ameliorated with ammonium nitrate (34% N) at 120 pounds per acre and tilled to a depth of six inches. Uniform seedlings of begonia, ageratum, nicotiana, marigold, impatiens, celosia, salvia, geranium, and basil were transplanted on June 6. Each received about one-half inch of water by overhead irrigation.

On June 8, herbicides were applied with hand-held shakers at various rates (see tables). All plots received one inch of water via overhead irrigation immediately following herbicide application and as needed. On June 15, half of each plot was over-seeded with large crabgrass (*Digitaria sanguinalis* L. Scop.) and the other half with prostrate spurge (*Euphorbia humistata* Englem x Gray). Plots were hand-weeded biweekly to remove any weeds other than large crabgrass and prostrate spurge. Weedy and hand-weeded controls were included for the purposes of comparison. Data collection included plant injury, plant shoot dry weight, flower number, weeds per plot, and weed shoot dry weight.

TABLE 1. PHYTOTOXICITY RATING OF EIGHT BEDDING PLANT SPECIES FOLLOWING APPLICATION OF SELECTED GRANULAR PREEMERGENCE-APPLIED HERBICIDES AT 30 AND 60 DAYS AFTER TREATMENT [1]

Rate[2]	Ageratum		Basil		Begonia		Celosia		Impatiens		Marigold		Nicotiana		Salvia	
	30	60	30	60	30	60	30	60	30	60	30	60	30	60	30	60
Stakeout																
1.0	1.0	1.0	1.1	1.0	1.9	2.1	1.8	1.3	1.3	1.5	1.0	1.4	1.5	1.9	1.9	2.7
2.0	1.0	1.0	1.0	1.0	2.3	2.9	1.4	1.2	1.6	1.4	1.0	1.0	1.7	1.8	2.1	3.7
3.0	1.0	1.0	1.7	1.0	3.3	4.4	1.6	1.4	1.9	1.6	1.0	1.0	2.8	4.1	1.8	3.8
Snapshot																
1.5	1.0	1.0	1.0	1.0	1.6	1.4	1.3	1.0	1.5	1.4	1.0	1.0	1.0	1.3	1.7	2.7
3.0	1.0	1.0	1.7	1.8	2.1	2.0	1.3	1.3	1.8	2.4	1.0	1.0	1.8	2.0	2.6	3.1
6.0	1.0	1.0	2.7	2.5	1.9	1.5	1.3	1.0	1.8	1.3	1.1	1.0	1.1	1.4	3.9	4.4
Southern Weedgrass Control																
1.5	1.1	1.0	1.6	1.3	1.6	1.3	1.5	1.3	1.7	1.6	1.0	1.0	1.2	1.3	1.9	2.8
3.0	1.0	1.0	1.8	1.3	1.4	1.3	1.6	1.6	1.3	1.3	1.0	1.0	1.3	1.1	3.1	4.3
6.0	1.4	1.0	2.2	1.0	2.5	2.6	2.4	2.9	2.7	2.7	1.6	1.4	2.1	2.1	2.0	2.8
Rout																
1.5	1.9	1.0	1.5	1.0	2.3	2.3	2.7	1.7	3.7	3.9	1.8	1.0	1.9	1.6	2.1	2.7
3.0	2.2	1.0	2.0	1.4	2.7	2.7	2.7	2.3	4.5	4.4	1.9	1.0	2.5	1.6	2.6	3.4
6.0	2.8	1.0	2.4	1.3	3.0	4.3	2.8	2.8	4.8	5.0	2.1	1.0	2.9	2.4	2.8	2.2
Ronstar																
4.0	1.2	1.0	1.7	1.6	2.7	3.1	2.3	1.1	2.7	2.7	1.4	1.0	1.9	1.0	1.3	2.1
Nontreated																
0	1.0	1.0	1.0	1.0	1.1	1.5	1.4	1.3	1.0	1.5	1.0	1.0	1.0	1.1	1.0	2.0

[1]Phytotoxicity rating scale: 1 = no injury, 2 = slight chlorosis, necrosis, stunting; 3 = moderate to severe chlorosis, necrosis, 4 = defoliation, stem dieback, and 5 = dead plant. Only 30 and 60 DAT data are presented in Table 1 due to similarity in 15 and 30 DAT data.

[2]Rates are measured in pounds of active ingredient per acre.

RESULTS

Ageratum. Only Rout inflicted significant damage to ageratum transplants and injury was proportional to application rates (Table 1). Stakeout at two and three pounds of active ingredient per acre (a.i./a.) and Rout at six pounds a.i./a. produced significantly lower shoot dry weights than the hand-weeded control. Shoot dry weights were similar among all other treatments 30 days after treatment (DAT). Shoot dry weights for all plants were equal to or greater than the hand-weeded control by 60 DAT. Flowering of ageratum was suppressed 30 DAT with Stakeout at two and three pounds a.i./a. and Rout at six pounds a.i./a.. However, by 60 DAT flower numbers were similar among all treatments.

Basil. Plant injury increased with increasing rates of application for both Snapshot and Rout. In contrast to hand-weeded plants, annual shoot dry weights were suppressed with all treatments at 30 and 60 DAT. Only Snapshot gave a rate response in which shoot dry weight decreased as application rates increased.

Begonia. Damage to begonia was apparent with Stakeout, SWGC, and Ronstar. Plants treated with Ronstar exhibited severe necrosis, whereas defoliation and stem dieback were observed in plants treated with Stakeout and Rout. Rout-induced injury was proportional to the rates applied. Begonia shoot dry weight was suppressed with Stakeout, Rout, SWGC, and Ronstar as compared to the hand-weeded controls. Begonia treated with Ronstar produced 51% fewer flowers than hand-weeded controls.

Celosia. Injury was evident with all rates of Rout 30 DAT, and celosia continued to exhibit foliar necrosis 60 DAT with the highest rates of Rout and SWGC. With SWGC, injury increased with increasing rates of application. Rout and SWGC also suppressed celosia shoot dry weight at 60 DAT.

Impatiens. Within 30 DAT, most Rout-treated plants were either dead or severely defoliated. In addition, all rates of Rout suppressed impatiens shoot dry weight. Stakeout, SWGC, and Rout caused increasing plant injury with increasing rates. Impatiens receiving the highest rate of SWGC had fewer flowers than hand-weeded plants, and foliage was more sparse. Within 60 DAT, all impatiens except those treated with Rout had similar flower numbers.

Marigold. Initially, Rout inflicted slight necrosis in marigolds, but by 60 DAT, there was no significant injury associated with any herbicide treatment. Marigold shoot dry weights were similar for all herbicide treatments except Rout, which suppressed shoot dry weights. SWGC repressed the flowering of marigolds early on by 44%. Flower numbers were similar among all treatments by 60 DAT.

Nicotiana. At highest application rates, Stakeout, SWGC, and Rout inflicted slight to moderate injury on nicotiana 30 DAT. However, by 60 DAT, the Stakeout-treated plants exhibited defoliation and stem dieback, while those treated with SWGC and Rout had not worsened. Snapshot was the only herbicide that did not reduce shoot dry weight of nicotiana, regardless of application rate. Flower number for all treatments were similar except for the highest rate of Stakeout and SWGC, which suppressed flowering.

Salvia. Only Ronstar appeared safe for salvia. All other herbicides caused significant injury and suppressed shoot dry weight 60 DAT.

Geranium. Geranium was generally tolerant of all herbicides evaluated (data not shown). Slight injury occurred with the highest rate of both Stakeout and Rout 30 DAT, but the effects had dissipated by 60 DAT. Flower number and shoot dry weight were not affected by any herbicide treatment.

Weed Control. Excellent crabgrass and prostrate spurge control was obtained with most herbicide treatments (Table 2). The germination of weed seeds in the Snapshot plots with higher rates and with other herbicide treatments occurred primarily around the base of the transplants, possibly a result of transplants deflecting the herbicide during application.

TABLE 2. LARGE CRABGRASS AND PROSTRATE SPURGE CONTROL WITH SELECTED PREEMERGENCE-APPLIED HERBICIDES AT 15, 30, AND 60 DAYS AFTER TREATMENT

Rate[1]	Crabgrass[2]			Spurge[2]		
	15	30	60	15	30	60
			Stakeout			
1.0	1.0	1.5	2.3	0.4	0.0	0.2
2.0	0.2	0.0	0.0	0.2	0.0	0.6
3.0	0.0	0.0	0.0	0.0	0.0	0.0
			Snapshot			
1.5[3]	25.5	33.7	26.1	6.0	8.0	9.2
3.0	4.4	5.9	6.3	0.6	0.4	1.2
6.0	1.3	1.5	1.3	0.8	1.0	1.2
			Southern Weedgrass Control			
1.5	5.7	6.9	5.9	1.4	0.8	1.6
3.0	3.6	4.8	1.9	1.0	0.8	1.8
6.0	1.7	1.1	0.6	0.2	0.0	0.0
			Rout			
1.5	8.0	8.0	8.2	0.6	1.0	2.6
3.0	5.9	4.8	4.6	0.4	0.8	0.8
6.0	1.2	1.7	0.8	0.0	0.2	0.3
			Ronstar			
4.0	0.4	1.3	8.0	0.0	0.2	0.2
			Non-weeded			
0	176.2	171.4	177.1	43.6	61.8	41.8

[1]Rates are measures in pounds of active ingredient per acre.
[2]Number of weeds per 6.9-foot plot.
[3]This rate is approximately one-half the manufacturer's recommended rate and is not acceptable in a commercial landscape setting for grass control.

Herbicide-Coated or -Blended Fertilizers Control Weeds and Reduce Pesticide Runoff

Cynthia K. Crossan, Charles H. Gilliam, Gary J. Keever, Donald J. Eakes, and William A. Dozier, Jr.

Pesticides in runoff water from container nursery operations pose a possible environmental threat. Previous AAES research showed that when granular herbicides are broadcast over the top of container plants, 20% to 80% of the herbicides miss the containers and can be washed away by irrigation or rain water. One method of reducing or eliminating nontarget herbicide loss would be direct application of fertilizers blended or coated with herbicide to individual containers.

A recent AAES study compared herbicide-coated and -blended Nursery Special 12-6-6 fertilizer with standard application methods for prostrate spurge control. Data demonstrated that these new methods provide weed control in containers similar to traditional broadcast applications, while reducing the amount of herbicide runoff to practically zero.

METHODS

Gardenia augusta 'August Beauty' were grown in full gallon containers in a pine bark:sand medium (6:1 by volume). Media was amended with five pounds of dolomitic lime and 1.5 pounds of Micromax per cubic yard. Plants were irrigated as needed with overhead irrigation. Plants were treated on Aug. 9, 1993. Treatments were spread uniformly across the individual containers and seeded with prostrate spurge one week after treatment.

To prepare the herbicide-coated or -blended treatments, 25 pounds of Nursery Special 12-6-6 fertilizer was placed in a Patterson-Kelley (P-K) Twin Shell Blender. Ronstar (2G and 50WP) and Pennant (5G and 7.8E) were either blended or coated onto the fertilizer at four rates ranging from 2-16 pounds of active ingredient per acre (a.i./a.). Non-weeded controls were

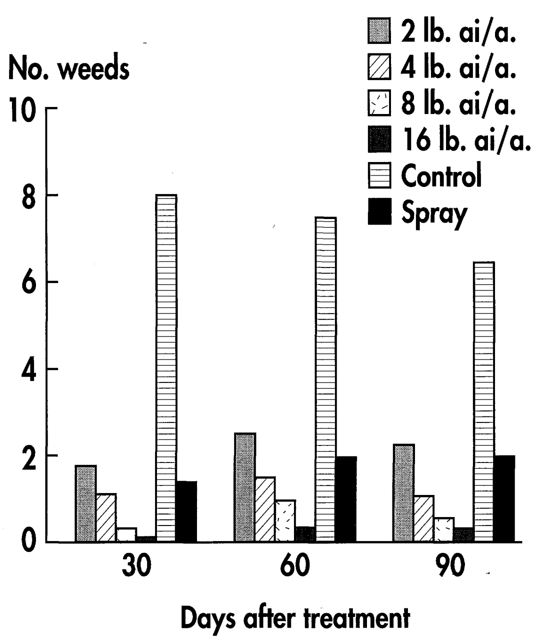


Figure 1. Spurge number per container with coated Ronstar 50WP. At each date, spurge decreased as herbicide rate increased. All treatments provided similar or better control than the conventional spray. The control was not weeded or treated with herbicides.

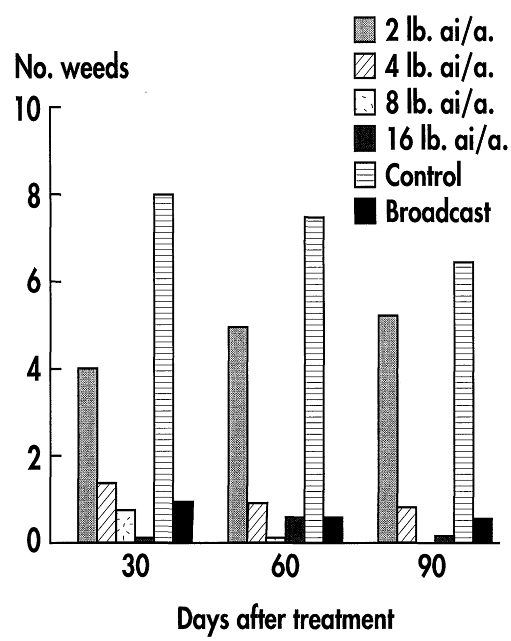


Figure 2. Spurge number per container with blended Ronstar 2G. At the two-pound rate, weed number was greater than the conventional broadcast treatment. The control was not weeded or treated with herbicides.

included for comparison, along with a spray and broadcast application at the rate of four pounds a.i./a. All calculations were based on the surface area of a full-gallon container receiving 6.5 grams of Nursery Special 12-6-6 fertilizer per container.

Blended treatments (Ronstar 2G and Pennant 5G) were mixed by layering the fertilizer with the herbicide and blending for about five minutes. Herbicide-coated treatments were prepared by first mixing the herbicide (Ronstar 50WP or Pennant 7.8E) with 100 milliliters of water. This solution was then poured through the P-K Twin Shell Blender funnel and sprayed onto the fertilizer in the shell through pore spaces in a rotating horizontal bar which extends across the center of the blender. The shell was in continuous rotation as the herbicide was sprayed and mixed for about five minutes.

RESULTS

At rates up to eight pounds a.i./a., Ronstar 50WP-coated fertilizer provided weed control similar to standard sprayed applications (Figure 1). With Ronstar 2G-blended fertilizer, all rates above two pounds provided weed control similar to the broadcast application (Figure 2).

Both the Pennant 5G-blended and the Pennant 7.8E-coated fertilizer treatments provided ineffective spurge control (Figures 3, 4). However, the response for a direct container application of Pennant 5G-blended fertilizer was similar to the traditional broadcast application. Likewise, the Pennant 7.8E-coated fertilizer provided control similar to the spray control. Only the 16-pound rates of the Pennant blended and coated treatments reduced the number of weeds to less than two per container.

Fresh and dry spurge weights followed a similar trend to weed number per container, with the lowest spurge weights occurring at the highest herbicide rates (data not shown). Growth indices of *Gardenia* were not effected by any treatment, nor were there any observed phytotoxic symptoms, even when four times the recommended herbicide rate was applied.

Ronstar 50WP and Ronstar 2G provided the greatest spurge control at 30, 60, and 90 days after treatment (data not shown). There was no difference between the two formulations. However, one concern with the blended (granular) formulation is the potential for separation of the herbicide and fertilizer in shipping.

