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## Disease Resistance and Response of Shrub and Ground Cover Roses to Fungicides



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# DISEASE RESISTANCE AND RESPONSE OF SHRUB AND GROUND COVER ROSES TO FUNGICIDES

A.K. Hagan, M.E. Rivas-Davila, J.R. Akridge, and J.W. Olive

## INTRODUCTION

**A**cross much of the United States, black spot, which is caused by the fungus *Diplocarpon rosae*, is the most widespread and destructive disease of rose (*Rosa* sp). In Alabama and adjacent states, temperature and rainfall patterns from April to early November are conducive to the development of black spot (10,27,29). On susceptible roses, leaf spotting and premature defoliation due to black spot often starts shortly after leaf emergence, and disease development continues until the first hard frost. In addition to poor plant aesthetics, black spot-induced premature defoliation is related to poor bloom set and significantly reduced height of some hybrid tea rose cultivars (3).

Of the other diseases reported on roses nationwide, powdery mildew is often considered second in importance only to black spot (27). The distinctive white mycelial mat of the causal fungus *Sphaerotheca pannosa* var. *rosae* on the leaves, flower buds, shoots, and thorns, as well as yellowing and distortion of the unfurling leaves are characteristic of a severe powdery mildew outbreak on rose (10,27). Recent Alabama (3,4,6,7) and North Carolina (1) field trials on hybrid tea and grandiflora roses indicate that the risk of significant powdery mildew damage is negligible in the Southeastern United States compared with black spot.

Leaf spotting and premature defoliation on rose can also be attributed to Cercospora leaf spot, which is caused by the fungus *Cercospora rosicola* (29). While the lack of information on Cercospora leaf spot suggests that this disease is considered to be of little importance (10), damaging outbreaks of this disease, particularly on shrub roses, have recently been noted in Alabama (4) and North Carolina (1). Previously, Cercospora leaf spot was reported on greenhouse roses in California (11) and hybrid tea roses in South Africa (2).

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Shrub roses (*Rosa* sp.) are a loosely defined group of unrelated heirloom, garden, florabunda, and modern hybrid roses that are considered hardier, more vigorous, and versatile, but equally as colorful as hybrid tea and grandiflora roses. Depending on the rose cultivar chosen, their growth habit ranges from erect bushy to a sprawling low-growing ground cover form with multiple simple, semi-double, or double blossoms on each stem. While good or excellent disease resistance is claimed in the patent documentation and sales literature for many of roses in the Meidiland® series that were included in this study, specific references to resistance to black spot or other rose diseases are not made (13,14,15,16,17,18,19,21). However, resistance to black spot and powdery mildew is listed in patent documents for Mystic Meidiland® (22) and Ice Meidiland® (23), and to black spot alone for Cherry Meidiland® (20). In the patent documentation for Knock Out™ (28), resistance to black spot and rust is noted, while Kent™ is described as having excellent resistance to black spot, powdery mildew, downy mildew, and rust (26). Black spot, powdery mildew, and rust resistance are claimed for White Flower Carpet™ (25) and First Light™ (12), while Flower Carpet™ (24) reportedly is resistant to black spot.

Dirr (5) noted that Scarlet Meidiland® and White Meidiland® suffered the least black spot-related leaf spotting and premature defoliation of selected rose cultivars in the Meidiland® series in a landscape in Athens, Georgia. Clendenen *et al.* (4) noted in a rose planting near Montgomery, Alabama, that Red Meidiland® was sensitive to *Cercospora* leaf spot but was relatively free of black spot. At Fletcher, North Carolina, in the Appalachian Mountains, black spot and *Cercospora* leaf spot were noted on Alba Meidiland®, Scarlet Meidiland®, and Pink Meidiland® (1). By the end of the growing season, Pink Meidiland® and Linda Campbell™ were almost completely defoliated by the combination of black spot and *Cercospora* leaf spot (1). Bir *et al.* (1) also noted that *R. rugosa* rose selections, ‘Blanc Double de Coubert’, ‘Fru Dagmar Hastrup’, *Rugosa alba*, and ‘Topaz Jewel’ were largely free of diseases. Spencer and Wood (30) reported significant differences in the response of selected roses in the Alba, Bourbon, Cenifolia, China, Damask, Gallica, Hybrid Perpetual, Moss, and Portland (Old Garden Roses) classes to *D. rosae*. More recently, ‘The Fairy’, Belinda’s Dream™, Flower Carpet™, and ‘Le Vesuve’ were reported to have partial resistance to black spot, which could be controlled with bi-monthly applications of Daconil Weather Stik 6F (4). In Louisiana, the shrub roses Livin’ Easy™ and Carefree Delight™, when treated weekly with a fungicide, suffered less black spot damage than a sizable number of other hybrid tea, grandiflora, and floribunda roses (9). Hagan and Olive (8) noted that container-grown Magic Carpet™, Jeeper’s Creeper™, and Red Ribbons™ were much more susceptible to black spot than Ralph’s Creeper™.

The objectives of this study were to determine the susceptibility of roses in the Meidiland® series, as well as other selected shrub and ground cover roses, to black spot and powdery mildew in a simulated landscape planting and to assess the impact of fungicide inputs on disease severity and plant growth. In addition, other diseases that have a detrimental impact on the health and beauty of shrub roses were identified and cultivar reaction to diseases along with fungicide inputs was defined.

## MATERIALS AND METHODS

In 1998, a simulated landscape planting of selected Meidiland® roses, as well as other ground cover and shrub roses, was established at the Brewton Agricultural Research Unit, Brewton, Alabama, (USDA Plant Hardiness Zone 8a) to assess their susceptibility to black spot, powdery mildew, and other diseases, as well as their overall adaptability to the humid, warm, and often wet climate of the Coastal South. Typically, bare-root roses were potted into gallon containers in a pine bark/peat (3:1 by volume) medium amended with 14 pounds of Osmocote (17-7-12), 6 pounds of dolomitic limestone, 2 pounds of gypsum, and 1.5 pounds of Micromax per cubic yard at the Ornamental Horticulture Research Center in Mobile, Alabama.

Before the initial planting, soil fertility and pH of a Benndale (A) fine sandy loam were adjusted according to the results of a soil fertility assay conducted by the Auburn University Soil Testing Laboratory. On January 30 and March 19, 1998, roses were transplanted into raised beds at the Brewton Agricultural Research Unit. Subsequently, some bare-root rose selections were directly transplanted into the field plots. Beds were then mulched with 0.5 to 1 inch of aged pine bark. A drip irrigation system with a single emitter per plant was installed at the time of establishment and the plants were watered weekly as needed. Up to five applications of approximately 16N-4P<sub>2</sub>O<sub>5</sub>-8K<sub>2</sub>O, which was distributed uniformly around each plant, were made at six- to eight-week intervals during the growing season. Directed applications of 1 pound per acre of Gallery DF™ and 2.0 quarts per acre of Surflan T/O™ to the mulched beds were made in late winter and in late spring to control annual weeds. Hand weeding and spot applications of 912 Herbicide 6S™ (monosodium methanearsonate [MSMA]) were used to control yellow nutsedge, other escaped weeds, and encroaching centipedegrass. In January or February of each year, scaffold canes on each bush were cut back to approximately 12 to 16 inches above the soil surface. Fresh mulch was also added.

