

TIMELY INFORMATION

Agriculture & Natural Resources

Disease Resistance of Shrub Roses and Early Leaf Shed seen on some Knock Out Roses

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Search for the 'No Spray' Rose Continued



Figure 1. Black spot on rose.

Introduction: In Alabama's often wet and warm climate, diseases pose a significant threat to the health and beauty of roses. Black spot is the most common and destructive disease on roses (Figure 1). On black spot-susceptible roses, leaf spotting and early defoliation, which may appear as early as mid-April, will intensify until the plants are totally defoliated. In addition to being unattractive, defoliated roses also produce fewer blooms and have greatly reduced shoot growth. To maintain the health and beauty of susceptible roses, weekly fungicide applications starting at leaf-out and continuing through the first hard frost are required.

Black spot is the primary but not the only disease that damages Alabama's roses. *Cercospora* leaf spot also causes a noticeable leaf spotting and premature defoliation on some roses, particularly increasingly popular shrub roses (Figure 2). Typically, defoliation levels are not as high on *Cercospora* leaf spot- than black spot-damaged roses. Left unchecked, *Cercospora* leaf spot may slow rose growth nearly as much as black spot. Fungicides applied to control black spot will also protect roses from *Cercospora* leaf spot.



Figure 2. Cercospora leaf spot.

While the powdery mildew is considered nationally second in importance to black spot, damaging outbreaks of this disease are sporadic in Alabama. When this disease does appear, signs and symptoms of powdery mildew may be seen in early to mid-spring and again in late fall. Due to the low risk damage from this disease, fungicides targeting powdery mildew are rarely needed.

Shrub roses are loosely defined group of unrelated heirloom, garden, Floribunda, and other modern hybrid roses that are marketed as having superior hardiness and vigor compared with the classic hybrid tea rose. Their growth habits range from erect bushy to sprawling, low-growing ground covers forms with multiple simple, semi-double, or double blooms on each stem. Popularity of shrub roses is due in part to claims of resistance to often 'unspecified' diseases, and the possibility of eliminating or greatly reducing the number of protective fungicide treatments needed to control diseases that plague roses.



Figure 3. Hot Cocoa rose

The objective of this study was to determine the susceptibility of newly released shrub rose selections to black spot, *Cercospora* leaf spot, and powdery mildew in a simulated landscape planting.

Plant Management: On 14 February 2008, bare-root roses were transplanted into raised beds on 8 foot centers with 13 feet between rows at the Brewton Agricultural Research Unit in Brewton, AL. A drip irrigation system was installed shortly after planting and the beds were then mulched with aged pine bark. After each rose was pruned, fresh aged pine bark was distributed on 18 February 2009. Plants periodically received applications of a complete fertilizer. A split plot design consisting of five replications with rose varieties as the main plot and fungicide treatment as the sub-plot was used. Daconil Weather Stik 6F fungicide at 2 quarts per acre was applied at 2- and 4-week intervals to one plant in each plot. The remaining plant in each plot was not treated with a fungicide. Fungicides were applied with a hand wand with a TX-8 nozzle to run-off using a tractor-mounted sprayer from mid-April to early October. Black spot (BS) and *Cercospora* leaf spot (CLS) damage was visually rated using a modified 1 to 10 Florida peanut leaf spot rating scale where 1 = no disease, 2 = very few lesions in canopy, 3 = few lesions noticed in lower and upper canopy, 4 = some leaf spotting and $\leq 10\%$ defoliation, 5 = lesions noticeable and $\leq 25\%$ defoliation, 6 = lesions numerous and $\leq 50\%$ defoliation, 7 = lesions very numerous and $\leq 75\%$ defoliation, 8 = numerous lesions on few remaining leaves and $\leq 90\%$ defoliation, 9 = very few remaining leaves covered with lesions and $\leq 95\%$ defoliation, and 10 = plants defoliated. Significance of treatment effects were tested by analysis of variance and the least significant difference (LSD) test ($P \leq 0.05$).

Results and Discussion: In 2009, rainfall totals for the months of March, April, May, July, August, September and October were average to above average, while totals for Jun fell below the 30-yr average for the study location. As a result of frequent showers, black spot and *Cercospora* leaf spot ratings for many rose varieties were higher in 2009 compared with the previous year.

The results for the non-fungicide-treated roses in 2008 and 2009 are presented in Table 1.