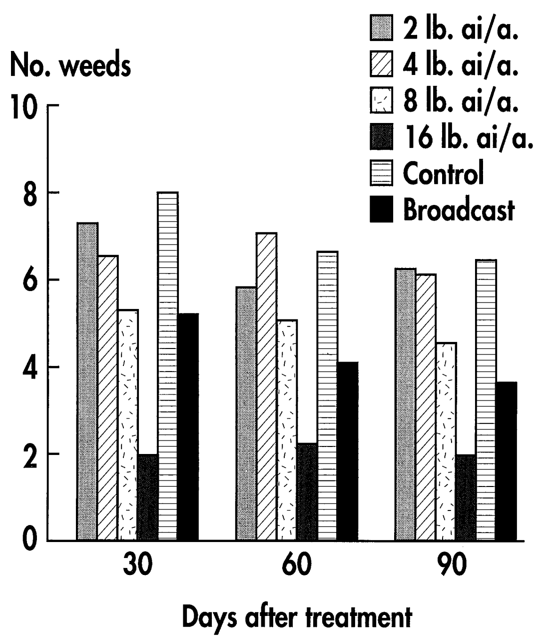


Figure 3. Spurge number per container with blended Pennant 5G. All rates had less weed control than the Ronstar treatments. The eight- and 16-pound rates provided control similar to the conventional broadcast treatment. The control was not weeded or treated with herbicides.

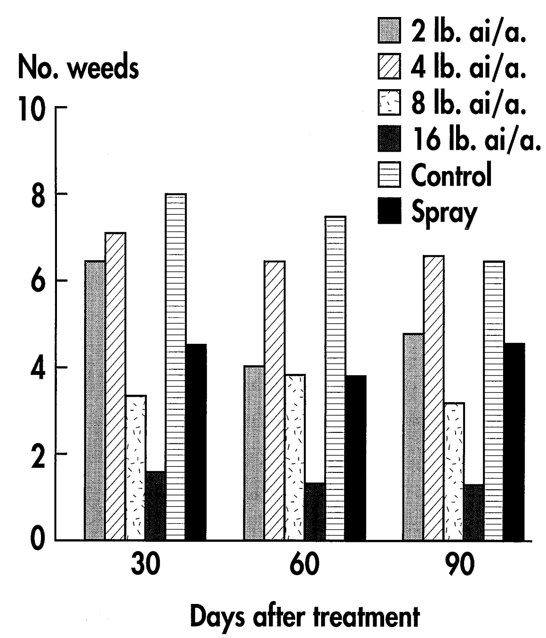


Figure 4. Spurge number per container with coated Pennant 7.8E. All rates had less weed control than the Ronstar treatments. The eight- and 16-pound rates provided control similar to the conventional spray treatment. The control was not weeded or treated with herbicides.

Reaction of Dogwood Selections to Powdery Mildew

Austin K. Hagan, Charles H. Gilliam, Gary J. Keever, and J. David Williams

In recent years, widespread outbreaks of the disease powdery mildew, caused by the fungus *Oidium* sp., have been reported on flowering dogwood throughout the South. In landscapes, disease-resistant varieties are an effective, economical, and environmentally responsible means of controlling this and other diseases of woody ornamentals.

A recent AAES study identified a number of powdery mildew-resistant dogwood selections. Severity of powdery mildew was assessed in a field planting containing several selections of flowering kousa (*Cornus kousa*) and Rutgers hybrid dogwood (*C. florida* x *kousa*), along with single selections of the giant dogwood (*C. controversa*) and the pacific x florida dogwood (*C. nuttallii* x *florida*) 'Eddie's White Wonder.'

There was considerable variation in the severity of disease symptoms in 1994. Symptoms first appeared in late spring or early summer, and the disease spread throughout the season. Trees in heavy shade to full sun appeared equally susceptible. The white, cottony growth of the fungus often covered the upper surface of new leaves. Some discoloration and severe distortion of mature leaves was common. Although this blemished foliage is unattractive, it is unlikely that the disease has a lasting effect on tree vigor. Extended periods of mild, humid, and cloudy weather may have contributed to the severity of 1994's outbreak.

METHODS

Bare-root dogwoods were planted on March 3, 1993, in Auburn into a Marvyn loamy sand soil on 20-foot centers in rows spaced 25 feet apart. Planting holes were dug to a depth of 24 inches. A trickle irrigation system was installed shortly after tree establishment. The dogwoods were grown in full sun and irrigated as needed. Each tree was topdressed with 3.2 ounces of fertilizer (13-13-13) on May 26 and June 24, 1994. Weeds around the base of each tree were controlled with a weed trimmer and directed applications of glyphosate (Roundup). Alleys between each row were periodically mowed. A visual rating of powdery mildew severity was made on Aug. 4, 1994.

RESULTS

Among the trees screened, cultivars of the flowering dogwood (*C. florida*) generally were most susceptible to powdery mildew (see table). Some discoloration of the foliage, premature leaf shed, and severe leaf distortion was commonly seen on the majority of the cultivars of this species. Of these, 16 cultivars were considered highly susceptible. The foliage of an additional seven cultivars, including Au-

Reaction of dogwoods to powdery mildew

Cultivar[1]	Disease severity[2]
Junior Miss (CF)	2.8
First Lady (CF)	2.6
Welch's Bay Beauty (CF)	2.6
Ozark Spring (CF)	2.6
Rainbow (CF)	2.6
Rubra Pink (CF)	2.5
World's Fair (CF)	2.4
Stokes Pink (CF)	2.3
Cloud Nine (CF)	2.3
Cherokee Princess (CF)	2.3
Double White (CF)	2.3
Pink Beauty (CF)	2.3
Sunset (CF)	2.2
Red Beauty (CF)	2.2
Pink Flame (CF)	2.2
Purple Glory (CF)	2.0
Autumn Gold (CF)	1.7
Fragrant Cloud (CF)	1.7
Springtime (CF)	1.5
Cherokee Chief (CF)	1.5
Eddie's White Wonder (CN)	1.4
Weaver's White (CF)	1.1
Ruth Ellen (CF)	1.1
Barton White (CF)	1.1
Wonderberry (CF)	1.0
Aurora (RH)	0.6
Milky Way (CK)	0.5
Satomi (CK)	0.3
Constellation (RH)	0.3
Galaxy (RH)	0.3
Star Dust (RH)	0.2
Stellar Pink (RH)	0.2
Milky Way Select (CK)	0.1
Dwarf White (CF)	0.0
National (CK)	0.0
Cherokee Brave (CF)	0.0
Giant Dogwood (CC)	0.0

[1]CF = flowering dogwood, CN = pacific x florida dogwood hybrid, CK = kousa dogwood, CC = giant dogwood, RH = Rutgers hybrid dogwood.
[2]Powdery mildew severity was rated visually on Aug. 4, 1994, using a 0-4 scale: 0 = no disease; 1 = 1-25% of the leaves damaged or extensively colonized by the powdery mildew fungus; 2 = 25-50%; 3 = 50-75%; and 4 = 75-100%.

tumn Gold, Fragrant Cloud, Springtime, Cherokee Chief, Weaver's White, Wonderberry, and Barton's White suffered light to moderate mildew-related injury. The absence of symptoms on the foliage of the cultivars Dwarf White and Cherokee Brave indicate that both have excellent mildew resistance.

Generally, other dogwoods in the study were more resistant than the majority of flowering dogwoods. Infestations of the powdery mildew fungus on the foliage of the Rutgers hybrid and kousa dogwoods were limited to a few, scattered colonies. No distortion of the leaves or premature leaf drop occurred. The pacific x flowering dogwood cultivar Eddie's White Wonder was moderately susceptible. Among the Rutgers hybrids, Ruth Ellen was moderately susceptible, while Constellation, Galaxy, Star Dust, and Stellar Pink were highly resistant. All the cultivars of the kousa dogwood, as well as the giant dogwood selection, were highly disease resistant.

In summary, dogwoods vary considerably in their sensitivity to powdery mildew. Generally, flowering dogwoods are much more likely to be damaged by this disease than kousa or hybrid dogwoods. Two mildew-resistant flowering dogwood cultivars along with a number of disease resistant hybrid and kousa dogwoods are readily available to Alabama consumers.

Southern Red Mite Control on Azalea

JAMES C. STEPHENSON AND CHARLES P. HESSELEIN

The Southern red mite, *Oligonychus ilicius* (McGregor), is considered to be the most important and destructive spider mite on broad-leaved evergreens, especially Japanese hollies, camellias, and azaleas. An AAES study was conducted to determine efficacy of labeled miticides, non-labeled pesticides, a numbered experimental compound, and low-environmental impact materials for IPM programs to control red mites.

In addition to the plants listed above, the red mite's host range also includes other plants in the Ericaceae and Aquifoliaceae families. In South Alabama, this pest can be found throughout the year, but greatest numbers occur during cooler weather when populations can build up rapidly and cause plant defoliation. Symptoms of infestation include brownish or bronzed plant appearance which becomes more pronounced with cooler temperatures. These symptoms reflect plant damage produced by mites feeding on the lower leaf surfaces.

METHODS

Mite-infested *Rhododendron* x 'Tradition' were selected for a single foliar-applied treatment (see table). Sprays were applied to upper and lower leaf surfaces to runoff on May 18, 1994. No spray adjuvants were used. The azaleas were growing in trade gallon, black plastic containers of an amended pine bark-peat moss medium. Plants were maintained in a vented glass greenhouse under standard horticultural practices.

RESULTS

Seven days after treatment, a number of materials provided good control of Southern red mite at the rates listed in the table, compared to the untreated check. Two of these effective pesticides, Sunspray 6E and M-Pede, are considered low environmental impact chemicals. The other effective treatments -- Pentac Aquaflow, Kelthane 35W, Tame 2.4EC + Orthene 75S, and Orthene 75S -- are in different pesticide chemical groups. This is beneficial for pesticide rotation in a resistance management program. Control with Mavrik Aquaflow, Talstar T&O 10WP, Avid 0.15 EC, Margosan-O 0.3%, and AC 303-630 2SC was similar to the untreated check. No phytotoxicity was observed with any treatment.

SOUTHERN RED MITE CONTROL ON R. x 'TRADITION'

Treatment	Rate[1]	No. mites[2]
Pentac Aquaflow	16 fl. oz.	1.0
Kelthane 35W	1 lb.	0.3
Tame 2.4 EC +	10.6 fl. oz. +	
Orthene 75S	1 lb.	7.8
Orthene 75S	1 lb.	3.8
Mavrik Aquaflow 2F	10 fl. oz.	37.0
Talstar T&O 10 WP	1 lb.	45.8
Sunspray 6E	1 gal.	1.5
Avid 0.15 EC	4 fl. oz.	22.5
Margosan-O 0.3%	64 fl. oz.	19.5
M-Pede 49%	2 gal.	4.8
AC 303-630 2SC	6.4 fl. oz.	16.0
Untreated Check	--	50.3

[1]Rate per 100 gallons of water
[2]Mean number of mites per sample.

Pesticides to Control Crapemyrtle Aphids

Gregory S. Hodges, Michael L. Williams, and Zandra DeLamar

Many crapemyrtle varieties are widely used in Southeastern landscape plantings. Throughout the summer, these plants produce colorful blooms ranging from white to lavender to bright pink. Crapemyrtle aphid, *Tinocallis kahawaluokalani*, can be a serious problem on both container-grown and landscape plantings of these plants.

An AAES study showed that Orthene 75S provided complete control of crapemyrtle aphids two days after treatment (see table). CGA 215944 provided good to excellent control, with a steady decrease in aphids over time. No phytotoxicity was observed.

Crapemyrtle aphids feed on the underside of leaves, twigs, and bud terminals. Heavy infestations can decrease foliage and floral production. In addition to feeding damage, honeydew production promotes growth of sooty-mold and mildew on leaves, thus ruining the plant's appearance and reducing plant vigor by decreasing photosynthesis.

METHODS

In 1994, three pesticides were evaluated for control of the crapemyrtle aphid on landscape plantings of crapemyrtle, *Lagerstroemia indica.* Test materials were applied on Sept. 28 to 12, eight- to 12-foot-tall plants heavily infested with aphids. In addition to Orthene 75S and CGA 215944, Precision 25 W was tested. Pretreatment counts averaged 193 aphids per leaf. A single foliar spray of each insecticide was applied to runoff using hand-held compressed air sprayers.

Crapemyrtle Aphid Control by Three Pesticides

Treatment[1]	Rate[2]	Mean no. live aphids[3]		
		2 DAT	7 DAT	14 DAT
Untreated	--	382	406	260.0
Precision 25 W	8 grams	263	660	433.0
CGA 215944 50W	40 grams	94	61	2.0
Orthene 75 S	0.33 lb.	0	0	0.3

[1]Treatments were applied Sept. 28,1994.
[2]Rates are measured in the amount of active ingredient per 100 gallons.
[3]Treatments evaluated two, seven, and 14 days after treatment (DAT) by determining the mean number of live aphids per leaf.

Pesticides to Control Azalea Lacebugs

Gregory S. Hodges, Michael L. Williams, and William H. Reynolds

Southern growers are searching for new ways to control the azalea lacebug (*Stephanitis pyrioides*), which is common in azalea plantings across the region. It has potential for extensive damage to azaleas in the Alabama landscape due to its ability to reproduce in great numbers and its relative resistance to some pesticides.

In an AAES study, the best control was seen after using Orthene 75S (see table). Orthene 15 G, applied at one or two pounds, was nearly as effective. Orthene 75S and Orthene 15 G at the one-pound rate reduced the lacebug populations greatly after seven days and provided complete control after 14 days. No phytotoxicity was observed.

Lacebugs damage the plant by feeding on the underside of the leaves. Extensive feeding on plants by the azalea lacebug will cause a mottling of the upper leaf surface and leaf drop which can detract from the aesthetic value of landscape plantings. In addition, continuous feeding can also cause the plant to be weakened and less resistant to disease and winter damage.

Control of Azalea Lacebug on Container-Grown *Rhododendron indicum*

Treatment[1]	Rate (AI)	Mean no. lacebugs[2]		
		7 DAT	14 DAT	28 DAT
Merit 2.5% G	0.04 g/pot	1.75	0.75	0.25
Orthene 15 G	0.30 g/pot	1.75	0.25	0.25
Orthene 75S	0.5 lb./100 gal.	0.25	0.00	0.00
Orthene 15 G	1 lb./a.	0.50	0.00	0.00
Orthene 15 G	2 lb./a.	1.25	0.25	0.00
Control	Untreated	3.25	1.50	0.75

[1]Treatments applied October 1, 1993.
[2]Number of live lacebugs per plant at seven, 14, and 28 days after treatment (DAT).

METHODS

In 1993, three pesticides were evaluated for control of the azalea lacebug on container-grown azaleas, *Rhododendron indicum.* Test materials were applied on Oct. 1 to 24 lacebug-infested plants, potted in three-gallon containers. Orthene 75S and one rate of Orthene 15 G were applied to the potting medium directly. Two additional rates of Orthene 15 G were broadcast applied using a hand-held cyclone spreader. The third pesticide was Merit 2.5% G.

Evaluation of Selected Fungicides for Control of Photinia Leafspot

JOHN W. OLIVE, AUSTIN K. HAGAN, AND LEONARD C. PARROTT JR.

Photinia leafspot is a common and destructive disease of *Photinia* x *fraseri* (red-top or red-tip photinia). This fungal disease attacks the leaves and young stems, causing leaf spotting, defoliation and in severe cases, death of infected plants.

In an AAES study, two formulations of Daconil, and Banner sprayed at 14-day intervals provided excellent control of photinia leafspot. Weekly applications of neem oil provided no control; at the end of the study, plants treated with neem oil were stunted and severely defoliated. Triforine was ineffective at controlling the disease.

METHODS

Healthy, non-infected photinia liners were potted in trade gallon containers in mid-July in a pine bark:peat moss medium (3:1 by volume) amended with 14 pounds of 17-7-12 Osmocote, six pounds of dolomitic limestone, two pounds of gypsum, and 1.5 pounds of Micromax per cubic yard of media. Plants were heavily pruned to encourage new growth and were watered daily by overhead impact sprinkler irrigation. Severely infected photinia plants were placed within the block to serve as an inoculum source and to provide heavy disease pressure. The first treatment application was made July 26 and continued until the final application was made on Nov. 17. Treatments were applied to runoff with a CO_2-pressurized sprayer. Disease incidence was evaluated monthly, and the final rating was taken four months after initial application (see table).