On January 30, 1998, 'Betty Prior', Bonica® (*Rosa* sp. 'Meidomonac'), Fushia Meidiland® (*R. sp.* 'Meipelta'), Carefree Delight™ (*R. sp.* 'Meipotal'), First Light™ (*R. sp.* 'Devrudi'), Livin' Easy™ (*R. sp.* 'Harwelcome'), Mystic Meidiland® (*R. sp.* 'Meialate'), 'Nearly Wild', Pearl Sevillana™ (*R. sp.* 'Meichonar'), Sevillana™ (*R. sp.* 'Meigekanu'), Cherry Meidiland® (*R. sp.* 'Meirumour'), Red Cascade™ (*R. sp.* 'Moorcap'), 'Petite Pink Scotch', 'Nozomi', Royal Bonica® (*R. sp.* 'Meimodac'), 'Sea Foam', and *R. wichurana* were planted. Flower Carpet™ (*R. sp.* 'Noatraum'), Magic Carpet™ (*R. sp.* 'Jaclover'), Ralph's Creeper™ (*R. sp.* Morpapplay), Happy Trails™ (*R. sp.* 'Jaccasp'), Jeeper's Creeper™ (*R. sp.* 'Korissel'), 'The Fairy', and White Flower Carpet™ (*R. sp.* 'Noaschnee') were transplanted on March 19, 1998. Butterfly rose (*R. chinensis* 'Mutabulis') was planted on June 4, 1998, and Double Delight™ (*R. sp.* 'Andeli'), Carefree Wonder™ (*R. sp.* 'Meipitac'), 'Hansa', and 'Pink Grootendorst' were established on February 11, 1999. In 2000, Kent™ (*R. sp.* 'Poulcov'), Knock Out™ (*R. sp.* 'Radazz'), Fire Meidiland® (*R. sp.* 'Meipsoidue'), Ice Meidiland® (*R. sp.* 'Meivahyn'), 'Therese Bugnet', Raven™ (*R. sp.* 'Frytrooper'), and Sweet Chariot™ (*R. sp.* 'Morchari') were substituted for 'Nearly

Wild', 'Betty Prior', Royal Bonica®, Magic Carpet™, Bonica®, and Double Delight™. Polar Ice™ (*R. sp.* 'Stronin'), *R. damascena* 'Madame Hardy', and Lillian Austin™ (*R. sp.* 'Ausmond'), which were added to this study on February 26 2001, replaced Livin' Easy™, Sevillana™, and White Flower Carpet™. Ralph's Creeper™ was replaced with 'Pink Pet' (syn. 'Caldwell Pink') on November 11, 2002.

The study consisted of a split plot with five replications of rose selections as the main plot and fungicide treatment as the split-plot. The contact fungicide Daconil Weather Stik® 6F (chlorothalonil) was applied at two-or four-week intervals at 2 quarts per 100 gallons of spray volume. One plant in each plot was left untreated. Fungicides were applied at the above intervals with a hand wand to run-off using a tractor-mounted sprayer from March 22 to November 12, 1999; April 5 to October 19, 2000; March 22 to October 17, 2001; March 15 to October 9, 2002; and March 20 to September 25, 2003.

Severity of black spot was visually evaluated in all five years at six- to eight-week intervals. Simultaneously, plants were examined for the characteristic symptoms and signs of powdery mildew, downy mildew, and *Cercospora* leaf spot. Leaf samples were collected periodically to confirm the identification of black spot or *Cercospora* leaf spot on selected rose selections. A modified Florida peanut leaf spot rating scale, where 1 = no disease, 2 = very few spots in lower canopy, 3 = light spotting lower and upper canopy, 4 = some spots in lower and upper canopy with light defoliation ( $\leq 10\%$ ), 5 = spots noticeable with moderate defoliation ( $\leq 25\%$ ), 6 = spots numerous with significant defoliation ( $\leq 50\%$ ), 7 = spots numerous with severe defoliation ( $\leq 75\%$ ), 8 = most remaining leaves spotted with excessive defoliation ( $\leq 90\%$ ), 9 = very few remaining leaves covered with spots, and 10 = plants defoliated, was used to assess the severity of black spot and *Cercospora* leaf spot. In 1999, severity ratings for black spot and *Cercospora* leaf spot were recorded on March 23, May 6, June 24, August 30, October 7, and November 11. For 2000, ratings for black spot and *Cercospora* leaf spot were logged on April 12, May 23, June 27, September 11, September 29, and November 10. Black spot and *Cercospora* leaf spot severity was recorded on April 4, May 16, June 15, August 9, September 7, and November 2, 2001; April 25, May 29, August 12, October 2, and November 6, 2002; and April 17, May 28, July 26, September 13, and October 8, 2003. The growth index (GI) was calculated using the following formula: height + width 1 + width 2/3 = GI.

## RESULTS

As expected, black spot was the most common and damaging disease observed over the evaluation period. Noticeable leaf spotting and premature leaf shed due to *Cercospora* leaf spot was also seen on a number of shrub and ground cover roses. Typically, only one of these two diseases developed on any single rose selection during the study period. Powdery mildew severity was low. Despite extended periods of heavy rainfall, downy mildew never developed on any cultivar.

### Black Spot

In March and early April, newly unfurled leaves were free of symptoms of black spot. On the most black spot-susceptible roses, significant lesion formation and leaf chlorosis that appeared in early to mid-May was quickly followed in mid- to late June by noticeable premature defoliation (data not shown). Lesion formation and premature defoliation intensified through the summer until peaking in September or October. In contrast, noticeable leaf spotting and premature defoliation on the more black spot-resistant selections was usually delayed until August or September.

In all years, sizable differences in the severity of black spot were noted among shrub and ground cover roses that were not treated with Daconil Weather Stik® 6F (Table 1). In addition, this disease was found on approximately 70 percent of the rose selections screened. Black spot did not damage Carefree Delight™, Flower Carpet™, White Flower Carpet™, Fire Meidiland®, Fuchsia Meidiland®, Happy Trails™, 'Petite Pink Scotch', Polar Ice™, *R. wichurana*, 'The Fairy', and 'Therese Bugnet'. Claims of black spot resistance that previously were made for Flower Carpet™ (24), White Flower Carpet™ (25), and 'The Fairy' (12) were confirmed. All of the above rose selections, however, were damaged by *Cercospora* leaf spot (Table 2).

Untreated Ice Meidiland®, Mystic Meidiland®, and Red Cascade™ as well as 'Hansa' often had lower black spot ratings than those of many of the remaining rose selections (Table 2). Black spot ratings for Ice Meidiland® were below those obtained for Red Cascade™ in 2001 and 2003, Mystic Meidiland® in 2000, 2001, and 2003, and 'Hansa' in each of the four years. The level of leaf spotting and premature defoliation recorded for Red Cascade™ was considerably lower compared with the symptom severity noted on Mystic Meidiland® and 'Hansa' in two and three years, respectively. Beginning in 2001, black spot ratings for Carefree Wonder™ and 'Madam Hardy' were similar to those of Red Cascade, Mystic Meidiland®, and 'Hansa'. In 2002 and 2003, disease ratings for Carefree Wonder™ were also similar to that of Ice Meidiland®. In three of five years, black spot severity on 'Pink Grootendorst' also did not differ from the damage level on 'Hansa', as well as on several of the above roses. In contrast, Ice Meidiland® consistently suffered less black spot-induced leaf spotting and premature leaf loss than 'Pink Grootendorst'. While Pearl Sevillana™ had black spot severity ratings that were similar to those for 'Pink Grootendorst' in 1999 and 2000, defoliation levels for this cultivar were much higher in 2001, 2002, and 2003. In 2003, disease ratings for 'Pink Pet', which suffered less than 25 percent defoliation, were similar to those recorded for Ice Meidiland® and Mystic Meidiland®.