In 2008, the level of spotting and premature defoliation was heavier for black spot than for *Cercospora* leaf spot. No mixed outbreaks of the two diseases were seen. Knock Out, Blushing Knock Out, Pink Knock Out, and Double Knock Out roses were free of black spot and *Cercospora* leaf spot. Moderate black-spot related leaf spotting with some premature defoliation was also seen on Pink Drift, Easy Going, Pretty Lady and Baby Love. Roses that suffered objectionable black spot-induced defoliation were Gourmet Popcorn, Rabble Rouser, Rockin' Robin, and Johann Strauss. As indicated by disease ratings of 3.8 to 4.0, light to moderate *Cercospora* leaf spot-related leaf spotting with no more than 10% defoliation was seen on Coral Drift, Ivory Drift, Peach Drift, and Red Drift as well as Lovely Fairy. A low

level of leaf spotting due to *Cercospora* leaf spot with no defoliation was also noted on Rainbow Knock Out.

For 2009, the level of leaf spotting and premature defoliation was heavier for black spot compared with *Cercospora* leaf spot. No mixed outbreaks of black spot and *Cercospora* leaf spot were seen on any rose variety. Of the varieties screened, only Knock Out, Blushing Knock Out, and Pink Knock Out were free of both black spot and *Cercospora* leaf spot (Table 1). Among the remaining cultivars not damaged by *Cercospora* leaf spot, Pink Drift and Belinda's Dream showed the highest level of black spot resistance. Moderate levels of black spot-related leaf spotting with some premature defoliation were noted on the White Meidiland, and Bonanza. Rose varieties that suffered greater than 50% black spot-induced premature defoliation and heavy spotting of the remaining leaves included Eureka, Gourmet Popcorn, Rabble Rouser, Rockin' Robin, Julia Child, About Face, Hot Cocoa, Heart N' Soul, Baby Love, and Johann Strauss. Among all rose varieties damaged by *Cercospora* leaf spot, the highest level of leaf spotting and premature defoliation was noted on Rainbow Knock Out and Coral Drift. The remaining Drift series varieties except for Pink Drift, as well as Lovely Fairy, Home Run, and Palmengarten Frankfort showed no black spot symptoms but developed moderate *Cercospora* leaf spot-related leaf spotting with some defoliation. *Cercospora* leaf spot was not seen on the black spot-damaged roses.

As previously noted (2,3), shrub roses differed considerably in their reaction to black spot and *Cercospora* leaf spot. In addition rose varieties were damaged by either black spot or *Cercospora* leaf spot but not simultaneously by both diseases (2,3). On susceptible varieties, defoliation levels were usually higher with black spot compared with *Cercospora* leaf spot (2).

In the absence of protective fungicide treatments, Knock Out, Pink Knock Out, Double Knock Out, and Blushing Knock Out remained free of black spot and *Cercospora* leaf spot (Table 1). While similarly high levels of resistance to both of the above diseases were previously reported (1,3), premature defoliation, which apparently was not disease related, was observed in both this and the above studies. In contrast to the above Knock Out varieties, Rainbow Knock Out rose proved to be so susceptible to *Cercospora* leaf spot that this selection cannot be produced in a nursery or maintained in the landscape without twice monthly fungicide treatments. Among the Drift series groundcover roses, an unacceptably high level of *Cercospora* leaf spot-induced defoliation was seen in 2009 on Coral Drift. While light to moderate *Cercospora* leaf spot-caused defoliation was noted on Peach Drift, Ivory Drift, and Red Drift as well as Palmengarten Frankfort and Home Run, these roses could be maintained in Alabama landscapes without protective fungicides. While Home Run proved to be more susceptible to *Cercospora* leaf spot than noted by Mynes *et al.* (3), the level of defoliation on Palmengarten Frankfort and Lovely Fairly reported in the Tennessee study did not greatly differ from that noted here.

Eureka, Gourmet Popcorn, Rabble Rouser, Rockin' Robin, Julia Child, About Face, Hot Cocoa, Heart N' Soul, Baby Love, Be-Bop, and Johann Strauss, which suffered a minimum of 50% defoliation in at least one year, were unacceptably susceptible to black spot and would require weekly to twice monthly fungicide treatments to maintain plant health and promote flower bud set. Previously, Mynes *et al.* (3) reported that Be-Bop and Julia Child but not About Face were susceptible to black spot. Rose selections that displayed partial resistance to black spot included Pink Drift, Belinda's Dream, Bonanza, and White Meidiland. In Tennessee (3), Belinda's Dream showed a higher level of disease than was noted in this study. Fungicide treatments may not be needed to maintain the health and vigor of the latter four roses in landscape plantings.