EFFECT OF SELECTED FUNGICIDES ON PHOTINIA LEAFSPOT

Treatment	Spray interval	Rate/ 100 gal.	Disease incidence[1]
Banner 1.1E	21 Day	6 fl. oz.	7.2
Banner 1.1E	14 Day	6 fl. oz.	3.5
Daconil 2787 4.17F	14 Day	32 fl. oz.	1.8
Daconil 2787 SDG	14 Day	1.4 lb.	2.7
Neem Oil	7 Day	0.5 gal.	12.0
Neem Oil	7 Day	1.0 gal.	12.0
Neem Oil	7 Day	1.5 gal.	12.0
Triforine 1.6E	14 Day	18 fl. oz.	7.8
Control	--	--	11.7

[1]Disease incidence was measured using a Horsfall Barrett rating scale of 1-12: 1 = no disease; 2 = 0-3%, 3 = 3-6%; 4 = 6-12%; 5 = 12-25%, 6 = 25-50%; 7 = 50-75%; 8 = 75-87%; 9 = 87-94%; 10 = 94-97%; 11 = 97-100%; 12 = 100% of leaves diseased.

WOODY ORNAMENTALS

Chemically Induced Branching of *Vinca Minor*

James T. Foley and Gary J. Keever

Vinca minor L. (lesser periwinkle), a common vining, evergreen groundcover, is characterized by a prostrate, mat-forming growth habit. Flowers of white, blue, or purple are produced on long runners with few lateral branches. *Vinca* with multiple runners typically command a higher price. Using more than one cutting or plant per pot requires large amounts of plant material, while repeated pruning to increase branching is labor intensive. Developing a well-branched plant from a single cutting without repeated pruning should increase efficiency of production.

Synthetic cytokinins, such as Pro-Shear, Promalin, and Accel, reduce apical dominance, thereby promoting the growth of lateral buds. Atrimmec, another plant growth regulator, has both chemical pinching and growth retardant properties. AAES research showed that Promalin and Atrimmec are effective at inducing lateral budbreak and axillary shoot elongation of *Vinca*.

METHODS

In an earlier experiment, Pro-Shear and Accel proved ineffective at improving the branching of *Vinca* (Table 1). Since Atrimmec and Promalin both increased the numbers of runners produced, they were selected for further study to determine optimum application rates.

In the followup test, young plants in 4.5-inch standard pots were pruned to five nodes, and all lateral and basal shoots were removed just before treatment. Treatments consisted of a foliar spray of 250-1,000 parts per million (ppm) of Promalin or Atrimmec. Pruned controls were included for comparison. Foliar sprays were reapplied without pruning seven weeks after treatment (WAT). Data collected included primary runner numbers, basal (from the growth medium) runner numbers, primary runner lengths, nodes per primary runner, secondary runners per primary runner, and lengths of the three longest secondary runners.

Table 1. Number and Length of Primary Runners from Five-Node Cuttings of *Vinca Minor* Treated with Four Growth Regulators (Experiment 1)

Rate	2 WAT[1]		4 WAT		6 WAT		8 WAT		10 WAT	
	No.	Length	No.	Length	No.	Length	No.	Length	No.	Length
ppm		*in.*		*in.*		*in.*		*in.*		*in.*
Promalin										
125	1.0	11.3	3.8	15.2	3.8	18.5	4.1	23.7	4.3	27.0
250	1.0	11.9	6.3	16.3	6.6	19.1	6.7	24.9	7.3	26.3
500	1.0	9.0	5.8	13.5	6.8	16.6	6.8	23.1	6.8	25.4
Atrimmec										
1,000	1.0	6.7	1.6	6.8	5.4	7.3	7.1	11.5	7.1	15.2
2,000	1.0	6.7	1.0	6.8	3.1	6.9	7.2	8.2	7.6	11.5
3,000	1.0	6.0	1.0	6.0	1.8	6.1	5.8	6.2	6.3	8.5
Pro-Shear										
62.5	1.0	8.4	1.7	13.3	2.4	17.6	3.3	23.5	3.3	26.1
125	1.0	9.5	2.6	14.2	3.6	17.7	4.2	24.5	4.2	26.5
250	1.0	11.6	3.1	16.2	3.4	19.3	4.0	25.9	4.6	27.7
Accel										
62.5	1.0	10.1	2.3	15.2	2.6	18.2	3.1	24.1	3.7	27.6
125	1.0	8.5	1.9	13.5	2.5	16.7	3.3	24.3	3.4	26.9
250	1.0	8.7	1.3	13.2	3.6	16.6	3.6	23.6	4.0	25.4
Control										
0	1.0	5.5	2.2	9.9	2.9	14.1	3.2	21.6	3.5	25.0

[1]WAT = weeks after treatment.

Table 2. Effects of Various Rates of Promalin and Atrimmec on Five-Node Cuttings of *Vinca minor* (Experiment 2)[1]

Rate[2]	Primary runners/ plant					Nodes/ primary runner[3]	Secondary runners/ primary runner[3]	Secondary runner length[3,4]
	3 WAT[5]	5 WAT	7 WAT	11 WAT	16 WAT			
ppm	*no.*	*no.*	*no.*	*no.*	*no.*	*no.*	*no.*	*in.*
Promalin								
250	4.3	4.3	3.7	4.4	7.1	17.4	5.6	7.6
500	5.7	5.7	5.7	5.7	8.8	15.5	8.4	8.1
1,000	6.6	6.6	7.2	7.2	7.6	16.1	16.4	7.8
Atrimmec								
250	2.9	2.9	3.0	3.2	6.1	17.3	1.2	4.8
500	2.2	2.2	2.2	2.2	7.5	15.7	1.1	4.6
1,000	3.1	3.1	3.2	3.2	8.3	13.0	1.0	4.1
Control								
0	2.6	2.8	2.8	2.8	6.8	17.2	1.1	4.9

[1] Different responses to Atrimmec in Experiment 1 and Experiment 2 may be due to seasonal differences. Atrimmec is most effective when applied to lush spring growth or under good growing conditions. Experiment 1 began in the spring, while Experiment 2 began in the fall.

[2] Foliar spray treatments were reapplied without pruning seven weeks after treatment (WAT).

[3] Measurements were taken at 16 weeks after treatment.

[4] Mean length of three longest secondary runners.

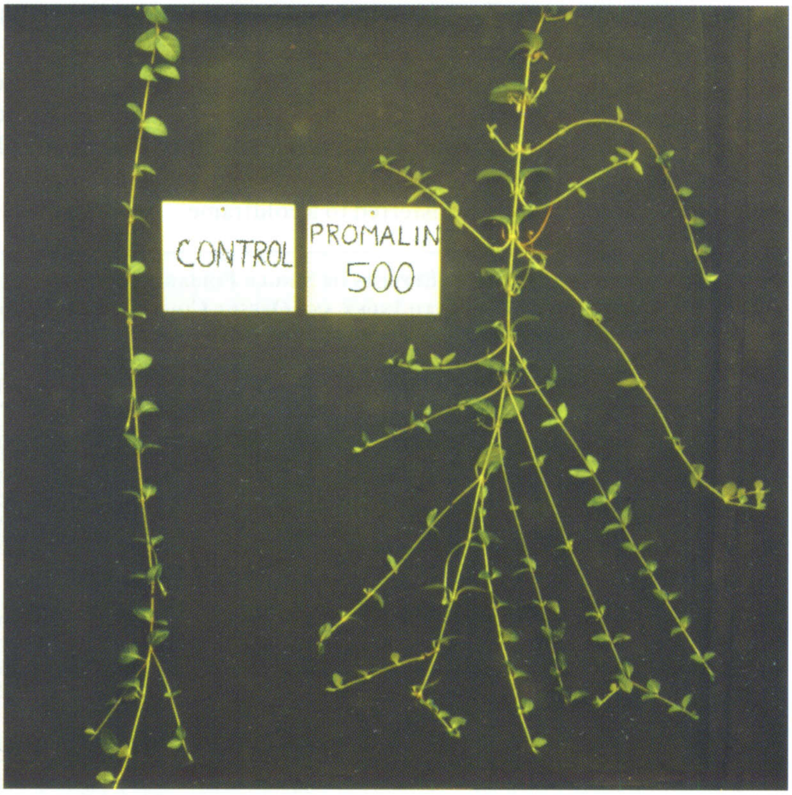
[5] WAT = weeks after treatment.

RESULTS

Primary runner numbers increased throughout the experimental period as rate of Promalin increased (Table 2); at 11 WAT, numbers increased from 63% to 148%. Primary runner lengths were not affected by Promalin rate at any sampling time. Promalin also increased secondary runner numbers (409% to 1,400%) and lengths (54% to 59%). The increase in secondary runners resulted in noticeably fuller plants which should be more marketable. Basal runner numbers or the number of nodes per primary runner was not influenced by Promalin rate.

Primary runner numbers were not affected by Atrimmec through week 11. However, runner numbers at 16 WAT increased as rate increased, with the greatest increase (22%) from the 1,000 ppm treatment. Secondary runner numbers and lengths were not affected by Atrimmec application.

The most effective chemical at promoting the branching of *Vinca* is Promalin, applied twice at the rate of 1,000 ppm. Results show that it should be applied when plants are actively growing, just after pruning.



Branching of *Vinca minor* after treatment with a 500 ppm foliar spray of Promalin (right).

BA-Induced Offset Formation in Hosta

GARY J. KEEVER

Hosta, a popular herbaceous perennial in the lily family, is usually propagated in the spring or fall by crown division, a process that produces only a few plants per mother plant. The plant's slow propagation rate greatly delays and increases the cost of introducing new hosta cultivars.

AAES research has shown that foliar and drench applications of the cytokinin Pro-Shear (BA), a chemical growth regulator, can stimulate offset (plant shoot) development from dormant buds of blue hosta. Without BA, growth from the plant's crown tends to suppress development of buds in leaf axils (the angle between the leaf and stem) and in the rhizomes (underground stem tissue).

Cytokinins induce development of randomly occurring buds, break bud dormancy, help lateral buds overcome the dominance of the upper part of the plant, and stimulate elongation of buds in leaf axils. Pro-Shear and other cytokinins enhance shoot formation and branching in both woody and herbaceous plants.

METHODS

Blue hosta plants in five-inch pots received one of several Pro-Shear treatments: single foliar sprays ranging from 125-2,000 parts per million (ppm) applied to runoff (approximately 0.18 ounce per plant); or single drenches ranging from 5-80 milligrams of active ingredient (a.i.) per pot (Table 1). Several weeks after treatment, plants were transferred to a coldframe and allowed to enter dormancy. Growth index and offset counts were determined before and after dormancy. Offsets were cut from the mother plants 300 days after treatment (DAT) and placed in open flats of Metro-Mix 360 under intermittent mist; six weeks later, percent rooting and root density were evaluated.

Increases in offset counts from increased foliar rates of Pro-Shear in the first experiment indicated that possibly optimal rates had not been applied. Therefore, a second experiment was set up to examine the effects of higher spray and drench rates of Pro-Shear. Methods were similar to those in the first experiment, but foliar sprays ranged up to 4,000 ppm, and drenches ranged up to 120 mg a.i. per pot.

RESULTS

Extensive damage was seen in blue hosta foliage drenched with 80 mg or more a.i. per pot. New foliage that developed on these plants in 1992 was frequently smaller, twisted, or strap-shaped. Symptoms began as a distal bleaching of leaf margins that spread toward the midrib and leaf base. Foliage that developed in 1993 following a period of dormancy appeared normal. No phytotoxicity occurred on plants receiving other drench treatments. Minor tip and marginal bleaching occurred on plants sprayed with 3,000 or 4,000 ppm Pro-Shear, but no phytotoxic symptoms occurred on foliage that developed in 1993.

Growth index of plants receiving a single foliar

TABLE 1. EFFECTS OF SINGLE FOLIAR SPRAYS OR DRENCHES OF PRO-SHEAR ON GROWTH INDEX AND OFFSET COUNTS OF BLUE HOSTA (EXPERIMENT 1)

Rate	Growth index[1]				Offset count			
	30 DAT	60 DAT	90 DAT	300 DAT	30 DAT	60 DAT	90 DAT	300 DAT
				Foliar Applications[2]				
125	20.6	21.4	21.5	41.2	1.4	1.6	1.3	1.6
250	22.5	24.4	25.0	40.0	0.7	1.0	0.7	1.6
500	22.3	23.6	24.2	37.6	2.9	2.4	2.6	3.0
1,000	23.4	24.0	23.9	40.8	2.1	2.6	2.4	2.4
2,000	23.4	24.0	24.3	39.4	3.9	4.0	3.4	3.7
				Drench Applications[3]				
5	20.7	22.1	22.3	37.5	1.9	1.7	1.3	2.7
10	22.0	23.7	24.2	40.2	0.4	0.4	0.4	1.7
20	23.1	24.0	24.6	39.4	2.9	2.7	2.6	4.1
40	20.2	21.6	21.9	36.5	3.7	4.1	3.6	3.9
80	18.6	19.7	20.2	32.7	2.9	3.4	3.0	3.0
				Control				
--	22.1	23.0	23.6	37.4	0.0	0.0	0.0	0.0

[1]Growth index = (height + $width_1$ + $width_2$)/3. $Width_1$ was at the widest point, and $width_2$ was perpendicular to $width_1$. It is measured in centimeters.
[2]Foliar applications are measured in parts per million.
[3]Drench applications are measured in milligrams of active ingredient per pot.

spray was not significantly affected by Pro-Shear rate in Experiment 1 (Table 1). In the second experiment, no effect was seen until 260 DAT, which occurred after a period of dormancy; at this time, growth index decreased with increasing spray rate (Table 2).

Growth index for plants receiving a drench application decreased with increasing rate 30, 60, and 90 DAT in both experiments. This trend continued until 260 DAT in Experiment 2. After the dormant period in Experiment 1 (approximately 300 DAT), growth index was similar among all drench and spray treatments. The large decrease in growth index of plants drenched with 80 mg or more was primarily due to loss of leaves through foliage death.

Within 14 days of treatment, elongation of rhizomic and axillary buds was evident on plants sprayed with 1,000 ppm or more and on those drenched with 80 mg or more. At all sampling dates in Experiment 1, offset counts increased with increasing rates of foliar or drench-applied Pro-Shear, and were similar for the two methods of application (see figure). Experiment 2 continued this trend to certain point, but offsets declined at the highest rates, indicating that optimal rates had been exceeded. Few or no offsets developed from non-treated control plants during either experiment.

However, offset counts decreased over time during the season of treatment for most application methods in both experiments. This decrease reflected the abortion of random offsets and may represent another expression of phytotoxicity. A follow-up study (Page 32) later determined that offsets removed as stem cuttings soon after bud elongation could be successfully rooted.

Offset formation in blue hosta 60 days after treatment with 2,000 ppm BA, left, compared to the control.

Considering phytotoxicity, plant growth, and bud development, the optimal rates of foliar-applied Pro-Shear ranged from 2,000 ppm, the highest tested rate in the first experiment, to 3,000 ppm in the second. The optimal rate for drench-applied Pro-Shear was 20 mg in Experiment 1 and 40 mg in Experiment 2. Both foliar and drench applications appeared to be equally effective.

All offsets cut from the mother plants and placed under intermittent mist developed into plants with well-developed root systems within six weeks after offset removal. These data demonstrate that use of Pro-Shear can be an effective means for increasing the number of offsets in hosta.