When left untreated with a fungicide, Cherry Meidiland®, First Light™, Kent™, Jeeper's Creeper™, Livin' Easy™, Lillian Austin™, 'Nearly Wild', 'Nozomi', Butterfly rose, Ralph's Creeper™, Raven™, 'Sea Foam', Sevillana™, and Sweet Chariot™ suffered severe leaf spotting and premature leaf loss (Table 2). Other roses that were highly susceptible to black spot were 'Betty Prior', Bonica®, 'Nearly Wild', and Royal Bonica® (data not shown). However, Butterfly rose often had a lower black spot severity rating than many of the above rose selections. Defoliation levels on this unique rose ranged between approximately 35 percent in 2000 to nearly 65 percent in the following year. The roses that were most susceptible to black spot

**TABLE 1. EFFECT OF FUNGICIDE INPUTS ON THE SEVERITY OF BLACK SPOT ON CULTIVARS OF SHRUB AND GROUND COVER ROSES AT THE BREWTON AGRICULTURAL RESEARCH UNIT**

Cultivar	Black spot severity <sup>1</sup>														
	1999			2000			2001			2002			2003		
	Application Interval <sup>2</sup> UTC <sup>3</sup> 4 wk	2 wk	UTC	Application Interval UTC 4 wk	2 wk	UTC	Application Interval UTC 4 wk	2 wk	UTC	Application Interval UTC 4 wk	2 wk	UTC	Application Interval UTC 4 wk	2 wk	UTC
Carefree Wonder™	6.5	6.6	6.0	5.6	5.3	4.3	5.8	5.0	4.0	5.0	5.3	4.3	4.6	4.3	3.0
Cherry Meidiland®	7.2	7.0	5.2	7.3	5.0	3.4	7.3	6.5	3.4	6.3	5.8	4.5	6.0	4.5	2.8
First Light™	6.2	6.0	4.2	6.5	5.0	3.6	6.8	6.0	3.5	7.0	5.3	4.8	6.3	4.8	3.6
'Hansa'	4.8	4.2	3.8	5.4	4.6	4.2	5.5	4.8	3.8	5.8	5.0	4.8	5.8	4.4	4.4
Ice Meidiland®	---	---	---	3.0	2.0	1.6	4.0	3.2	2.0	4.8	3.2	2.6	4.0	3.0	1.4
Jeeper's Creeper™	7.2	6.8	6.2	7.0	5.6	4.2	7.4	5.6	3.8	7.8	6.8	5.8	7.2	6.2	5.0
Kent™	---	---	---	6.8	5.4	3.2	6.2	5.8	3.2	6.2	6	4	5.2	5.2	2.2
Lilian Austin™	---	---	---	---	---	---	6.5	5.3	4.0	6.8	6.5	5.0	6.2	6.8	5.4
Livin' Easy™	5.4	5.8	5.4	7.0	7.2	5.0	---	---	---	---	---	---	---	---	---
'Madam Hardy'	---	---	---	---	---	---	5.8	2.8	2.2	5.8	4.0	2.6	5.8	3.4	1.8
Mystic Meidiland®	5.0	4.8	3.2	4.2	3.2	2.0	4.0	4.0	3.0	5.5	4.8	3.8	4.8	3.4	3.0
'Nozomi'	5.6	5.6	4.0	6.0	5.4	4.6	6.6	6.0	5.8	6.8	5.8	5.4	6.6	5.4	5.4
Pearl Sevilana™	5.6	5.6	5.0	5.6	4.2	2.4	7.2	6.6	4.8	6.6	5.6	4.0	7.0	5.8	3.8
'Pink Grootendorst'	5.0	4.4	2.4	5.6	4.0	2.6	6.0	5.2	4.0	6.2	5.0	3.8	5.4	4.6	2.6
Butterfly rose	6.2	5.8	4.8	5.6	3.4	2.0	6.6	5.4	3.4	6.0	5.2	3.6	5.4	4.6	3.4
Ralph's Creeper™	6.6	6.0	3.4	6.6	5.3	4.0	7.8	6.5	4.6	6.0	5.8	5.2	---	---	---
Raven™	---	---	---	7.0	6.0	3.6	7.0	6.6	4.8	7.0	6.6	5.4	6.8	5.6	4.6
Red Cascade™	3.4	2.4	1.6	3.6	2.4	1.5	5.8	4.0	2.6	5.0	4.0	2.0	4.8	3.6	2.0
'Sea Foam'	5.6	5.6	4.0	6.0	4.2	2.8	7.0	4.2	3.2	6.8	4.0	2.4	5.8	2.6	1.8
Sevilana™	6.8	6.2	5.6	7.0	5.6	3.6	---	---	---	---	---	---	---	---	---
Sweet Chariot™	---	---	---	6.8	4.8	3.2	6.4	4.4	2.2	6.8	6.2	4.6	5.8	5.2	3.8

<sup>1</sup>Black spot severity was recorded on October 7, 1999; September 29, 2000; September 7, 2001; October 2, 2002; and September 13, 2003.

<sup>2</sup>Chlorothalonil (Daconil Weather Stik®) was applied at two- and four-week intervals.

<sup>3</sup>UTC = Untreated controls, which were not sprayed with chlorothalonil.

<sup>4</sup> --- = No data, cultivar not yet installed or removed.



**TABLE 2. EFFECT OF FUNGICIDE TREATMENTS ON THE SEVERITY OF CERCOSPORA LEAF SPOT ON SELECTED CULTIVARS OF SHRUB AND GROUND COVER ROSES AT THE BREWTON AGRICULTURAL RESEARCH UNIT**