TABLE 2. EFFECTS OF SINGLE FOLIAR SPRAYS OR DRENCHES OF PRO-SHEAR ON GROWTH INDEX AND OFFSET COUNTS OF BLUE HOSTA (EXPERIMENT 2)

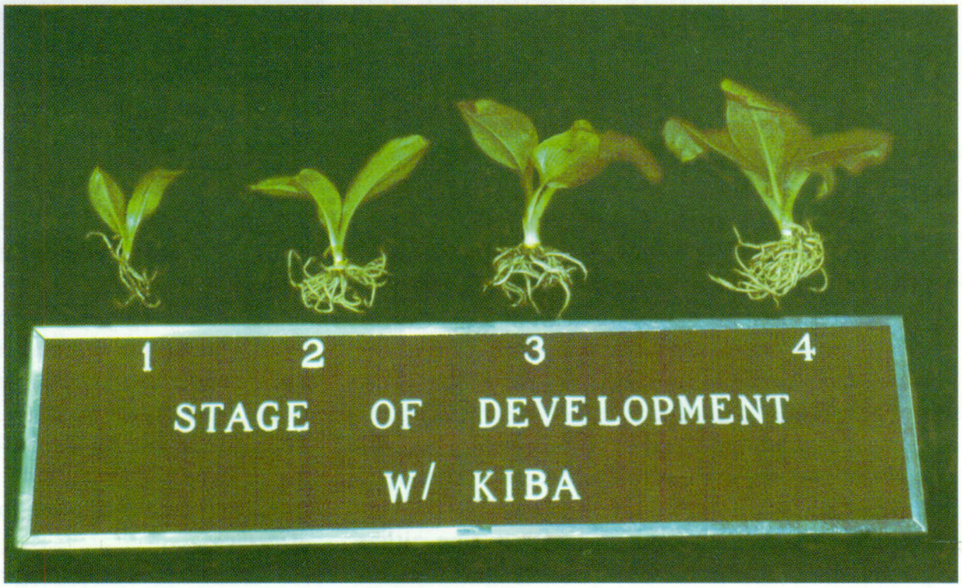
Rate	Growth index[1]				Offset number			
	30 DAT	60 DAT	90 DAT	260 DAT	30 DAT	60 DAT	90 DAT	260 DAT
Foliar Applications[2]								
250	20.9	21.0	21.1	37.2	0.7	0.4	0.3	1.3
500	19.0	19.1	19.1	36.8	1.9	1.6	1.0	2.1
1,000	18.9	18.9	19.1	35.6	3.6	2.9	2.6	3.1
2,000	19.1	19.3	19.4	36.4	4.1	3.0	2.6	2.6
3,000	20.1	20.1	20.7	35.4	5.4	4.6	4.4	4.7
4,000	19.7	20.0	20.1	33.4	3.6	3.4	2.9	2.6
Drench Applications[3]								
20	22.2	22.5	23.3	40.4	2.0	1.7	1.6	2.3
40	20.2	20.3	20.7	35.2	4.6	3.7	3.6	4.0
60	22.6	22.6	19.9	35.3	2.9	2.4	2.4	3.1
80	20.1	18.8	18.9	31.4	3.9	3.1	2.9	3.3
100	19.8	18.3	18.6	29.8	3.9	3.6	3.1	2.4
120	15.4	15.1	14.0	27.2	4.6	3.9	3.9	2.0
Control								
—	18.7	18.8	18.8	40.1	0.0	0.0	0.0	0.3

[1]Growth index = (height + $width_1$ + $width_2$)/3. $Width_1$ was at the widest point, and $width_2$ was perpendicular to $width_1$. It is measured in centimeters.
[2]Foliar applications are measured in parts per million.
[3]Drench applications are measured in milligrams of active ingredient per pot.

Offset Stage of Development Affects Hosta Propagation by Stem Cuttings

Gary J. Keever, D. Joseph Eakes, and Charles H. Gilliam

Following the results of an earlier study (Page 30), subsequent AAES research yielded a method for producing rooted offsets (plant shoots) in less than 10 weeks from hosta plants that had no visible buds initially. This approach to hosta propagation provides a more rapid method of multiplication than through annual crown division.



Stages of development of stem cuttings treated with KIBA as they appeared six weeks after removal.

Applications of the cytokinin Pro-Shear (BA) caused buds in lateral areas and in the rhizomes (underground stem tissue) to elongate within 14 days of treatment in the previous study. Offsets from these buds formed well-developed root systems after being cut from mother plants. However, offset counts decreased over time during the season of treatment, indicating the abortion of random offsets.

The followup study determined that offsets removed as stem cuttings soon after bud elongation could be successfully rooted. This procedure not only decreases the time required to increase stock, it avoids the loss of offsets seen over time in the earlier study.

METHODS

Uniform, single eye (no offsets) stock plants of blue hosta were transferred on July 13, 1993, from a 47% light-exclusion shade house to a shaded, double-layer polyethylene greenhouse with ventilation and heat setpoints of 78°F and 70°F, respectively. Plants were grown in five-inch azalea pots containing Metro-Mix 360 and fertilized three times per week with 300 parts per million (ppm) of nitrogen from 20-10-20 Peters Peatlite Special. On July 20, a single foliar spray of 2,500 ppm Pro-Shear was applied to runoff (approximately 0.22 ounce per plant). Buffer-X at 0.2% was added as a surfactant to the spray solution.

On Aug. 13, offsets were cut from the mother plants and divided into four stem cutting groups based upon stage of development (SOD): SOD 1 -- elongated bud, first leaf unfurled; SOD 2 -- one furled and one unfurled leaf; SOD 3 -- two unfurled leaves; and SOD 4 -- three unfurled leaves. Only SOD 4 cuttings had visible preformed root initials. Basal ends (half inch) of half the offsets representing each SOD were dipped for five seconds in a 1,000 ppm solution of KIBA, a rooting hormone. Stem cuttings were stuck in 804 cell-packs of Metro-Mix 360 medium and placed under intermittent mist (three seconds every five minutes) from 8 a.m. to 5 p.m. The study was terminated on Sept. 24, and response was measured as percent rooting, primary and secondary root counts; root length, root rating, root dry weight, and shoot SOD.

RESULTS

Within 24 days of treatment, numerous offsets had formed on mother plants. Most of these offsets rooted after they were removed from the mother plant and placed under mist for six weeks. All measured characteristics were influenced by stem cutting SOD (see table). Percent rooting increased from 56.3% for cuttings removed at SOD 1 to over 90% for cuttings initially at SOD 3 or 4. When the experiment was terminated, none of the cuttings had died. It is possible that percent rooting for each treatment would have been higher if the rooting period had been extended.

Primary and secondary root counts were highest for cuttings removed at SOD 4, followed by those at SOD 4. These counts were least for those at SOD 1 and 2, which were similar. Compared to SOD 1, primary root counts were 106% higher at SOD 3 and 170% higher at SOD 4; secondary root counts were 296% higher at SOD 3 and 52% higher at SOD 4 (see figure). A similar trend in root dry weight was observed. Root weights at SOD 3 and 4 were 270% and 557%, respectively, greater than those of cuttings removed at SOD 1. Lengths of the three longest primary roots and root ratings were similar for cuttings at SOD 3 and 4, but higher than those of cuttings at SOD 1 and 2. Development of all cuttings increased during rooting, indicating continued leaf growth. The initial differences in SOD were still present when the experiment was terminated.

Of all the root and shoot characteristics examined, only primary root number was affected by KIBA treatment. Primary root counts averaged 8.1 without KIBA and 10.9 with KIBA, a 35% increase. Although other measured root characteristics were not influenced by KIBA, visible root formation was observed sooner on SOD 3 and 4 cuttings treated with KIBA. On Aug. 30, two and one-half weeks after cutting removal, six cuttings from each treatment were examined and then reinserted into the rooting medium. Roots were visible only on SOD 3 and 4 cuttings treated with KIBA. This observation suggests a quicker rooting response with KIBA, at least at more advanced stages of development, while data show similar rooting six weeks after offset removal.

Results suggest at least two alternatives to enhance rooting. First, cuttings were removed only 24 days after treatment. If cuttings had not been removed so soon, it is likely that a higher percentage would be at a more advanced SOD, which should enhance rooting. A potential limitation to this strategy would be the decrease in offset counts over time reported earlier; however, this decrease did not generally occur until at least 60 days after treatment. A second approach would be to remove only cuttings at SOD 3 or greater; these cuttings should root readily, and removal may stimulate remaining offsets to develop more quickly. However, this option may not lend itself to commercial production because of the need to remove offsets more than once during a season.

In summary, most offsets stimulated to develop in three and one-half weeks rooted following removal from the mother plant and placement under mist for six weeks. Less than 10 weeks were needed to produce rooted offsets from mother plants with no visible offsets. This approach to hosta propagation provides a more rapid method of multiplication than through annual division.

ROOTING RESPONSE OF BLUE HOSTA STEM CUTTINGS BASED ON STAGE OF DEVELOPMENT

SOD[1]	Rooting pct.	Root number		Root			Shoot SOD[2]
		Primary	Secondary	Dry weight	Rating[3]	Length[4]	
	pct.			*oz.*		*in.*	
1	56.3	5.3	5.3	0.0032	1.6	1.2	2.6
2	68.8	7.5	8.2	0.0058	2.1	1.6	3.3
3	81.3	10.9	21.0	0.0118	3.0	2.3	4.0
4	87.5	14.3	32.9	0.0210	3.6	2.8	4.9

[1]This factor represents the stage of development (SOD) of stems when they were cut from the mother plant. SOD 1 = elongated bud, first leaf furled; 2 = one furled and one unfurled leaf; 3 = two unfurled leaves; 4 = three unfurled leaves.
[2]Shoot SOD measures development of offshoots six weeks after they were removed from mother plants and placed under mist. It includes SOD 1-4, which are the same as those defined above. It also includes SOD 5 (four or five unfurled leaves) and SOD 6 (six or more unfurled leaves). This measurement shows that plants continued to develop until the end of the study. For example, offsets removed at SOD 1 had developed to SOD 2.6 by the study's end.
[3]Root rating: 0 = no roots; 5 = dense root mass.
[4]Root length: mean of the three longest primary roots per cutting.

Growth and Flowering Response of Butterfly-Bush to Cutless

GARY J. KEEVER AND CHARLES H. GILLIAM

Rank shoot growth during container production of butterfly-bush necessitates multiple prunings to develop a well-branched, marketable plant. However, most growth inhibitors are either uneconomical or cause undesirable side effects.

Flurprimidol, registered as Cutless for use on turfgrasses, reduces shoot growth, apparently by inhibiting gibberellin synthesis, without causing overt injury. Cutless has effectively suppressed shoot elongation of several tree species when applied as a trunk or subsoil injection and several shrub species when applied as a foliar spray. Now, AAES research has shown that Cutless also can effectively retard shoot elongation of butterfly-bush; its effect on flower development is minimal at low rates of application.

Butterfly-bush is a large shrub, five to ten feet high, that is grown in USDA Zones 5-9. It is characterized by rapid growth; long, arching canes; and four- to 10-inch-long fragrant panicles throughout the summer.

METHODS

Liners of 'Royal Red' butterfly-bush were transplanted on April 28, 1992, into three-gallon pots of an amended pine bark:sand (7:1 by volume) growth medium. On May 16, plants were pruned to a uniform height of six inches. Five days later, single foliar sprays ranging from 500-2,500 parts per million (ppm) of Cutless were applied to the plants until runoff. Plants were topdressed with Polyon 24-4-16 on April 13, 1993.

A second, similar experiment was later initiated to evaluate the response of butterfly-bush to lower rates of Cutless, as well as rates that provided effective growth suppression in the first experiment. Cutless was applied as a foliar spray at rates ranging from 62.5-2,000 ppm.

In Experiment 1, foliar color rating and growth index, as well as inflorescence number, index, and stage of development were determined 30 days after treatment (DAT). Growth indices were also determined at 60, 90, and 120 DAT. At termination of the experiment (360 DAT), growth indices and lengths of the three longest shoots per plant were measured. The formula for determining plant growth index is: (height + $width_1$ + $width_2$) divided by three; $width_1$ is the widest point of the plant, and $width_2$ is perpendicular to $width_1$. Inflorescence index is calculated by adding the length of the inflorescence, the width at the top, and the width at the bottom; this sum is divided by three.

TABLE 1. EFFECTS OF SINGLE FOLIAR SPRAYS OF CUTLESS ON VEGETATIVE GROWTH AND FLOWERING OF 'ROYAL RED' BUTTERFLY BUSH (EXPERIMENT 1)

Rate	Foliar color[1]	Growth index[2] 30 DAT	60 DAT	90 DAT	120 DAT	360 DAT	Shoot length[3]	Inflorescence number	Inflor. index[4]
ppm		*cm*	*cm*	*cm*	*cm*	*cm*	*in.*		*cm*
0	1.4	92.8	102.1	104.2	106.7	102.7	23.7	19.4	2.4
500	3.3	67.1	81.8	86.5	90.4	99.6	28.1	16.3	2.1
1,000	2.7	67.5	73.7	74.5	74.6	95.3	26.1	14.4	2.0
1,500	3.9	65.8	68.1	69.9	76.5	94.5	27.3	11.1	1.8
2,000	3.4	67.6	72.6	77.7	77.7	90.2	25.5	12.9	2.0
2,500	4.3	68.8	70.1	76.5	76.5	94.7	26.7	11.9	1.9

[1]Foliar color rating: 1 = light green, 3 = medium green, and 5 = dark green. Color was rated 30 days after treatment (DAT).
[2]Growth index = (height + $width_1$ + $width_2$)/3 in centimeters. $Width_1$ was at the widest point, and $width_2$ was perpendicular to $width_1$. One inch equals 2.54 cm.
[3]Shoot length is the mean of the three longest shoots per plant, measured 360 DAT.
[4]Inflorescence index = (length + width 1 cm from top + width 1 cm from bottom)/3, in cm. Five terminal inflorescences per plant were measured.

Table 2. Effects of Single Foliar Sprays of Cutless on Vegetative Growth and Flowering of 'Royal Red' Butterfly Bush (Experiment 2)

Rate	Growth index[1]			Shoot length[2]	Inflorescence no.	Inflor. index[3]
	45 DAT	120 DAT	286 DAT			
ppm	*cm*	*cm*	*cm*	*in.*	*no.*	*cm*
0	105.9	106.7	118.3	30.2	21.7	2.7
62.5	96.0	104.6	115.3	32.5	22.2	2.8
125	84.9	95.4	111.3	33.3	21.2	2.4
250	85.8	89.9	108.2	35.6	20.3	2.6
500	80.4	80.3	107.7	33.9	16.3	2.6
1,000	60.3	65.3	105.9	35.2	14.3	2.2
2,000	56.7	57.2	94.5	31.0	13.5	2.1

[1]Growth index = (height + $width_1$ + $width_2$)/3 in centimeters. $Width_1$ was at the widest point, and $width_2$ was perpendicular to $width_1$. One inch equals 2.54 cm.
[2]Shoot length is the mean of the three longest shoots per plant, measured 360 DAT.
[3]Inflorescence index = (length + width 1 cm from top + width 1 cm from bottom)/3, in cm. Five terminal inflorescences per plant were measured.

In Experiment 2, growth index and inflorescence number, index, and stage of development were determined at 45 DAT. Growth index was also measured at 120 DAT and at the termination of the experiment following the 1993 spring growth flush (286 DAT). At that time, the lengths of the three longest shoots per plant were measured.

RESULTS

Foliar color of plants treated with Cutless was noticeably darker than that of control plants 30 DAT (Table 1). This response is common in plants treated with growth retardants, and in most cases the darker green appearance has been correlated with increased chlorophyll content. Darker green foliage of treated plants was apparent throughout the 1992 season, although foliar color was rated only at 30 DAT.

In both experiments, inflorescence number and size decreased with increasing Cutless rates (see tables). In Experiment 1, the decrease in inflorescence numbers ranged from 16% to 43%, while inflorescence indices decreased 14% to 27%. However, in the second experiment most of the decrease in inflorescence size and number occurred with plants treated with the two or three highest rates of Cutless. Inflorescences of treated plants were noticeably shorter, narrower at the base, and more rounded at the apex than those of control plants. The rate at which flowers developed was not affected in either experiment.

Both experiments confirmed that Cutless can effectively suppress growth, a finding supported by the decreased growth index of treated plants. Magnitude and duration of growth suppression was rate dependent. However, rates of 500 ppm or higher were found to be excessive for container production. Rates of 250 ppm or less provided adequate growth suppression but minimized the negative impacts on flower development.

The impact of Cutless lessened over time in both experiments. Retardant-treated plants experience accelerated growth after growth suppression effects have dissipated. This factor may relate to the accumulation of large reserves of carbohydrates during the period of growth inhibition. These large reserves stimulate rapid growth as effects of the growth retardant lessens. Growth inhibition of control plants, caused by the plants being potbound, could also explain the similarity of all plants in the final days of each experiment.

In both experiments, lengths of the three longest shoots, which typically originated deep within the plant canopy, were similar among treatments. Shoots of treated plants tended to be as long or longer than those of control plants, suggesting similar or greater vigor. Much of the new growth that developed in spring 1993 was upright, rank shoots formed near the base of the plant. Similarities in plant height but a decrease in growth index indicated a decrease in plant width with increasing Cutless rate.

Findings of these two experiments indicate that Cutless can effectively retard shoot elongation of butterfly-bush, resulting in more uniform, compact plants with dark green foliage. Cutless-treated plants were considered more marketable. The optimal rate of application is approximately 225 ppm.

Growth Control of Asiatic Jasmine and Carolina Jessamine

Gary J. Keever and William J. Foster

Asiatic jasmine and Carolina jessamine, two popular evergreen vines, are among the most widely used ground covers in the South. However, these vigorous, twining vines require frequent hand pruning, making them costly and labor intensive to produce.

Sumagic, a plant growth regulator, has shown promise for reducing pruning frequency of woody plants in nursery and landscape settings, but plant response has varied depending on species and application rate. Its use on Asiatic jasmine and Carolina jessamine had not been tested. In an AAES study, Sumagic did control shoot elongation of the two vigorous species, but the rates required are cost prohibitive. Hand pruning is probably still the most economical approach.

METHODS

Asiatic jasmine. An initial experiment in 1988 tested Sumagic spray rates ranging from 75-300 parts per million (ppm), but most of these rates did not sufficiently control shoot elongation. A second experiment was conducted using higher foliar spray rates, as well as drench applications.

In the second experiment, uniform liners were transplanted into one-gallon pots of an amended pine bark:peat growth medium on May 9, 1989, pruned to approximately four inches on June 21, and treated on July 12. Sumagic was sprayed in a volume of two quarts per 100 square feet at rates ranging from 300-900 ppm. It also was applied as a medium drench at rates ranging from 3-20 milligrams of active ingredient (a.i.) per pot. Because of vigorous vine growth, treatments were reapplied on Aug. 28. Due to excessive growth in most treatments and to determine if there was a growth-inhibiting effect following pruning, plants were pruned to eight inches after data collection 13 weeks after the second treatment (WAST). Data collected included shoot dry weights, length of the three longest runners per plant, and number of runners longer than eight inches. Runners shorter than eight inches, a typical pruning length during production, were considered to be positively affected by Sumagic.

Carolina jessamine. Methodology was similar to that used in the Asiatic jasmine test, except that jessamine was pruned to approximately six inches after potting. Foliar spray treatments ranged from 75-300 ppm. Growth medium drench treatments ranged from 1-5 mg a.i. per pot. Data collected were shoot lengths, shoot dry weights, foliar color ratings, and root ratings. In 1989, researchers conducted a second, similar experiment, which was terminated 13 WAST, instead of 40 WAST.

Table 1. Response of Asiatic Jasmine to Sumagic [1]

Rate	Runner length[2]		Number of runners[3]			Dry weight
	6 WAT[4]	13 WAST[4,5]	6 WAT	13 WAST[5]	40 WAST	40 WAST
	in.	*in.*	*no.*	*no.*	*no.*	*oz.*
Spray (ppm)						
0	26.3	48.7	16	29	27	5.7
300	19.4	37.5	8	19	14	3.9
600	19.2	35.7	6	19	12	3.6
900	17.4	33.5	5	17	11	3.7
Drench (mg a.i./pot)						
0	26.3	48.7	16	29	27	5.4
3	22.6	44.6	7	17	13	3.7
5	19.9	38.0	5	13	9	3.4
10	21.1	43.1	7	13	8	3.1
15	20.4	44.3	6	16	11	3.3
20	20.4	54.5	5	11	7	2.6

[1]An initial experiment was conducted, using only spray applications ranging up to 300 parts per million (ppm). Most of these rates provided insufficient growth suppression. A second experiment analyzed spray rates up to 900 ppm, as well as a range of drench application. This table presents results of the second experiment.
[2]Average of three longest runners per plant.
[3]Number of runners longer than eight inches.
[4]Treatments were initially applied on July 12, 1989, and reapplied on Aug. 28, 1989, 6.5 weeks after treatment (WAT); WAST = weeks after second treatment.
[5]Plants were pruned to eight inches following data collection.

RESULTS

Asiatic jasmine. In the second experiment, runner length of Asiatic jasmine decreased with increasing spray rates six weeks after treatment (WAT) and 13 WAST (Table 1), but not 40 WAST. Runner length also decreased with drench-applied Sumagic at 6 WAT, but not 13 or 40 WAST. Data suggest a dissipation of growth suppression of at least some runners followed by accelerated shoot elongation. Runner lengths of sprayed plants were less than those of drenched plants at 6 WAT and WAST, but by 40 WAST, values were similar.

Number of runners exceeding eight inches decreased with increasing spray and drench rates at all sampling dates. Since plants were pruned at 13 WAST,

Table 2. Response of Carolina Jessamine to Sumagic (Experiment 1)

Rate	Shoot dry weight	
	19 WAST[1]	49 WAST
	oz.	oz.
Spray (ppm)		
0	3.4	6.4
75	3.4	6.4
100	2.9	5.6
150	2.7	5.3
200	2.6	4.6
300	2.5	4.8
Drench (mg a.i./pot)		
0	3.5	6.4
1	2.2	4.7
3	2.3	3.9
5	2.3	3.6

[1]Treatments were initially applied on June 16, 1988, and re-applied on Sept. 22, 19 weeks after treatment (WAT); WAST = weeks after second treatment.

the greater decrease in runner number at 40 WAST with both spray and drench treatments indicates that pruning elongated shoots of Sumagic-treated plants may enhance growth suppression. Runner numbers were similar for sprayed and drenched plants 6 WAT, but were less for drenched plants 13 and 40 WAST. Fewer elongated shoots on drenched plants indicate a more persistent suppression compared to sprayed plants. Shoot dry weight response to Sumagic treatments was similar to that of runner number. Dry weights of drenched plants averaged 14% less than those of sprayed plants. Foliar color was not affected by Sumagic.

Carolina jessamine. Jessamine showed no obvious growth differences among plants receiving the different treatments at 9 WAT. This observation was supported by the fact that shoot length at 14 WAT lacked a rate response to either foliar- or drench-applied Sumagic. However, drenched plants, averaged over all rates, were shorter than sprayed plants. Shoot dry weights of jessamine 19 and 40 WAST decreased with increasing foliar and drench rates (Table 2). However, results suggests a dissipation of growth suppression over time. At both dates, weights of sprayed plants were greater than those of drenched plants. Foliar color was unaffected by treatments.

In the second jessamine experiment, shoot length decreased at 6 WAT and 13 WAST with increasing rates of both foliar- and medium-applied Sumagic (Table 3). Shoot lengths were similar on both dates, regardless of treatment. Of all the treatments, foliar sprays of 300 ppm or drenches of three or five milligrams per pot produced plants of the highest quality. They were elongated sufficiently to be staked but did not require frequent pruning. Also, higher rates stunted the plants and made them appear undersized (see figures).

Table 3. Response of Carolina Jessamine to Sumagic (Experiment 2)

Rate	Shoot length[1]	
	6 WAT[2]	13 WAST[2]
	in.	in.
Spray (ppm)		
0	25.1	65.7
300	10.2	26.6
600	8.5	23.9
900	8.5	12.1
Drench (mg a.i./pot)		
0	25.1	65.7
3	15.9	37.8
5	13.7	32.1
10	6.5	8.3
15	6.1	6.9
20	6.6	7.9

[1]Longest shoot was straightened and measured.
[2]Treatments were initially applied on July 12, 1989, and re-applied on Aug. 28, 6.5 weeks after treatment (WAT); WAST = weeks after second treatment.

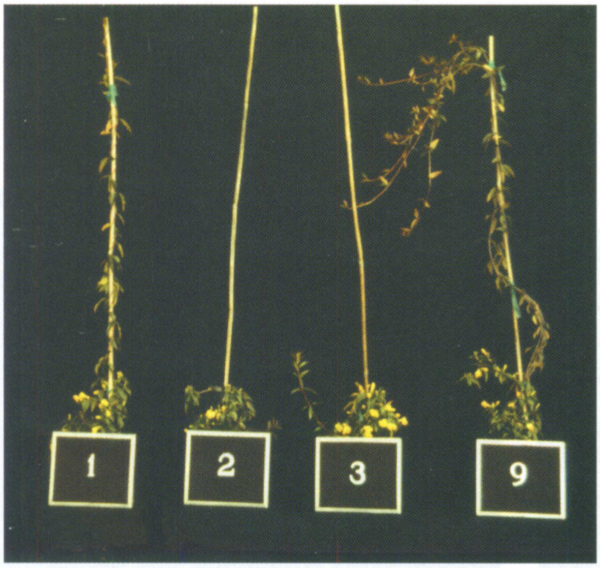


Figure 1. Carolina jessamine 13 weeks after the second foliar application of (left to right) 300, 600 or 900 ppm Sumagic; control plant on the right.

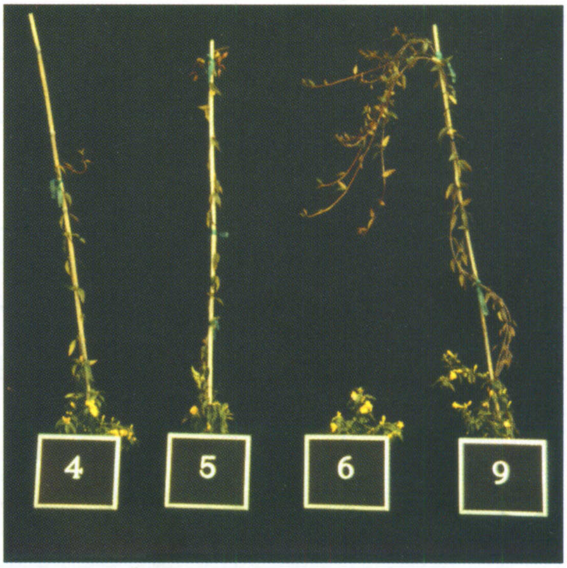


Figure 2. Carolina jessamine 13 weeks after the second medium drench application of (left to right) 3, 5 or 10 mg a.i./pot; control plant on the right.

Cutless Controls Shoot Growth of 'China Girl' Holly

Gary J. Keever, Charles H. Gilliam, and Donald J. Eakes

Hollies are among the most widely planted woody landscape plants in the Southeast, but they require repeated pruning during container production to maintain a compact growth habit. Numerous growth retardants have been evaluated as inhibitors of woody plant growth, but most remain uneconomical or cause undesirable side effects.

However, the retardant flurprimidol, registered as Cutless for use on turfgrasses, has reduced shoot growth without causing visible injury in other plants. An AAES study showed that foliar-applied Cutless can effectively reduce shoot growth on 'China Girl' holly during container production.

METHODS

Liners of 'China Girl' holly were transplanted on April 28, 1992, into seven-gallon pots of an amended pine bark:sand (7:1 by volume) growth medium. On May 14, plants were pruned to a uniform height of five inches. Seven days later, single foliar sprays ranging from 500-2,500 parts per million (ppm) of Cutless were applied to runoff. Plants were topdressed on April 13, 1993, and transplanted into 10-gallon pots on June 9. At 364 days after treatment (DAT), which followed the spring 1993 growth flush, and at 534 DAT, most plants needed some pruning to improve quality. Plants were pruned to shape, similar to the pruning that occurs during typical nursery production of vigorous, upright hollies. Clippings were bagged, dried, and weighed. Data collected included growth index (see tables), foliar color rating, and lengths of the three longest shoots per plant.

RESULTS

Growth index at 30 DAT indicated a suppression of shoot growth by Cutless. Mean values for plants receiving the 500 ppm and 2,500 ppm rates were 6.2% and 19% less, respectively, than those for non-treated control plants (Table 1). Growth index decreased with increasing Cutless rate at all other sampling dates. Growth index of plants treated with 500 ppm Cutless was 16-17% less at 60, 90, and 120 DAT. At 2,500 ppm, growth index was 32% less at 60 DAT, 34% less at 90 DAT, and 40% less at 120 DAT. This range of growth suppression was relatively consistent during the first growing season, particularly for plants receiving 500 ppm. The widening of the range over time (between 60 and 364 DAT) reflected continued growth of control plants and almost no growth of plants treated with 2,500 ppm Cutless.

After the spring 1993 growth flush (364 DAT), mean growth index of plants treated with the 500 ppm rate was similar to control plants, indicating a more rapid growth rate of treated plants. However, plants treated with rates above 500 ppm had a growth index 33.3-46.6% less at 364 DAT. By 534 DAT, growth index of plants treated with 500 or 1,000 ppm Cutless was similar to the control. Growth index of plants treated with higher rates was 10.4-22.5% less, indicating growth suppression for at least two seasons.

After the spring 1993 growth flush (364 DAT), shoot lengths of plants treated with 500 or 1,000 ppm Cutless were similar to those of control plants (Table 2). Shoots of plants treated with higher rates tended to

TABLE 1. EFFECTS OF SINGLE FOLIAR SPRAYS OF CUTLESS ON GROWTH INDEX OF 'CHINA GIRL' HOLLY

Rate	Growth index[1]					
	30 DAT[2]	60 DAT	90 DAT	120 DAT	364 DAT	534 DAT
ppm	*cm*	*cm*	*cm*	*cm*	*cm*	*cm*
0	65.7	78.9	82.5	91.3	106.6	99.2
500	61.6	65.7	69.4	75.7	105.3	102.7
1,000	61.6	63.6	66.7	69.9	71.1	101.5
1,500	60.5	63.9	63.0	65.1	70.9	77.3
2,000	59.8	61.5	60.0	65.0	76.4	88.9
2,500	53.2	53.7	54.2	54.5	56.9	76.9

[1]Growth index = (height + $width_1$ + $width_2$)/3. $Width_1$ was at the widest point, and $width_2$ was perpendicular to $width_1$.
[2]DAT = days after treatment.

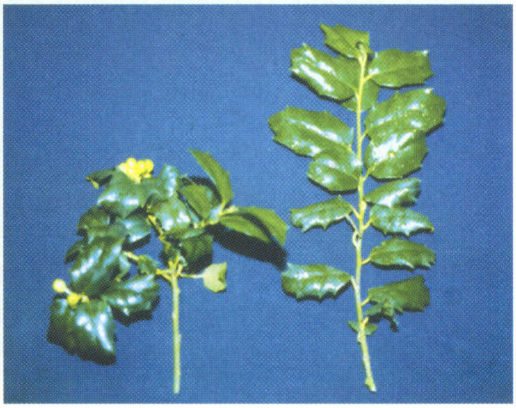


Figure 1. Reduced size and pronounced curling (left) of 'China Girl' holly foliage treated with 2,500 ppm Cutless.