Cultivar	Black spot severity <sup>1</sup>											
	1999		2000		2001		2002		2003			
	UTC <sup>3</sup>	Application Interval <sup>2</sup> 4 wk 2 wk	UTC	Application Interval 4 wk 2 wk	UTC	Application Interval 4 wk 2 wk	UTC	Application Interval 4 wk 2 wk	UTC	Application Interval 4 wk 2 wk	UTC	Application Interval 4 wk 2 wk
Carefree Delight™	7.0	6.5 5.2	7.0	6.0 3.2	7.6	5.4 3.2	7.0	5.8 4.0	7.0	5.8 3.4	7.0	5.8 3.4
Flower Carpet™	5.8	6.0 5.8	6.0	5.4 6.0	5.0	2.2 2.8	6.8	5.5 5.8	6.8	5.5 5.8	4.7	4.0 3.5
Fire Meidiland®	---	---	5.2	3.4 3.2	4.0	2.4 1.6	5.8	4.8 3.4	5.8	4.8 3.4	4.4	2.4 1.6
Fuchsia Meidiland®	5.6	5 3.3	4.8	3.2 2.4	3.8	2.4 2.0	5.0	4.2 3.0	5.0	4.2 3.0	4.0	2.6 2.2
Happy Trails™	5.5	5.0 3.0	5.8	4.0 2.8	6.0	3.6 3.0	6.6	4.4 3.6	6.6	4.4 3.6	6.6	3.8 3.0
'Petite Pink Scotch'	5.6	4.8 4.0	4.8	2.4 1.6	5.6	4.0 2.8	6.2	3.8 2.0	6.2	3.8 2.0	6.0	4.0 2.0
Polar Ice™ <sup>5</sup>	---	---	---	---	3.6	2.6 1.8	4.8	3.2 2.6	4.8	3.2 2.6	4.6	3.6 2.0
R. wichurana	3.0	1.3 1.3	3.4	1.8 1.8	1.8	1.0 1.2	3.4	1.4 1.8	3.4	1.4 1.8	2.6	1.6 1.4
'Therese Bugnet'	---	---	5.2	5.8 3.8	6.0	6.4 5.4	6.8	6.2 6.2	6.8	6.8 6.2	6.2	6.4 5.2
'The Fairy'	6.4	5.8 4.2	6.2	5.4 3.2	6.0	4.0 2.6	6.6	5.0 4.0	6.6	5.0 4.0	5.8	4.0 2.2
White Flower Carpet™	7.0	6.0 5.4	6.3	6.0 4.2	---	---	---	---	---	---	---	---

<sup>1</sup>Cercospora leaf spot severity was assessed on October 7, 1999; September 29, 2000; September 7, 2001; October 2, 2002; and September 13, 2003.

<sup>2</sup>Chlorothalonil (Daconil Weather Stik®) was applied at two- and four-week intervals.

<sup>3</sup>UTC = Untreated controls, which were not sprayed with chlorothalonil.

<sup>4</sup> --- = no data, plants not yet installed or removed.

<sup>5</sup> Polar Ice™ was added to study in 2001.

were Jeeper's Creeper™, Ralph's Creeper™, Raven™, and Cherry Meidiland®. With black spot severity ratings of 7.0 or above, the above rose selections had defoliation levels that consistently reached or exceeded the 75 percent level and very few lesion-free leaves were found by the end of the summer.

As previously noted by Meilland (23), Ice Meidiland® is resistant to black spot. Of the 21 rose cultivars susceptible to black spot, this rose selection had among the lowest damage ratings. With a black spot rating no higher than the 4.8 recorded after the unusually wet summer of 2002, the defoliation levels for untreated Ice Meidiland® were below 25 percent. In 2001 and 2003, black spot-induced defoliation on this rose selection did not exceed 10 percent. In the drought year of 2000, no black spot-induced defoliation was observed on Ice Meidiland®. While Red Cascade™ had higher black spot ratings in two of four years than Ice Meidiland®, Red Cascade™ also is partially resistance to this disease. Results of this study agree with Meilland (22) that Mystic Meidiland® also has some resistance to black spot. As indicated by a disease rating of 4.0 to 5.0 in most years, defoliation on untreated Mystic Meidiland® fell in the 10 to 25 percent range. Reduced levels of leaf spotting and defoliation were also noted on 'Hansa', 'Pink Grootendorst', Carefree Wonder™, and 'Pink Pet'. In contrast to available information, Cherry Meidiland® (20), First Light™ (12), and Kent™ (26) were highly susceptible to black spot. Ralph's Creeper™, which previously showed good resistance to black spot (8), suffered from 50 to more than 75 percent premature leaf shed, as well as heavy spotting of the remaining leaves. As was noted in this study, Hagan and Olive (8) reported that Jeeper's Creeper™ was highly susceptible to black spot. In addition, heavy and objectionable levels of black spot-induced defoliation were also noted on Livin' Easy™, Lillian Austin™, 'Nearly Wild', 'Nozomi', Butterfly rose, Raven™, 'Sea Foam', Sevilliana™, and Sweet Chariot™.

### **Cercospora Leaf Spot**

Development of *Cercospora* leaf spot on susceptible rose selections closely followed the pattern observed for black spot. Symptoms of *Cercospora* leaf spot were found on all of the rose selections that were not damaged by black spot. Considerable differences in the severity of leaf spotting and premature defoliation due to *Cercospora* leaf spot were noted on Carefree Delight™, Flower Carpet™, White Flower Carpet™, Fire Meidiland®, Fuchsia Meidiland®, Happy Trails™, 'Petite Pink Scotch', Polar Ice™, *R. wichurana*, 'The Fairy', and 'Therese Bugnet' that were not treated with Daconil Weather Stik® 6F (Table 2). In contrast, *Cercospora* leaf spot was not observed on Cherry Meidiland®, First Light™, Kent™, Jeeper's Creeper™, Livin' Easy™, Lillian Austin™, 'Nearly Wild', 'Nozomi', Butterfly rose, Ralph's Creeper™, Raven™, 'Sea Foam', Sevilliana™, and Sweet Chariot™ as well as Ice Meidiland®, Mystic Meidiland®, Red Cascade™, 'Hansa', 'Pink Grootendorst', Carefree Wonder™, Pearl Sevilliana™, and 'Pink Pet'.

The least *Cercospora* leaf spot damage was observed on the creeping ground cover *Rosa wichurana*. By late summer to early fall, symptoms on this rose were limited in four of five years to light to moderate spotting on the leaves and light pre-

ture defoliation around the base of the plant (Table 2). Leaf spot development was concentrated in the area around the base of *R. wichurana* but was rarely seen on leaves along the runners. In 2001, *Cercospora* leaf spot development on this cultivar was restricted to light spotting in the lower canopy with no premature leaf loss.

Of the remaining roses damaged by *Cercospora* leaf spot, noticeable spotting of the leaves and premature defoliation was noted. Of these, the untreated Polar Ice™, Fire Meidiland®, and Fuchsia Meidiland®, which suffered from 10 to 40 percent premature leaf loss over a three-, four-, or five-year period, respectively, were among the selections least susceptible to *Cercospora* leaf spot (Table 2). Defoliation levels, which ranged from 25 to 50 percent for Happy Trails™ and Flower Carpet™, were often slightly higher for ‘Petite Pink Scotch’ and ‘The Fairy’. Carefree Delight™, which suffered from 70 to 80 percent premature leaf loss and heavy spotting of all remaining leaves, proved to be the most susceptible of all of the rose selections to *Cercospora* leaf spot. In 2002 and 2003, ‘Therese Bugnet’ lost all but a few leaves at the shoot tips to *Cercospora* leaf spot.

*Cercospora* leaf spot was more widespread and damaging than expected. Outbreaks of this disease were seen on nearly 30 percent of the roses screened from 1999 through 2003. Damage on susceptible roses was comparable to the level of leaf spotting premature leaf loss attributed to black spot. *Cercospora* leaf spot is a particular cause for concern on some Meidiland® roses (1,4). In addition to Fire Meidiland® and Fuchsia Meidiland®, Alba Meidiland®, Scarlet Meidiland®, and Pink Meidiland® in North Carolina (1), as well as Red Meidiland® in Alabama (4) are susceptible to *Cercospora* leaf spot. Anecdotal information concerning the susceptibility of Flower Carpet™ and White Flower Carpet™ to *Cercospora* leaf spot is also confirmed. Other roses that are unacceptably sensitive to *Cercospora* leaf spot were Happy Trails™, ‘Petite Pink Scotch’, ‘The Fairy’, Carefree Delight™, and ‘Therese Bugnet’.