Table 2. Effects of Single Foliar Sprays of Cutless on Foliar Color, Shoot Length, and Shoot Dry Weight of 'China Girl' Holly

Rate	Color[1]		Length[2]	Dry weight[3]	
	30 DAT[4]	534 DAT		364 DAT	534 DAT
ppm			*in.*	*oz.*	*oz.*
0	1.6	3.3	7.1	11.3	5.4
500	2.3	3.8	8.8	7.5	6.8
1,000	2.9	3.8	6.8	2.0	5.8
1,500	2.8	3.5	5.7	1.7	4.2
2,000	2.8	4.0	6.5	1.5	3.5
2,500	2.6	5.0	3.3	0.0	1.9

[1]Foliar color rating: 1 = light green, 3 = medium green, and 5 = dark green.
[2]Shoot length is the mean length of the three longest shoots per plant taken 364 DAT.
[3]Dry weights of shoots removed when plants were pruned for uniformity.
[4]DAT = days after treatment.

be shorter; those treated with 2,500 ppm were 54% shorter than controls.

Shoot dry weights of clippings removed 364 DAT decreased with increasing Cutless rates; means ranged from 34.2% to 100% less than the controls. Most of the decrease in shoot dry weights occurred in plants sprayed with rates above 500 ppm. A somewhat different trend was present at the end of 1993. Shoot dry weights of prunings from plants treated with 500 and 1,000 ppm Cutless were 24.8% and 7.2% percent greater, respectively, than control plants, indicating a greater vigor of treated plants. Shoot dry weights of plants treated with higher rates were 23.7% to 64.9% less than controls.

Foliage of plants treated with 1,500 ppm Cutless appeared slightly smaller and more cupped than that of control plants; effects were more pronounced with the 2,000 and 2,500 ppm rates (Figure 1). Although greater cupping was apparent when plants were compared to controls, the natural cupping of 'China Girl' foliage made the effect less obvious.

Beginning as early as 60 DAT, plants treated with Cutless were noticeably more compact and uniform than control plants. This effect was more pronounced with higher rates of Cutless (Figures 2-4). Foliage color of plants treated with Cutless also was noticeably darker green than that of control plants 30 DAT. This difference in foliar color continued throughout 1992 and 1993, although it was less noticeable at the end of the second season in plants treated with the lower rates.

Plants treated with Cutless were more compact and uniform, and all except for those treated with 2,000 and 2,500 ppm were considered more marketable. However, minimal pruning for shape was required for highest quality.

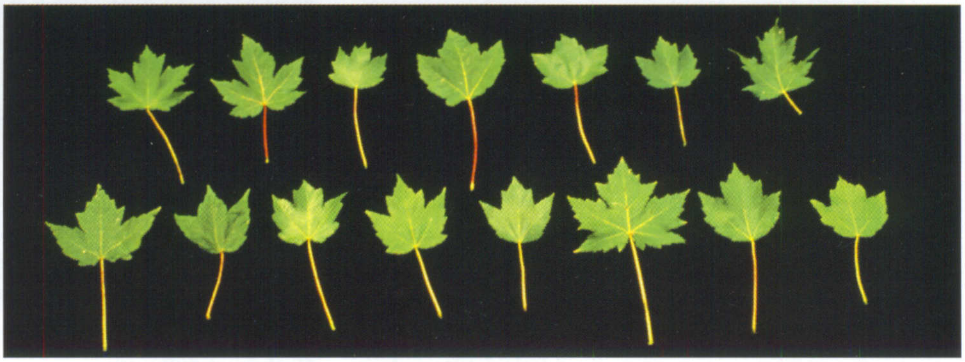
Figure 2. 'China Girl' holly 90 days after treatment with Cutless at 500 ppm .

Figure 3. 'China Girl' holly 90 days after treatment with Cutless at 1,500 ppm.

Figure 4. 'China Girl' holly 90 days after treatment with Cutless at 2,500 ppm.

Foliage Characteristics of Selected Red Maple Cultivars

Jeff L. Sibley, D. Joseph Eakes, Charles H. Gilliam, Gary J. Keever, William A. Dozier, Jr., and Curt M. Peterson



Foliage of red maple cultivars (top row, left to right): 'Armstrong,' 'Autumn Blaze,' 'Autumn Flame,' 'Bowhall,' 'Fairview Flame,' 'Gerling,' 'Karpick,' (bottom row, left to right) 'Morgan,' 'Northwood,' 'October Glory,' 'Redskin,' 'Red Sunset,' 'Scarsen,' 'Schlesingeri,' and 'Tilford.'

The popularity of tree cultivars is due to their uniformity in a particular form, unique foliage, summer or fall leaf color, or some other feature. A trend towards increasing production and use of cultivars necessitates determination of characteristics that readily identify each cultivar. Few of these characteristics have been catalogued to any degree.

Growers seldom have the opportunity to evaluate multiple cultivars of a species in a single location. Often the only observational data available have been collected under different growing conditions. Such observations are difficult or impossible to compare and interpret.

AAES researchers have completed a comparative evaluation of selected red maples, which are among the most frequently planted landscape trees. These trees were grown under the same environmental conditions in order to characterize them based on leaf anatomy, morphology, and appearance.

METHODS

Cultivars of red maple were obtained in March 1988 from Microplant, Inc., of Fairview, Ore., as tissue-cultured microplantlets. Trees were containerized, grown for two years under standard nursery practices, and transplanted in March 1990. Ten leaves were harvested arbitrarily from the midpoint of actively growing shoots from each tree in May, July, August, and September, 1993.

A unique feature of this study was to compare red maple cultivars (*Acer rubrum* L.) previously reported to perform well in the Southeast with cultivars that had not been tested. In addition to *A. rubrum* cultivars, the study included selections of Freeman (*A.* x *freemanii*) maple cultivars, which are a cross between red and silver maples (*A. saccharinum* L.). The study also included a group of seedling red maples from seed collected in 1987 at A. McGill & Son Nurseries in Fairview, Ore.

A. rubrum cultivars included: 'Autumn Flame,' which was introduced in 1964; 'Fairview Flame,' 1992; 'Franksred' (Red Sunset), 1966; 'Karpick,' 1985; 'Northwood,' 1980; 'October Glory,' 1961; 'Redskin,' 1982; 'Schlesingeri,' 1888; and 'Tilford,' 1951. *A.* x *freemanii* cultivars included: 'Autumn Blaze' ('Jeffersred'), which was introduced in 1980; 'Morgan' ('Indian Summer'), 1971; and 'Scarsen' (Scarlet Sentinel), 1972.

Leaf samples also were taken from three additional red maple selections planted in a shade tree trial initiated in 1978. These trees have not been maintained in the same manner as the current study, are from budded origins, and are 10 years older. Therefore, results from these trees should be interpreted separately from the previously mentioned selections. These selections were *A.* x *freemanii* 'Armstrong,' *A. rubrum* 'Bowhall,' and *A. rubrum* 'Gerling.' For comparison, leaves were collected from silver maples (*A. saccharinum*) in the shade tree study.

RESULTS

'Scarsen' had the largest leaves, followed by 'Morgan' and 'Autumn Blaze' (see table). 'Autumn Flame' had the smallest leaves, a trait noted in previous studies. The figure depicts leaf shapes of the cultivars evaluated in this study. 'October Glory' had the longest petioles (leaf stalks), followed by 'Fairview Flame'; both have striking red petioles throughout the growing season. Lowest nitrogen (N) concentrations occurred with seedlings and 'Redskin'; highest concentrations, 'Autumn Flame.' There also were differences in bloom type, as shown in the table.

Results also indicated that for red maples grown under the same conditions, the SPAD-502 Chlorophyll Meter (Minolta Camera Co., Ltd., Japan) can be a useful tool for ranking cultivars in leaf greenness. Often leaf greenness is considered to be highly correlated with foliar N levels, but correlations between N concentrations and SPAD-502 values were poor in this study. For example, 'Franksred,' generally accepted among growers as having the deepest green color of red maple cultivars, had one of the lowest concentrations of N while having one of the highest SPAD-502 values.

All stomata (breathing pores) were found on the lower surface for the maple selections evaluated. There were fewer stomata on the sampled silver maple (314,619 per square inch) than on any of the red maples evaluated. There was no apparent correlation between stomatal density and other leaf characteristics including leaf size. There were 351,529 trichomes (epidermal hair structures) per square inch on the silver maple evaluated. No trichomes were evident on the *Acer rubrum* or *A.* x *freemanii* selections in this study.

LEAF CHARACTERISTICS OF SELECT RED MAPLE CULTIVARS AND A SEEDLING GROUP[1]

Cultivar /seedling	Average leaf area[2]	Petiole length	Stomata[3]	Foliar nitrogen[4]	Chlorophyll content[5]	Flower type[6]
	in.^{2}	*in.*	*no.*	*pct.*		
Armstrong	13.1	6.2	440,445	2.2	44.2	female
Autumn Blaze	13.0	4.7	589,354	2.3	42.5	male
Autumn Flame	6.2	4.8	440,452	2.6	46.2	female
Bowhall	13.9	4.8	355,665	2.2	41.8	female
Fairview Flame	9.0	6.1	409,419	2.4	45.8	male
Franksred	8.3	3.7	492,968	2.2	52.0	female
Gerling	8.5	4.5	390,819	2.0	44.2	female
Karpick	10.3	3.8	452,839	2.1	45.3	male
Morgan	14.6	4.5	423,935	2.2	42.9	female
Northwood	8.5	4.2	428,065	2.4	51.1	male
October Glory	9.6	6.7	415,613	2.5	43.2	female
Redskin	10.2	4.5	436,323	2.0	41.8	female
Scarsen	20.4	5.0	344,645	2.5	43.1	female
Schlesingeri	10.3	4.9	467,355	2.3	49.6	female
Seedling	8.2	2.4	460,968	2.1	43.5	varied
Tilford	9.4	3.7	434,258	2.2	42.9	male

[1]Samples used to obtain means by column: 640, 640, 320, 9,600, and 9,600, respectively.
[2]Leaf area was determined with a Transparent Belt Conveyer Accessory Leaf Area Meter, LI-COR Model LI-3050A (LI-COR Inc., Lincoln, Neb.).
[3]Number of stomata per square inch. Stomatal densities calculated using an eyepiece reticle with an area of 2.4×10^{-5} inch^2 at 40x magnification. Means were derived from five leaves per cultivar, with four fields (subsamples) per leaf, for a total of 20 observations per cultivar.
[4]Nitrogen levels determined with LECO CHN-600 analyzer (LECO Corp., St. Joseph, MI).
[5]Chlorophyll content measurements were taken with a SPAD-502 Chlorophyll Meter in August and September. On a scale of 0-80, leaf color becomes deeper as the rating increases.
[6]Bloom types were determined based on the predominate flower structure present in the spring of 1993 and 1994. Pistillate flowers were considered female and staminate flowers male.

Results from these evaluations define distinctions that characterize foliage features among several red maple cultivars. These data show morphological differences in a non-subjective way, and may be used for identification purposes.

Red Maple Cultivar Performance in the Southeast

JEFF L. SIBLEY, D. JOSEPH EAKES, CHARLES H. GILLIAM, GARY J. KEEVER, WILLIAM A. DOZIER, JR., AND JOHN T. OWEN

When landscapers and homeowners plant red maple seedlings, they expect rapid tree growth, attractive canopy form, and excellent red fall color. Unfortunately, red maples show considerable variations when grown from seed. On the other hand, red maple cultivars, which are cloned from tissue collected from a superior mother tree, are uniform in shape, foliage, and color.

However, cultivars are often selected for Alabama based only on evaluations in the plants' native regions. Many of these cultivars prove to be unsuitable for the Southeast. Of the 52 named red maple cultivars, none have been released from selections originating in the southern portion of their native range, which extends from throughout the Eastern U.S. and Canada. To address this problem, an AAES study identified several superior red maples for the Southeast.

Cultivars included in the AAES trials represent a broad cross section of the classified red maples (*Acer rubrum* L.). Red maple cultivars known to perform well in the Southeast were compared with selections from the Freeman maple group. Freeman maples are generally grouped with red maple cultivars but are recognized botanically as *Acer* x *freemanii*, a cross between red maple and silver maple (*Acer saccharinum* L.).

METHODS

Cultivars were obtained in March 1988, as microplantlets from Microplant, Inc., in Fairview, Ore., and grown in containers for two years. Trees ranged from four to five feet tall when transplanted in March 1990, into a Cecil gravelly sandy loam soil.

Table 1. Height of Red Maple Selections

Cultivar/seedling	Height increase[1]					Final height
	1991	1992	1993	1994	Annual avg.	1994
	cm	*cm*	*cm*	*cm*	*cm*	*cm*
Autumn Blaze	94	106	98	97	99	575
Autumn Flame	71	105	92	89	89	571
Fairview Flame	66	77	73	76	73	470
Franksred	80	73	70	72	74	477
Karpick	62	65	85	33	61	394
Morgan	85	116	84	69	89	519
Northwood	24	49	40	46	40	386
October Glory	65	88	87	79	80	515
Redskin	63	82	58	47	63	408
Scarsen	88	122	72	72	89	509
Schlesingeri	76	84	71	79	78	445
Seedling	79	98	79	94	88	542
Tilford	98	70	82	52	76	456

[1]Growth increases were determined by the difference in current and the previous season's measurements. One inch equals 2.54 centimeters (cm).

Trees were planted on a 30x35 foot spacing and were fertilized with one pound of 13-13-13 per inch of caliper at planting and in March of following years prior to bud break. Drip irrigation was supplied to each tree based on 100% replacement of net evaporation from a class A pan. Height and caliper measurements were taken through the 1994 growing season. Initial size differences between cultivars were not significant. Foliar fall color patterns were evaluated two to three times weekly from September through December of 1992 and 1993. Growth increases were determined by the difference in current and the previous season's measurements.

Acer x *freemanii* cultivars included 'Autumn Blaze,' 'Morgan' ('Indian Summer'), and 'Scarsen' (Scarlet Sentinel). *Acer rubrum* cultivars included 'Autumn Flame,' 'Fairview Flame,' 'Franksred' ('Red Sunset'), 'Karpick,' 'Northwood,' 'October Glory,' 'Redskin,' 'Schlesingeri,' and 'Tilford.' Since the traditional practice has been to plant trees from seed, a group of seedlings from seed collected from A. McGill & Son Nursery of Fairview, Ore., were planted for comparison.

RESULTS

Cultivars 'Autumn Flame' (*A. rubrum*) and three Freeman maple selections 'Autumn Blaze,' 'Scarsen,' and 'Morgan,' generally increased the most in height over the five years (Table 1). 'Northwood' increased the least in height, about one-half that of most other cultivars. Average annual height increase for 'Autumn Flame' was 117% greater than had been reported in previous studies; 'Franksred,' 50% greater; 'Scarsen,' 47% greater; 'Schlesingeri,' 36% greater; seedlings, 71% greater; and 'Tilford,' 35% greater. These enhanced growth differences could be attributed to the use of irrigation or own-root trees versus budded trees.

Caliper increases did not follow height increase trends (Table 2) from 1991 through 1994 as a general rule. While the Freeman group selections had a tendency for height growth typical of silver maple, the caliper growth on an annual basis was different for each. Among the 13 selections of red maple evaluated, 'Autumn Blaze,' an *A.* x *freemanii*, had the greatest annual increase in caliper. 'Morgan' was ranked near the middle, and 'Scarsen' was ranked near the bottom. 'Northwood' and 'Karpick' had the least annual increase in caliper. Most selections developed greater increases in caliper each successive year following establishment until 1994. Caliper increases were lower in 1994 than 1993 for all but 'Autumn Blaze.'

Fall color duration varied yearly. The longest duration of fall color in 1992 occurred with 'October Glory' and 'Fairview Flame' (Figure 1), while in 1993 'Fairview Flame,' 'Schlesingeri,' 'Franksred,' and 'October Glory' had the longest duration (Figure 2).

Cultivars showed greater variability in the timing of peak fall color in 1992 than in 1993. In both years

Table 2. Trunk Caliper of Red Maple Selections

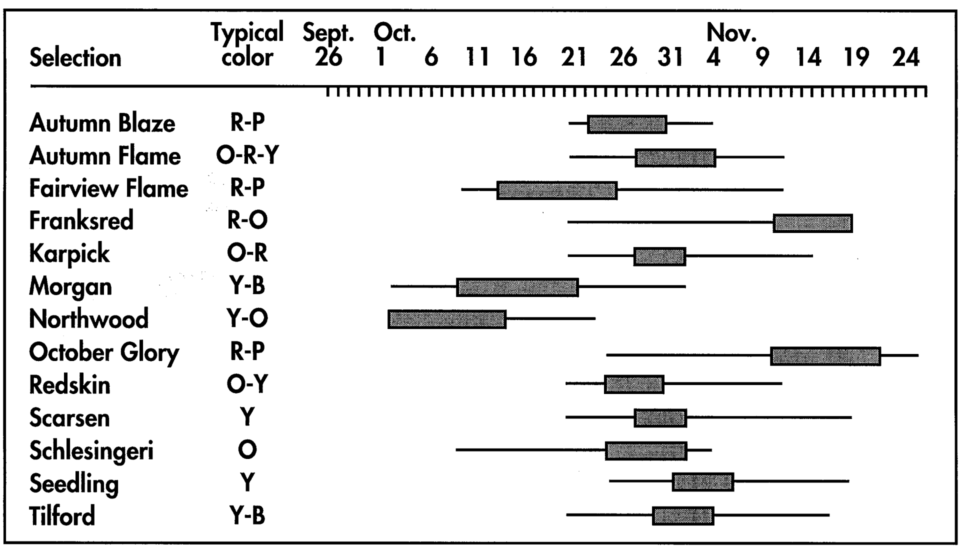
Cultivar/seedling	Caliper increase[1]					Final caliper
	1991	1992	1993	1994	Annual avg.	1994
	mm	*mm*	*mm*	*mm*	*mm*	*mm*
Autumn Blaze	18	27	31	32	27	136
Autumn Flame	15	25	29	29	24	132
Fairview Flame	14	23	28	28	23	122
Franksred	13	17	23	21	19	99
Karpick	5	16	15	12	12	69
Morgan	13	22	24	22	20	103
Northwood	8	12	15	15	12	73
October Glory	14	20	29	24	22	119
Redskin	13	22	21	18	19	102
Scarsen	11	19	22	19	18	95
Schlesingeri	13	19	24	23	20	101
Seedling	17	25	28	27	24	123
Tilford	14	13	19	19	16	83

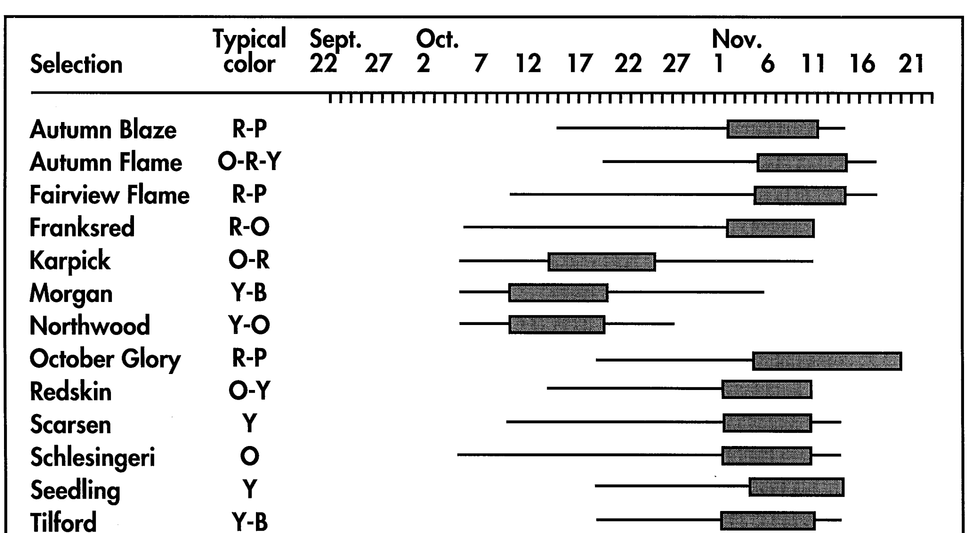
[1]Growth increases were determined by the difference in current and the previous season's measurements. One inch equals 25.38 millimeters (mm).

'Northwood' and 'Morgan' were the first cultivars to exhibit fall color and to have fall color peaks. However, 'Northwood' had completely defoliated near the time 'Autumn Blaze' was at its peak and before 'October Glory' had begun to display notable fall color. Peak fall color was displayed 7-10 days later in 1993 for most cultivars. For the two seasons that fall color evaluations were made, the cultivars 'Fairview Flame' and 'October Glory' had the best display of red coloration, based on typical color hue and duration, while 'Northwood,' 'Morgan,' and 'Redskin' had poor fall color. Defoliation coincided with the end of fall color for most cultivars each year. While all trees of a particular cultivar developed the same fall color, only 20% of the seedlings exhibited red fall color; other seedlings had yellow to brown fall color.

In a previous evaluation, six of the cultivars used in this study were evaluated for bud union incompatibility. Observed deaths of the cultivars in this study from tissue culture were not as prevalent as deaths in the previous study among budded trees. Tree deaths in the previous study, compared to deaths in this study were: 'Autumn Flame,' 11% versus 0%; 'Franksred,' 0% vs. 0%; 'Scarsen,' 55% vs. 0%; 'Schlesingeri,' 78% vs. 40%; and 'Tilford,' 22% vs. 50%. Of the remaining cultivars in the current study, one tree each of 'Northwood' and 'Karpick' died.

Superior red maple cultivars for the Southeast were 'Autumn Flame,' 'Autumn Blaze,' 'Fairview Flame,' and 'October Glory.' By this same criteria, 'Karpick' and 'Northwood' were poor selections. The Freeman red maple selections, along with *A. rubrum* 'Autumn Flame,' had the best growth performance with no apparent adaptability limitations to the climate found in this part of the Southeast.





Figures 1-2. Hue and duration of fall color for red maple selections in 1992 (top left) and in 1993 (bottom left). Color notation: B = brown; O = orange; P = purple; R = red; Y = yellow (primary color listed first).

——— = Presence of color.

▭ = Peak color period.

Foliar color patterns were evaluated two or three times weekly from September through December of 1992 and 1993 using a modified Munsell Color System. Color peak was the maximum ranking the cultivar attained for the season. Peak color periods were determined to be one observation before the peak date and one observation after the established peak.

Buddleia Varieties Root Differently in Response to Rooting Hormone

C. Chris Montgomery, Bridget K. Behe, D. Joseph Eakes, and Tammy S. Krentz

Butterfly bush is a popular perennial landscape plant because it attracts wildlife and is heat and drought tolerant. Both the professional horticulturist and avid gardener may be interested in better methods for propagating this attractive shrub.

An AAES study showed that butterfly bush cuttings rooted readily when treated with the synthetic rooting hormone IBA. Most of the 11 *Buddleia* cultivars evaluated were found to root best in the spring and with moderate amounts of the rooting hormone -- 1,500 to 3,000 parts per million (ppm).

Cultivars evaluated were *Buddleia davidii* 'White Profusion,' 'Empire Blue,' 'Black Knight,' 'Royal Red,' 'Opera,' 'Charming Summer,' and 'Pink Delight;' *Buddleia davidii nanhoensis* 'Nanho Blue' and 'Nanho Purple'; *Buddleia fallowiana* 'Lochinch'; and *Buddleia* x *weyeriana* 'Sungold.'

METHODS

Three-gallon stock plants were grown for eight months from liners obtained from a single Alabama nursery. Four-node softwood cuttings were taken from stock plants in September 1993 and May 1994 and stored overnight in a cooler at 40°F. The next day, plants received IBA treatments ranging from 0-6,000 ppm. For each cultivar, 20 cuttings were used per treatment. IBA was applied to the basal 1.5 inches of the stem after the leaves were removed from the lowest node. Treated cuttings were placed in two-inch containers filled with medium grade vermiculite. Containers were placed in a glass-covered propagation house and irrigated by an intermittent mist system for eight seconds every fifteen minutes from 8 a.m. to 5 p.m.

Cuttings were evaluated 21 days after treatment for average length of the three longest roots per cutting, number of roots, visual root rating, and root dry weight. Shorter, more numerous roots were considered an indication of good rooting.

RESULTS

Nearly all cuttings rooted in both the 1993 and 1994 studies (see table). The lowest rooting percentage occurred in 1993 for 'Empire Blue' and 'Royal Red' when no IBA was applied. More cuttings failed to root without IBA than with any treatment. More cuttings failed to root in 1994 than 1993. Overall, 'Royal Red' had the poorest rooting percentage followed by 'Lochinch' and 'Empire Blue.' Other cultivars rooted better.

In 1993, root count increased as IBA concentration increased for 'Empire Blue,' 'Nanho Purple,' 'Opera,' and 'Royal Red.' Root length decreased as IBA concentration increased for 'Pink Delight,' 'Nanho Purple,' 'Nanho Blue,' and 'Lochinch.' The visual root rating increased with higher IBA concentration for 'Lochinch.' 'Royal Red' had the highest visual rating at 1,500 ppm IBA. IBA concentration did not affect root dryweight for any cultivar. For most cultivars, rooting improved as IBA concentration increased.

In 1994, IBA concentration increased root count

Table 1. Rooting Percentages of 11 Cultivars of *Buddleia* 21 Days after Treatment with Four Concentrations of IBA Quick Dip

Cultivar	1993				1994			
	0 ppm	1,500 ppm	3,000 ppm	6,000 ppm	0 ppm	1,500 ppm	3,000 ppm	6,000 ppm
	pct.	*pct.*	*pct.*	*pct.*	*pct.*	*pct.*	*pct.*	*pct.*
Black Knight	95	100	100	100	100	100	100	90
Empire Blue	80	100	100	90	95	100	100	100
Royal Red	80	95	100	100	95	95	85	100
White Profusion	100	100	100	95	100	100	100	100
Lochinch	95	100	90	90	90	100	100	95
Nanho Blue	100	100	95	100	95	100	100	100
Nanho Purple	100	100	100	100	95	100	100	95
Pink Delight	100	100	100	100	95	95	100	100
Sun Gold	100	100	100	100	95	95	100	100
Charming Summer	90	100	100	100	95	100	95	100
Opera	90	100	100	95	100	100	100	100

for all cultivars tested, with the exception of 'Empire Blue' and 'Lochinch.' 'Lochinch' had the highest root count at 3,000 ppm IBA. The root count for 'Empire Blue' was not significantly affected by IBA concentration. Average root length decreased as IBA concentration increased for 'Nanho Purple,' 'Lochinch,' 'White Profusion,' and 'Nanho Blue.' Higher IBA concentrations increased visual root ratings for 'Nanho Blue,' 'Pink Delight,' and 'Sun Gold.' 'Nanho Purple' had the highest visual rating at 3,000 ppm IBA. Greater dry weights were recorded for roots of 'Nanho Blue' and 'Sun Gold' as IBA concentration increased. 'Lochinch' had the greatest dry weight at 1,500 ppm IBA. Again, rooting of cultivars improved as IBA concentration increased.

Root count on 'Royal Red,' 'Nanho Purple,' and 'Opera' was higher with increased concentrations of IBA, regardless of time of year. However, root count increased on 'Black Knight,' 'White Profusion,' 'Nanho Blue,' 'Pink Delight,' 'Sun Gold,' and 'Charming Summer' in the spring study but not in the fall. IBA concentration increased root count of 'Empire Blue' in the fall study but not in the spring. IBA concentration decreased root length for 'Lochinch,' 'Nanho Purple,' and 'Nanho Blue' in both studies. Average root length for 'Black Knight' and 'White Profusion' increased in the spring study but not in the fall study.

A higher visual root rating was given to 'Nanho Blue,' 'Pink Delight,' and 'Sun Gold' with higher concentrations of IBA (and 'Nanho Purple' at 3,000 ppm) in the spring study. 'Royal Red' and 'Lochinch' were given higher visual root ratings in the fall study. 'Lochinch,' 'Nanho Blue,' and 'Sun Gold' also showed higher root dry weights in the spring but not in the fall. Most Buddleia cultivars rooted best in the spring after being treated with 1,500 to 3,000 ppm IBA.

Comparison of *Buddleia* Cultivars as Cut Flowers

Tammy S. Krentz and Bridget K. Behe

Seven of the 10 butterfly bush (*Buddleia*) cultivars examined in an AAES study could be a potential source of cut flowers. 'Charming Summer,' 'Pink Delight,' 'Royal Red,' and 'Sungold' showed the most potential. 'Lochinch,' 'White Profusion,' and 'Nanho Blue' proved to have moderate potential.

Buddleia is a large, arching shrub that reaches up to six feet in height; dwarf forms often remain below three feet. Its fragrant flower is perfect, usually with an orange mouth, and has a wide range of colors including pink, purple, yellow, and white. The flower spike ranges from five to 25 inches long. Butterfly bush is an excellent source for cut flowers, since flowers are produced on new growth and can be cut heavily each year. The number of flowering stems on the *Buddleia* depends on cultivar, severity of previous harvest, and winter conditions. On a three-year-old plant, 60-100 stems could be harvested. Suggested harvesting time for butterfly bush flowers is when half the flowers on the inflorescence are open but before the open flowers have started to fade. Flowers should persist for five to eight days if properly conditioned.

TABLE 1. COMPARISON OF SURVIVAL DAYS AND AVERAGE TOTAL INFLORESCENCE LENGTH AMONG 10 *BUDDLEIA* CULTIVARS

Cultivar	Average survival days	Average inflorescence length
	no.	*in.*
Black Knight	5.6	3.1
Charming Summer	6.8	7.9
Empire Blue	5.5	4.8
Lochinch	7.3	5.1
Nanho Blue	6.4	5.4
Nanho Purple	5.5	3.1
Pink Delight	6.7	6.9
Royal Red	6.8	6.1
Sungold	7.4	2.1
White Profusion	6.9	6.0

METHODS

Flowers were harvested for another experiment on July 6 and 20, 1994, from one-year-old *Buddleia* bushes in five-gallon containers. The bushes had been pruned in the spring to remove dead flowers and stimulate new growth. Plants were fertilized weekly with 200 parts per million of soluble fertilizer (20N-8.7P-16.6K) and irrigated by a drip system.

This study began on Aug. 23, 1994, when flower stems were harvested with one- to two-thirds of the flower spike open. Fifteen stems obtained from each of the following cultivars were placed into vases containing tap water immediately after harvest: 'Black Knight,' 'Charming Summer,' 'Empire Blue,' 'Lochinch,' 'Nanho Blue,' 'Nanho Purple,' 'Pink Delight,' 'Royal Red,' 'Sungold,' and 'White Profusion.'

Within two hours, flowers were transported to a simulated consumer environment and recut under water. Flowers were placed in vases containing deion-

TABLE 2. COMPARISON OF PERCENT OPEN FLOWERS AMONG 10 *BUDDLEIA* CULTIVARS

Cultivar	Pct. open flowers		
	Day 3	Day 6	Day 9
Black Knight	82.4	79.0	--[1]
Charming Summer	67.3	77.4	94.1
Empire Blue	84.5	97.1	--[1]
Lochinch	69.0	80.3	78.9
Nanho Blue	80.6	97.0	--[1]
Nanho Purple	94.3	100.0	--[1]
Pink Delight	66.9	83.1	--[1]
Royal Red	84.0	96.0	100.0
Sungold	91.2	99.0	100.0
White Profusion	63.8	74.7	79.2

[1]Insufficient number of stems for an analysis to be performed.

ized water with Floralife at a concentration of 1.3 ounces per gallon. The vase solution was changed every three days to prevent bacterial growth. In the simulated consumer environment, the temperature was maintained between 68° and 72°F. The flowers received light provided by cool white fluorescent bulbs from 6 a.m. to 6 p.m. A ceiling fan provided air movement 24 hours a day to maintain a uniform temperature throughout the house.