### **Powdery Mildew**

Development of powdery mildew was limited to only a few roses. In 1999 and 2000, characteristic white mycelial mats of the powdery mildew fungus were not found on the leaves or flower buds of any rose. Heavy powdery mildew development was seen in late spring 2001, 2002, and 2003 on the leaves of ‘Therese Bugnet’ and to a lesser extent on Red Cascade™. In late spring 2002 and 2003, noticeable mildew development on the flower buds on ‘Petite Pink Scotch’ was also seen. First Light™ (12), Mystic Meidiland® (21), Ice Meidiland® (23), Flower Carpet™ (24), White Flower Carpet™ (25), and Kent™ (26), which were previously described as resistant to powdery mildew, were not colonized by the powdery mildew fungus.

### **Fungicide Inputs and the Severity of Black Spot and *Cercospora* Leaf Spot**

Regardless of cultivar sensitivity to black spot or *Cercospora* leaf spot, substantial reductions in the severity of both diseases on most rose selections were obtained with applications of the fungicide Daconil Weather Stik® 6F. Typically, black spot or *Cercospora* leaf spot ratings for roses treated at two-week intervals were

noticeably lower than those of the same cultivar maintained on a monthly treatment schedule. Monthly fungicide applications also reduced the severity of both of the above diseases compared with the unsprayed plants of the same rose selection.

On the partially black spot resistant Red Cascade™ and Ice Meidiland®, symptoms on the plants treated at two-week intervals with Daconil Weather Stik® 6F were limited in late summer or early fall to very light spotting of the leaves in the lower canopy and no premature leaf loss (Table 2). When Red Cascade™ and Ice Meidiland® were treated at four-week intervals with this fungicide, leaf spotting in the lower and upper canopy, as well as some light and unobtrusive defoliation ( $\leq 10$  percent), was well below the level seen on the untreated plants but was usually higher than disease severity on these same roses maintained on a two-week fungicide treatment schedule. In 2001, 2002, and 2003, the level of disease damage seen on Mystic Meidiland®, ‘Madame Hardy’, and ‘Sea Foam’ treated on a two- and four-week schedule with Daconil Weather Stik® 6F was similar to the severity of black spot on observed on Red Cascade™ and Ice Meidiland® maintained on the same spray schedules. Defoliation levels on Mystic Meidiland®, ‘Madame Hardy’, and ‘Sea Foam’ when treated monthly typically did not exceed 10 percent. In addition, disease severity on untreated Mystic Meidiland®, ‘Madame Hardy’, and particularly the black spot susceptible ‘Sea Foam’ was significantly higher compared with those obtained for these same selections treated monthly with the fungicide Daconil Weather Stik® 6F. When treated on a two-week schedule with Daconil Weather Stik® 6F, similar reductions in black spot severity were also recorded in three of five years for ‘Pink Grootendorst’ and two of four years for Sweet Chariot™. However, the level of defoliation recorded in the remaining one to two years on above rose selections ranged between 10 and 25 percent. When treated with a fungicide monthly, ‘Pink Grootendorst’ and Sweet Chariot™ had higher disease ratings than Mystic Meidiland®, ‘Madame Hardy’, Red Cascade™ and Ice Meidiland®. In one and two years, the disease ratings for the untreated ‘Pink Grootendorst’ and Sweet Chariot™, respectively, were similar to those of these same rose selections maintained on a monthly fungicide treatment schedule.

Extensive premature leaf loss was noted on Butterfly rose, Carefree Wonder™, Cherry Meidiland®, First Light™, Kent™, and Sevillana™ treated monthly or when left untreated; however, only moderate leaf spotting and relatively light defoliation was seen on these same roses treated at two-week intervals with Daconil Weather Stik® 6F (Table 1). Surprisingly, bimonthly and monthly fungicide treatments failed to prevent light to moderate defoliation on ‘Hansa’ and Knock Out™. Several rose selections such as Jeeper's Creeper™, Lillian Austin™, Livin' Easy™, ‘Nozomi’, Ralph's Creeper™, and Raven™ were so susceptible to black spot that the bi-monthly applications of Daconil Weather Stik® 6F failed to slow disease development. As indicated by disease ratings of 5.0 or above, a minimum of 25 percent defoliation was seen on Jeeper's Creeper™, Lillian Austin™, Livin' Easy™, ‘Nozomi’, Ralph's Creeper™, and Raven™ that were maintained on the two-week Daconil Weather Stik® 6F program. When the application interval was extended from two to four weeks, defoliation levels for the above rose selections increased to the 50 to 75 percent level. Disease severity for Jeeper's Creeper™, Lillian Austin™, Livin' Easy™,

‘Nozomi’, Ralph’s Creeper™, and Raven™ treated monthly with Daconil Weather Stik® 6F and the untreated controls of these roses often was similar.

When compared with the untreated controls, severity of Cercospora leaf spot was consistently lower on nearly all rose selections on which Daconil Weather Stik® 6F was applied at two- and four-week intervals. For the highly Cercospora leaf spot-resistant *R. wichurana*, symptoms on the fungicide-treated plants were limited to single leaf spots on a handful of leaves (Table 2). On the remaining roses, disease ratings were usually lower for the plants treated every two weeks than monthly with Daconil Weather Stik® 6F. For Fire Meidiland®, Fuchsia Meidiland®, Happy Trails™, ‘Petite Pink Scotch’, and Polar Ice™ damage on plants treated on a two-week schedule was usually limited to light leaf spotting in the lower and sometimes upper leaf canopy. While some light leaf shed was seen on the above roses treated monthly, the level of premature defoliation did not negatively impact their appearance or floral display. When treated on a two-week schedule, ‘The Fairy’, Carefree Delight™, and White Flower Carpet™ suffered considerably less leaf spotting and defoliation due to Cercospora leaf spot than did the same selections treated monthly with Daconil Weather Stik® 6F. ‘Therese Bugnet’ proved so susceptible to Cercospora leaf spot that Daconil Weather Stik® 6F applied at two-week intervals did not stop 25 to 50 percent premature leaf loss as well as considerable spotting of the remaining leaves. Response of Flower Carpet™ to fungicide inputs was very erratic. In two of four years, noticeable reductions in the severity of Cercospora leaf spot were obtained with both the two- and four-week Daconil Weather Stik® 6F programs. As was the case on the other roses, disease ratings for the plants treated at two-week intervals were lower than for those on a monthly fungicide schedule. On Flower Carpet™ in 2000 and 2002, both of the Daconil Weather Stik® 6F programs gave relatively little control of Cercospora leaf spot.

Knock Out™ did not appear to have been seriously damaged by either black spot or Cercospora leaf spot. While little lesion development was seen on the leaves of this rose selection, the dense leaf canopy seen on nearly all of the other rose selections, particularly the plants treated on a two-week schedule with Daconil Weather Stik® 6F, failed to develop. Since anecdotal reports indicate that Knock Out™ is resistant to black spot and Cercospora leaf spot, perhaps the thin canopy of this rose selection was due to fungicide phytotoxicity or sensitivity to high daytime temperatures during June, July, and August.