Fresh weight, total length of the flower, open length of the flower, and flower color were measured daily. The flower was considered terminated when the lower one-half of the florets on the spike were shriveling and the upper portion of the flower was fading in color. Survival days were defined as the number of days from the initiation of the study until the flower was terminated. Percent open was defined as the percentage of the flowers which were fully open based on the total length of the inflorescence. Fresh weight change was the daily fresh weight based on the original fresh weight of the flower.

RESULTS

'Sungold,' 'Lochinch,' 'White Profusion,' 'Charming Summer,' 'Royal Red,' and 'Pink Delight' had a similarly high number of survival days (Table 1). 'Nanho Blue' survived fewer days than 'Lochinch' and 'Sungold,' making this cultivar an intermediate cut flower performer. 'Black Knight,' 'Empire Blue,' and 'Nanho Purple' survived the fewest days, making these poor choices for cut flowers.

On Day 3 of the study, 'Nanho Purple' and 'Sungold' had similarly high percentages of open flowers, while 'Lochinch,' 'Charming Summer,' 'Pink Delight,' and 'White Profusion' all had similarly low percentages (Table 2). By Day 6, 'Empire Blue,' 'Nanho Blue,' 'Nanho Purple,' 'Sungold,' and 'Royal Red' had similarly high percentages of open flowers. Only five cultivars survived until Day 9, and all were similar. 'White Profusion' had about 80% open, which could be attributed to the more rapid decline of the white flowers. 'Nanho Blue,' 'Black Knight,' 'Empire Blue,' and 'Nanho Purple,' which were moderate to low in survival days, all had more than 95% of flowers open. Since all the cultivars were harvested at one- to two-thirds open, they should all have developed to an acceptable percentage of open flowers.

Fresh weight change was not an important factor in this study. Eight of the ten cultivars showed an initial increase in fresh weight, which signals an increase in cut flower mass (Table 3). But 'Nanho Blue' and 'Nanho Purple' then showed a rapid decline in fresh weight, which could be cultivar related and probably contributed to their lower number of survival days. Two cultivars, 'Black Knight' and 'White Profusion,' had no initial increase, and the fresh weight continued to drop rapidly. The decline in fresh weight would contribute to the shorter number of survival days for 'Black Knight' and the lower percent opening for flowers of 'White Profusion.'

Cultivar had little effect on flower color changes. The quality of most flowers declined at approximately the same rate and eventually reached the lowest color rating, regardless of cultivar. However, 'White Profusion' flowers did decline more rapidly due to the more noticeable browning of the white florets.

In summary, the following cultivars of *Buddleia* have an acceptable postharvest longevity and a high percentage of inflorescence development: 'Charming Summer,' 'Pink Delight,' 'Royal Red,' and 'Sungold.' 'Lochinch' and 'White Profusion' could be used with only a slight loss of flower opening offset by a high number of survival days. 'Nanho Blue' could also be a potential cut flower with a slightly lower survival time, but excellent opening of the inflorescence. 'Black Knight,' 'Empire Blue,' and 'Nanho Purple' lack the potential to be cut flowers.

TABLE 3. COMPARISON OF FRESH WEIGHT CHANGE AMONG 10 *BUDDLEIA* CULTIVARS

Cultivar	Fresh weight		
	Day 3	Day 6	Day 9
Black Knight	96	89	--[1]
Charming Summer	112	103	77
Empire Blue	112	119	--[1]
Lochinch	122	125	148
Nanho Blue	107	80	--[1]
Nanho Purple	108	79	--[1]
Pink Delight	165	158	--[1]
Royal Red	139	124	274
Sungold	103	101	139
White Profusion	82	74	69

[1]Insufficient number of stems for an analysis to be performed.

Response of 'Prize' Azalea to Sumagic Applied at Several Stages of Shoot Apex Development

GARY J. KEEVER AND JOHN W. OLIVE

When azaleas are forced to bloom, growth retardants are applied to restrict lateral shoot elongation, hasten flower bud initiation, promote uniform flower development, suppress bypass shoot development. Plant response to growth retardants depends on time of application and other factors. It is recommended that uniconazole, a triazole retardant labeled for use on azaleas as Sumagic, be applied four to six weeks after final pinch. However, even when applied according to label recommendations, the desired response may not always occur, due to cultivar differences or variation in light, temperature, or cultural conditions.

Ten stages of shoot apex development in forced azaleas have been described, and it was later suggested that performing the various cultural practices based on these stages would make allowances for cultivar, seasonal, and climatic differences. An AAES study evaluated the vegetative and flowering responses of forced 'Prize' azaleas to Sumagic applied at several shoot apex stages of development (SOD). Results showed that it is important to apply Sumagic at a very early SOD. Treatment at a later SOD resulted in less compact plants that flowered later with fewer blooms.

METHODS

'Prize' azaleas in 6.5-inch azalea pots containing amended sphagnum peat:softwood shaving (3:2 by volume) growth medium were obtained from a commercial grower in November 1991. Plants were immediately placed in a glass greenhouse, pruned for uniformity on Dec. 2, and topdressed with 12-4-6 on Dec. 10 and Jan. 10, 1992. When plants were at one of four stages of development, Sumagic was applied on foliage at 15 or 30 parts per million (ppm) in a volume of two quarts per 100 square feet. See the table for a description of SODs and dates of application.

On April 28, plants were placed in a cooler and subsequently held in darkness at 38°F for six weeks. Plants were removed from the cooler on June 9 and forced into flower in a shaded double polyethylene greenhouse. Time until flowering was determined from the time plants were removed from the cooler until half the flowers were fully open. At that time, plant height, growth index, flower count and diameter, and bypass shoot count and length were determined. The experiment was repeated in 1992.

TABLE 1. EFFECTS OF STAGE OF DEVELOPMENT AND PLANT GROWTH RETARDANT ON RHODODENDRON X 'PRIZE' AZALEAS (EXPERIMENT 1)

Stage[1]	Sumagic concentration	Height	Growth index[2]	Bypass shoot number	Bypass shoot length[3]	Days to open flowers[4]	Flower number	Flower diameter[5]
	ppm	*in.*	*cm*	*no.*	*in.*	*no.*	*no.*	*in.*
SOD 0	15	9.1	30.8	5.9	2.2	32	58	2.5
SOD 0	30	6.3	23.9	0.0	--	35	45	2.4
SOD 1	15	9.6	31.4	8.0	2.4	38	41	2.4
SOD 1	30	8.6	28.6	0.0	--	41	39	2.2
SOD 2-3	15	10.6	33.8	5.4	2.7	51	23	2.4
SOD 2-3	30	8.6	32.8	0.0	--	65	5	1.6
SOD 4	15	9.9	36.8	7.0	2.6	58	17	2.0
SOD 4	30	10.0	34.6	0.0	--	64	10	2.1
Control	0	11.4	39.7	6.8	3.4	48	27	2.4

[1]Stages and dates of application included SOD 0 (vegetative), January 10; SOD 1 (apex broadened), February 10; SOD 2-3 (sepal and petal initiation), March 17; and SOD 4 (stamen initiation), March 31. A non-treated control group was included for comparison.
[2]Growth index = (height + $width_1$ + $width_2$)/3. $Width_1$ was at the widest point, and $width_2$ was perpendicular to $width_1$. It is measured in centimeters (one inch equals 2.54 cm).
[3]Mean length of three longest bypass shoots on each plant.
[4]Days to full bloom began when plants were moved from cooler to greenhouse and were determined when 50% of flowers were fully opened.
[5]Mean of three randomly selected, fully opened blooms per plant.

TABLE 1. EFFECTS OF STAGE OF DEVELOPMENT AND PLANT GROWTH RETARDANT ON RHODODENDRON X 'PRIZE' AZALEAS (EXPERIMENT 2)[1]

Stage[2]	Sumagic concentration	Bypass shoot number	Bypass shoot length[3]	Days to open flowers[4]	Flower number
	ppm		*in.*		
SOD 0	15	4.4	3.8	41	75
SOD 0	30	0.9	3.5	38	92
SOD 1	15	4.9	2.0	46	41
SOD 1	30	0.9	1.4	48	26
SOD 2-3	15	0.9	1.3	44	40
SOD 2-3	30	0.5	1.2	46	19
SOD 4	15	0.5	1.2	44	37
SOD 4	30	0.5	2.3	46	25
Control	15	12.6	5.2	42	67

[1]Differences observed between Experiment 1 and Experiment 2 probably relate to seasonal variability in environmental conditions.
[2]Stages and dates of application included SOD 0 (vegetative), Aug. 17; SOD 1 (apex broadened), Sept. 18; SOD 2-3 (sepal and petal initiation), Sept. 24; and SOD 4 (stamen initiation), Oct. 6.
[3]Mean length of three longest bypass shoots on each plant.
[4]Days to full bloom began when plants were moved from cooler to greenhouse and were determined when 50% of flowers were fully opened.

RESULTS

Because of similar responses in the two experiments, results from only the first test are discussed in detail (Table 1). There were relatively minor differences between the experiments (Table 2), but Experiment 2 supported the conclusions of the first test. Differences that were observed probably relate to seasonal variability in environmental conditions. In the first experiment, Sumagic was applied in January, February, and March. Flower counts were lower and flowering was less concentrated than in the second experiment, when plants were final pinched in July.

Plant height and growth index increased as Sumagic was applied at increasingly later SODs; control plants were the tallest and had the highest growth index. These results were expected since earlier application of Sumagic should result in a more pronounced retardation. Plant height and growth index increments decreased with increasing rate of Sumagic, except for height at SOD 4. Treated plants were compact and uniform, particularly those treated at SOD 0 and 1, while control plants were loose, open, and irregular in growth habit. Bypass shoot number and length were not influenced by SOD, but they did decrease with increasing Sumagic rate.

Time to flower and flower number varied with SOD and Sumagic rate. Plants treated at SOD 0 or 1 flowered earlier and produced more blooms than control plants or plants treated at a later SOD. When plants were treated at these stages, time to flower decreased and flower number increased with increasing rate of Sumagic. At later stages, time to flower increased and flower number decreased with increasing rate. Plants treated with 15 ppm Sumagic at SOD 2-3 flowered at the same time as control plants, and flower numbers were similar. Plants treated with 30 ppm at SOD 2-3 or at SOD 4 flowered after control plants with fewer blooms

Flower diameters of plants treated at SOD 0 or 1 were similar to those of control plants and greater than those of plants treated at SOD 2-3 (30 ppm) or SOD 4. The higher rate of Sumagic did not affect flower diameter at SOD 0 or 1, but it did decrease the measurement at SOD 2-3 and 4.

A high percentage of plants in these treatments flowered very late and inconsistently; a few blooms opened at a time with no pronounced peak. These plants were considered unmarketable.

Results of this study indicate the importance of applying Sumagic when shoot apexes are vegetative (SOD 0) to produce compact plants, hasten flower initiation, and promote uniform flower development. At first, producers should dissect buds to be certain they are vegetative; however, with time vegetative buds will be easily recognizable, and dissection will not be necessary. At rates of 15-30 ppm, Sumagic promotes plant compactness, improves flowering, and retards bypass shoot development. A major advantage of this approach is that it avoids differences in response caused by cultivar differences and variations in light, temperature, and cultural conditions. These results agree with earlier research on Sumagic and emphasize the multiple role this plant growth regulator may play in the production of forced azaleas.

Survey of Preferences for Alternative Christmas Trees

KENNETH M. TILT, BRIDGET K. BEHE, J. DAVID WILLIAMS, MARY K. GAYLOR, AND J. HEATH POTTER

AAES surveys have shown that Alabamians are receptive to using trees other than the traditional Virginia pines, cedars, and spruces as Christmas trees. Surveys conducted in 1993 and 1994 identified an opportunity for the state's Christmas tree and nursery industries to develop and explore this new market for cut or containerized leyland cypresses, hollies, magnolias, and other species.

With growing concern for the environment, there has been an increase in the demand for living trees, those harvested with the roots for future transplanting. Also, when plants are grown in containers, all of the roots are preserved, reducing the problem of needle or leaf drop.

To meet this demand, some Christmas tree growers are offering container-grown trees and trees dug from the field that are balled and burlapped. These options allow the grower to sell living trees for Christmas or landscape plants throughout the year. Shearing hollies, cypresses, magnolias, and other plants into the proper, tapered form not only creates beautiful Christmas tree specimens, it also provides the desired uniformity for landscape designers or architects. However, the trees often sold are not adapted to high temperatures common in the South. The customer may end up disappointed and resort to buying an artificial tree.

Although the leyland cypress is new to Alabama, South Carolina has had tremendous success with this tree as a Christmas tree. It has a good shape, color, and branch strength, and it does not shed needles. Hollies have long been a symbol of Christmas and have a history of use as Christmas trees. Many of the older survey respondents reported that they grew up using hollies as Christmas trees.

METHODS

The 1993 survey was conducted at two locations: the Alabama State Fair and the Southern Homes and Gardens Garden Center in Montgomery. Three different trees were displayed: a cut live Virginia pine, a containerized Nellie R. Stevens holly, and a cut live leyland cypress. All were similar in size and quality. Two trees of each type were used, one of which was decorated. Identical ornaments and decorations were used to prevent judgement by decoration.

In 1994, the survey was conducted at the Birmingham Botanical Gardens and the Southern Homes and Gardens Garden Center. Seven different containerized trees were decorated and displayed: Carolina Sapphire Arizona cypress, leyland cypress, Martha Berry holly, Nellie R. Stevens holly, Fairhope magnolia, Little Gem magnolia, and Springhill magnolia. Using taper, density and color of foliage, uniformity, and distribution of branches as selection criteria, the best trees available for each species were selected.

TABLE 1. 1993 SURVEY RATINGS OF CUT OR CONTAINERIZED CHRISTMAS TREES

Type	Average rating[1]	Percent rating 4 or 5
Virginia Pine (cut)	3.8	61
Leyland Cypress (cut)	3.6	56
Holly (container)	3.3	50

[1]Rating: 1 = would not buy the tree; 5 = would definitely buy the tree.

RESULTS

Of 119 consumers surveyed in 1993, 55% said they purchased Christmas trees the previous year. Of these, 41% used an artificial Christmas tree, 54% purchased a cut live tree, and 3% purchased a living tree in a container. In the 1994 survey, 66% of 171 consumers said they purchased a Christmas tree in 1993. Of these, 34% used an artificial Christmas tree, 54% purchased a cut live tree, 3% purchased a living tree in a container, and 2% purchased a ball-and-burlapped Christmas tree.

TABLE 2. 1994 SURVEY RATINGS OF CONTAINERIZED CHRISTMAS TREES

Type	Average rating[1]	Percent rating 4 or 5
Leyland Cypress	3.8	64
Martha Berry Holly	3.5	54
Nellie R. Stevens Holly	3.3	50
Little Gem Magnolia	2.7	31
Carolina Sapphire Arizona Cypress	2.7	30
Springhill Magnolia	2.5	26
Fairhope Magnolia	2.4	24

[1]Rating: 1 = would not buy the tree; 5 = would definitely buy the tree.

1993 survey participants reported an equal preference for Virginia pine and leyland cypress; holly was not far behind (Table 1). In 1994, survey results showed a strong interest in containerized Christmas trees, especially leyland cypress and holly (Table 2). Although magnolias and Arizona cypresses were ranked low, 24-30% of the participants indicated a strong preference for these trees. More refined pruning techniques to develop trees targeted at this market could improve interests in other alternative Christmas trees.

In 1994, consumers were asked if they would buy a live tree in a container that could be planted outside after Christmas, even though they cost more than live, cut trees. Sixty-two percent said yes, while 38% still preferred the live, cut trees.

Traditional Virginia pine Christmas tree (top left); decorated Martha Berry Holly (top center); decorated Nellie R. Stevens Holly (top right); and decorated Leyland Cypress displayed with Carolina Sapphire Arizona Cypress (bottom).