### **Impact of Disease and Fungicide Inputs on the Growth of Shrub Roses**

Moderate to heavy leaf spotting and premature defoliation associated with severe outbreaks of black spot and Cercospora leaf spot often had a significant impact on the growth of many of rose selections. Canopy spread of heavily diseased plants of the black spot- and Cercospora leaf spot-susceptible roses was often much smaller than that of the adjacent fungicide-treated roses. In contrast, fewer differences in canopy height or spread could be seen between the unsprayed controls and the fungicide-treated plants of the cultivars that demonstrated partial resistance to either disease. Overall, black spot and Cercospora leaf spot appeared to have a similar impact on the growth of cultivars, particularly on those that were highly susceptible to either disease.

The growth index (GI) of the unsprayed controls for the black spot- or Cercospora-susceptible butterfly rose, Carefree Delight™, Carefree Wonder™, Cherry Meidiland®, Jeeper's Creeper™, Lillian Austin™, Pearl Sevillana™, 'Petite Pink Scotch', Raven™, Sweet Chariot™, and 'The Fairy' were reduced by 20 to 40 percent compared to the plants treated monthly with Daconil Weather Stik® 6F (Table 3). Sizable differences in the GI for Butterfly rose, Carefree Delight™, Cherry Meidiland®, Jeeper's Creeper™, Raven™, and 'Therese Bugnet' were also noted between the plants treated at two- and four-week intervals with Daconil Weather Stik® 6F. On several of the black spot and Cercospora leaf spot-susceptible roses, particularly 'Therese Bugnet', sizable increases in overall plant dimensions were seen despite heavy early fall leaf spotting and premature defoliation on the fungicide-treated roses. Previously, Bowen *et al.* (3) noted that severe outbreaks of black spot resulted in significant reductions in the growth and floral display of hybrid tea roses.

On cultivars partially resistant to black spot or Cercospora leaf spot such as Fire Meidiland®, Fuchsia Meidiland®, 'Hansa', Ice Meidiland®, Mystic Meidiland®, 'Pink Grootendorst', 'Pink Pet', Polar Ice™, Red Cascade™, and *Rosa wichurana*, a reduction of approximately 10 percent in plant size was seen between the roses treated monthly with a fungicide and the unsprayed controls of the same cultivar (Table 3). In most cases, the GI for the above roses differed by 10 percent or less for the two- and four-week Daconil Weather Stik® 6F programs. For Flower Carpet™ and 'Sea Foam',

**TABLE 3. IMPACT OF FUNGICIDE INPUTS ON THE GROWTH OF SELECTED SHRUB ROSES, BREWTON AGRICULTURAL RESEARCH UNIT, 2003<sup>1</sup>**

Cultivar	Growth Index (GI) <sup>2</sup>		
	Application Interval		
	2 wk	4 wk	UTC <sup>3</sup>
Butterfly rose	171	153	111
Carefree Delight™	154	137	113
Carefree Wonder™	98	88	62
Cherry Meidiland®	85	71	48
First Light™	83	76	66
Flower Carpet™	78	86	82
Fire Meidiland®	110	103	100
Fushia Meidiland®	139	136	119
Happy Trails™	103	103	77
'Hansa'	160	159	140
Ice Meidiland®	130	117	117
Jeeper's Creeper™	143	122	89
Kent™	108	107	91
Knock Out™	80	89	93
Lillian Austin™	73	67	44
'Madame Hardy'	93	81	68
Mystic Meidiland®	103	120	114
'Nozomi'	99	92	82
Pearl Sevillana™	90	80	57
'Petite Pink Scotch'	159	149	123
'Pink Grootendorst'	150	148	138
'Pink Pet'	77	75	63
Polar Ice™	125	139	119
Raven™	115	93	57
Red Cascade™	141	140	124
<i>Rosa wichurana</i>	103	97	95
'Sea Foam'	126	124	123
Sweet Chariot™	98	91	75
'The Fairy'	119	125	103
'Therese Bugnet'	148	135	134

<sup>1</sup>Height and widths for all rose selections were recorded on Oct. 6, 2003.

<sup>2</sup>Growth Index (GI) was calculated using the following formula: height + width 1 + width 2/3 = GI.

<sup>3</sup>UTC = Untreated controls were not sprayed with Daconil Ultrex.

which suffered considerable damage from *Cercospora* leaf spot and black spot, respectively, no substantial differences in plant size were noted between the two fungicide programs and the unsprayed plants. Similar results to those obtained for 'Sea Foam' were also observed for 'Nozomi', Sweet Chariot™, and Knock Out™.

### **Cultivar Sensitivity to Chlorothalonil and Heat Stress**

The potential for formulations of chlorothalonil including Daconil Weather Stik® 6F to scald, burn, or otherwise damage the leaves of roses is well known among rosarians. Typical symptoms associated with chlorothalonil-induced phytotoxicity, which were most noticeable on the roses treated with this fungicide on a two-week schedule, included bronzing or chlorosis of the leaves, noticeable irregular 'burnt' or brown spots on the upper leaf surfaces, and premature leaf shed. The most extensive leaf burn and premature leaf shed was observed on the hybrid tea rose Double Delight™ in 1999. The premature leaf shed and sparse canopy seen in 2003 on Knock Out™ may also be related to chlorothalonil-induced phytotoxicity. Other rose selections that were periodically damaged by applications of this fungicide were First Light™, Flower Carpet™, 'Hansa', Happy Trails™, Magic Carpet™, Mystic Meidiland®, 'Nozomi', and Raven™.

Sensitivity to high temperatures, which was characterized by yellowing or chlorosis of the leaves, as well as premature leaf loss and shoot dieback, was observed particularly during extended periods of hot (afternoon temperature greater than 95°F) summer weather in 2000 and 2001. Magic Carpet™ and White Flower Carpet™ proved especially sensitive to high temperature injury. On Magic Carpet™ and to a lesser extent on White Flower Carpet™, leaf roll, premature leaf shed, dieback of the lateral shoots, and finally plant death were observed shortly after the initial yellowing of the leaves. Considerable heat-related leaf yellowing was also noted in 2003 on Cherry Meidiland®.

## **SUMMARY**

While black spot was observed on more rose selections, *Cercospora* leaf spot was more widespread and damaging on shrub and ground cover rose selections than anticipated. While few references to *Cercospora* leaf spot are found in the literature, significant disease-related damage was recently reported in Central Alabama on several shrub and ground cover rose selections (4). Previously, rose pathology research has largely focused on black spot and powdery mildew. Little if any effort has been made to assess the importance of or to develop control strategies for *Cercospora* leaf spot. While Clendenen *et al.* (4) noted that *Cercospora* leaf spot caused relatively minor damage, the level of leaf spotting and premature defoliation attributed to *Cercospora* leaf spot that was seen here was quite similar to the damage seen on black spot-susceptible roses. In addition, reductions in plant growth similar to those previously noted on black spot-damaged roses by Bowen *et al.* (3) were also observed for those roses that suffered from serious leaf spotting and premature defoliation.

Considerable differences in susceptibility to black spot were noted among rose selections. Some roses proved immune to black spot, while other suffered heavy spotting of the leaves and premature defoliation. Little if any black spot was seen on Carefree Delight™, Flower Carpet™, White Flower Carpet™, Fire Meidiland®, Fuchsia Meidiland®, Happy Trails™, ‘Petite Pink Scotch’, Polar Ice™, *R. wichurana*, ‘The Fairy’, and ‘Therese Bugnet’, but all were damaged to some extent by *Cercospora* leaf spot. Buildup of black spot on the shrub rose selections Ice Meidiland®, Mystic Meidiland®, Red Cascade™, and ‘Pink Pet’ as well as the rugosa roses ‘Hansa’ and ‘Pink Grootendorst’ was much slower than the pace of disease development on most of the remaining roses. Since the season-end defoliation levels for all of the above roses, when left untreated, ranged from nearly 25 to 50 percent, monthly fungicide treatments would be required in the Coastal South and probably the remainder of Alabama to maintain health. In regions of the United States where black spot is less damaging, fungicide inputs may not be needed to maintain the beauty and vigor of these roses in the landscape.

‘Betty Prior’, Bonica®, Cherry Meidiland®, First Light™, Kent™, Jeeper’s Creeper™, Livin’ Easy™, ‘Madame Hardy’, ‘Nearly Wild’, ‘Nozomi’, Butterfly rose, Ralph’s Creeper™, Raven™, Royal Bonica®, ‘Sea Foam’, Sevilliana™, and Sweet Chariot™ were highly susceptible to black spot. Of these, Jeeper’s Creeper™, Lillian Austin™, ‘Nozomi’ and Ralph’s Creeper™ proved so sensitive to this disease that weekly fungicide treatments may be required to maintain these rose selections in Alabama landscapes.

While little if any black spot was found on Carefree Delight™, Flower Carpet™, White Flower Carpet™, Fire Meidiland®, Fuchsia Meidiland®, Happy Trails™, ‘Petite Pink Scotch’, Polar Ice™, *R. wichurana*, ‘The Fairy’, and ‘Therese Bugnet’, all of these roses suffered moderate to heavy *Cercospora* leaf spot related-leaf spotting and sometimes considerable early defoliation. Of these, the most attractive and least *Cercospora* leaf spot-susceptible selections were Polar Ice™, Fuchsia Meidiland®, and Fire Meidiland®. Along the Gulf Coast or other locations where the risk of heavy *Cercospora* leaf spot damage is high, monthly applications of chlorothalonil or another efficacious fungicide should control this disease on the above roses. In North Alabama and points further north, fungicide inputs may not be needed to maintain healthy and vigorous landscape plantings of Polar Ice™, Fuchsia Meidiland®, and Fire Meidiland®, as well as ‘Petite Pink Scotch’ and Happy Trails™. Flower Carpet™ and White Flower Carpet™ roses, which were not only susceptible to *Cercospora* leaf spot but also intolerant to the summer heat and humidity of the Coastal South, may be poor choices for this region (USDA Zone 8). In contrast, *Cercospora* leaf spot was not found on Flower Carpet™ in an earlier study conducted near Montgomery, Alabama (4). In a cooler and drier climate where *Cercospora* leaf spot may be less of a threat, both of these roses also may have relatively few disease problems and may be more attractive. ‘Therese Bugnet’ not only proved very susceptible to *Cercospora* leaf spot and powdery mildew but also failed to flower and was invasive. Although *R. wichurana* has the best overall disease resistance package of all the rose selections evaluated, sparse flower buds and an extremely invasive growth habit make this rose a poor choice except for right-of-way or other non-landscape uses.



Noticeable symptoms of *Cercospora* leaf spot were not found on 'Betty Prior', Bonica®, Cherry Meidiland®, First Light™, Kent™, Jeeper's Creeper™, Lillian Austin™, Livin' Easy™, 'Madame Hardy', 'Nearly Wild', 'Nozomi', Butterfly rose, Ralph's Creeper™, Raven™, Royal Bonica®, 'Sea Foam', Sevilliana™, and Sweet Chariot™, as well as Ice Meidiland®, Mystic Meidiland®, Red Cascade™, 'Pink Pet', 'Hansa', and 'Pink Grootendorst'.

As previously reported by Bowen *et al.* (3), severe black spot-related leaf spotting and premature defoliation may slow rose growth. In this study, similar reductions in plant growth were also linked to damaging outbreaks of *Cercospora* leaf spot. With both diseases, reductions in growth were greater for the more susceptible rose selections than for those with partial resistance to either black spot or *Cercospora* leaf spot. Plant growth, especially that of black spot- or *Cercospora* leaf spot-susceptible cultivars was greatly enhanced by fungicide inputs. Typically, the size of the black spot- and *Cercospora* leaf spot-susceptible rose selections was higher for the plants treated on a two- than on a four-week schedule with Daconil Weather Stik® 6F. For many of the disease-resistant roses, canopy spread for plants sprayed on a two- or four-week schedule often were not different. Bowen *et al.* (3) also noted that the number of flowers on several hybrid tea cultivars declined as the severity of black spot increased.

Fungicide treatments not only failed to appreciably increase leaf retention but also burned the leaves on Knock Out™ and Double Delight™. Leaf loss on Knock Out™ appeared to be related more to chlorothalonil phytotoxicity and/or heat-related stress rather than to black spot. Other noticeably chlorothalonil-sensitive cultivars included First Light™, Flower Carpet™, 'Hansa', Happy Trails™, Magic Carpet™, Mystic Meidiland®, 'Nozomi', and Raven™.

Historically, black spot, and to a lesser extent other diseases have often heavily damaged roses in landscapes across Alabama. Intensive fungicide programs, which are often required to control black spot and maintain plant health, have discouraged the installation of roses in residential and commercial landscapes. The disease-resistant shrub and ground roses, such as those described in this report, have the potential to greatly broaden the market for these colorful, versatile, and sometimes fragrant plants across Alabama.

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**APPENDIX: CHARACTERISTICS OF ROSE SELECTIONS EVALUATED AT THE BREWTON AGRICULTURAL RESEARCH UNIT FROM 1998 TO 2003**

Rose Selection	Flower Color	Dimensions		Fragrance	Hips	Growth Habit	Reaction to Diseases: —		
		Height ft.	Width ft.				Black Spot	Cercospora Leaf Spot	Powdery Mildew
'Betty Prior'	Medium Pink	3-4	1-2	Mild	No	Rounded	HS	HR	HR
Bonica®	Medium Pink	3-5	5	Fruity	Yes	Arching	HS	HR	HR
Butterfly rose	Yellow fading to Crimson	3-6	4	Light	No	Upright	S	HR	HR
Carefree Delight™	Carmine Pink and White Eye	3	5	Light	Yes	Arching	HR	HS	HR
Carefree Wonder™	Medium Pink	3-5	3-4	Light, Sweet	Yes	Bush	MS	HR	HR
Cherry Meidiland®	Cherry Red	4-5	3-4	None	Yes	Upright	HS	HR	MS
First Light™	Lavender Pink	2.5	3	Light, Spicy	Yes	Rounded, Compact	S	HR	HR
Flower Carpet™	Deep Pink	1-2	3-4	None	No	Low, Spreading	HR	S	HR
Fire Meidiland®	Bright Red	1	4	None	No	Low, Spreading	HR	MR	HR
Fuchsia Meidiland®	Mauve Pink	2	4	None	No	Low, Spreading	HR	MR	HR
'Hansa'	Violet Red	4-5	4-5	Strong Clove	Yes	Upright	MS	HR	HR
Happy Trails™	Pink	1.5	3	None	No	Low, Spreading	HR	S	HR
Ice Meidiland®	White	1.5	6	None	Some	Low, Spreading	MS	HR	HR
Jeeper's Creeper™	White	2	3	Mild	No	Low, Spreading	HS	HR	HR
Kent™	Clear White	2-3	2-4	None	No	Low, Spreading	S	HR	HR
Knock Out™	Cherry Red	3-4	3-4	Mild Spice	No	Compact Bush	MS	HR	HR
Lilian Austin™	Orange-Pink	4	4	Mild	No	Bush	S	HR	HR
Living Easy™	Apricot-orange	3-5	3-4	Fruity	No	Rounded	HS	HR	HR
'Madame Hardy'	White	5-6	3-4	Sweet	No	Upright	MS	HR	HR
Magic Carpet™	Mauve	2-4	4-6	Musky	No	Spreading			HR

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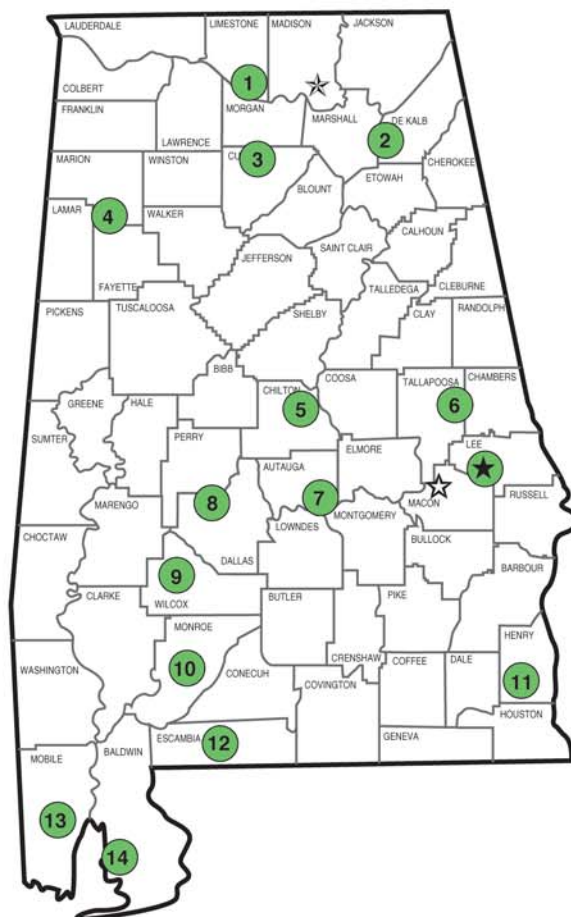
**APPENDIX, CONTINUED: CHARACTERISTICS OF ROSE SELECTIONS EVALUATED AT THE BREWTON AGRICULTURAL RESEARCH UNIT FROM 1998 TO 2003**

Rose Selection	Flower Color	Height ft.	Width ft.	Fragrance	Hips	Growth Habit	Reaction to Diseases:			
							Black Spot	Cercospora Leaf Spot	Powdery Mildew	HR
Mystic Meidiand®	Yellow suffused with Rose	3	3	None	Yes	Spreading	MS	HR	HR	HR
'Nearly Wild'	Pink	2-3	3-4	Mild	No	Short Bush	S	HR	HR	HR
'Nozomi'	Light Pink	1-3	2-4	Mild	No	Short Bush	S	HR	HR	HR
Pearl Sevilleana™	Pink fading to White	4-6	4	None	No	Bush	S	HR	HR	HR
'Petite Pink Scotch'	Light Pink	3-4	3	None	No	Spreading Mound	HR	S	MS	MS
'Pink Grootendorst'	Pink	4-5	4-5	Slight	No	Upright	MS	HR	HR	HR
'Pink Pet'	Medium Pink	3	3	Unknown	No	Bush	MS	HR	HR	HR
Polar Ice™	Pale Pink-White	3	3	Clove	Yes	Compact Bush	HR	MR	HR	HR
Ralph's Creeper™	Orange-Red	2	3	Light apple	Yes	Low, Spreading	HS	HR	HR	HR
Raven™	Dark Red	2-4	2	Unknown	No	Upright	HS	HR	HR	HR
Red Cascade™	Blood Red	2.5	5	Light	No	Arching	MS	HR	HR	HR
Rosa wichurana	White	1	6	None	No	Low, Spreading	HR	R	HR	HR
Royal Bonica®	Light Pink	4	4-5	None	Yes	Upright, Arching	HS	HR	HR	HR
'Sea Foam'	White	1.5	5	None	No	Low, Spreading	S	HR	HR	HR
Sevilleana®	Bright Red	4-5	3-4	None	Yes	Upright	HS	HR	HR	HR
Sweet Chariot™	Mauve	2	3	None	No	Rounded	S	HR	HR	HR
'The Fairy'	Pink	2-3	4-5	None	No	Spreading	HR	HS	HR	HR
'Therese Bugnet'	Lilac Pink	5-6	4	Yes	No	Upright	HR	HS	HS	S
White Flower Carpet™	White	1-2	2-4	Strong	Yes	Low, Spreading	HR	S	HR	HR

HS = Highly Susceptible, S = Susceptible, MS = Moderately Susceptible, MR = Moderately Resistant, R = Resistant, and HR = Highly Resistant.

## Alabama's Agricultural Experiment Station AUBURN UNIVERSITY

With an agricultural research unit in every major soil area, Auburn University serves the needs of field crop, livestock, forestry, and horticultural producers in each region in Alabama. Every citizen of the state has a stake in this research program, since any advantage from new and more economical ways of producing and handling farm products directly benefits the consuming public.



### Research Unit Identification

- ★ Main Agricultural Experiment Station, Auburn.
- ☆ Alabama A&M University.
- ☆ E. V. Smith Research Center, Shorter.

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| 1. Tennessee Valley Research and Extension Center, Belle Mina. | 8. Black Belt Research and Extension Center, Marion Junction. |
| 2. Sand Mountain Research and Extension Center, Crossville.    | 9. Lower Coastal Plain Substation, Camden.                    |
| 3. North Alabama Horticulture Research Center, Cullman.        | 10. Monroeville Agricultural Research Unit, Monroeville.      |
| 4. Upper Coastal Plain Agricultural Research Center, Winfield. | 11. Wiregrass Research and Extension Center, Headland.        |
| 5. Chilton Research and Extension Center, Clanton.             | 12. Brewton Agricultural Research Unit, Brewton.              |
| 6. Piedmont Substation, Camp Hill.                             | 13. Ornamental Horticulture Research Center, Spring Hill.     |
| 7. Prattville Agricultural Research Unit, Prattville.          | 14. Gulf Coast Research and Extension Center, Fairhope.       |