A summary of the reaction of shrub roses evaluated at Brewton to black spot, *Cercospora* leaf spot, and powdery mildew along with a description of the growth habit and flower color is presented in Table 2.

Literature Cited:

1. Hagan, A. K. and J. R. Akridge. 2009. Unknown leaf spotting and defoliation on Knock Out roses. SNA Res. Conf. 54:69-74
2. Hagan, A. K., M. E. Rivas-Davila, J. R. Akridge, and J. W. Olive. 2005. Resistance of shrub and groundcover roses to black spot, *Cercospora* leaf spot, and impact of fungicide inputs on the severity of both diseases. J. Environ. Hort. 23:77-85.
3. Mynes, J, M. Windham, A. Windham, Y. Li, W. Copes, and J. Spiers. 2007. 'No Spray' rose cultivars for the mid South. Proc. Southern Nursery Assoc. 52:300-302.

Table 1. Characteristics and reaction on non-fungicide treated roses to black spot and Cercospora leaf spot in a simulated landscape planting in Brewton, AL.

Rose Cultivar	Black spot		Cercospora leaf spot	
	2008	2009	2008	2009
Coral Drift	1.0 g**	1.0 h	4.0 a	5.8 a
Ivory Drift	1.0 g	1.0 h	4.0 a	4.4 bc
Peach Drift	1.0 g	1.0 h	3.6 a	5.0 b
Pink Drift	3.6 f	3.8 g	1.0 b	1.0 e
Red Drift	1.0 g	1.0 h	4.0 a	4.8 bc
Johann Strauss	6.4 abc	7.2 bcd	1.0 b	1.0 e
Eureka	5.5 cd	7.7 abc	1.0 b	1.0 e
Blushing Knock Out	1.0 g	1.0 h	1.0 b	1.0 e
Pink Knock Out	1.0 g	1.0 h	1.0 b	1.0 e
Rainbow Knock Out	1.0 g	1.0 h	1.4 b	6.4 a
Double Knock Out	1.0 g	1.0 h	1.0 b	1.2 e
White Meidiland	5.0 de	5.0 f	1.0 b	1.0 e
Lady Elsie May	6.2 bc	6.4 e	1.0 b	1.0 e
Knock Out	1.0 g	1.0 h	1.0 b	1.0 e
Easy Going	4.6 e	7.2 bcd	1.0 b	1.0 e
Julia Child	6.2 bc	7.0 cde	1.0 b	1.0 e
Palmengarten Frankfort	1.0 g	1.0 h	1.0 b	4.4 bc
About Face	6.2 bc	7.0 cde	1.0 b	1.0 e
Belinda's Dream	5.2 de	4.4 fg	1.0 b	1.0 e
Hot Cocoa	6.0 c	7.4 bcd	1.0 b	1.0 e
Baby Love	4.8 de	7.4 bcd	1.0 b	1.0 e
Gourmet Popcorn	7.2 a	7.6 abc	1.0 b	1.0 e
Lovely Fairy	1.0 g	1.0 h	3.8 a	4.2 c
Rabble Rouser	7.0 ab	7.8 ab	1.0 b	1.0 e
Rockin' Robin	7.2 a	8.2 a	1.0 b	1.0 e
Be-Bop	5.0 de	7.2 bcd	1.0 b	1.0 b
Home Run	1.0 g	1.0 h	1.0 b	4.8 bc
Bonanza	5.6 cd	5.0 f	1.0 b	1.0 e
Heart N' Soul	6.2 bc	7.0 cde	1.0 b	1.0 e
Pretty Lady	4.8 de	6.8 de	1.0 b	1.0 e

*Black spot and Cercospora leaf spot incidence was visually assessed using the modified Florida 1 to 10 peanut leaf spot rating scale on 4 Sep.

**Means in each column that are followed by the same letter are not significantly different according to the least significant difference test ($P \leq 0.05$).

Table 2. Characteristics and reaction of shrub rose selections to diseases at Brewton Agricultural Research Unit.

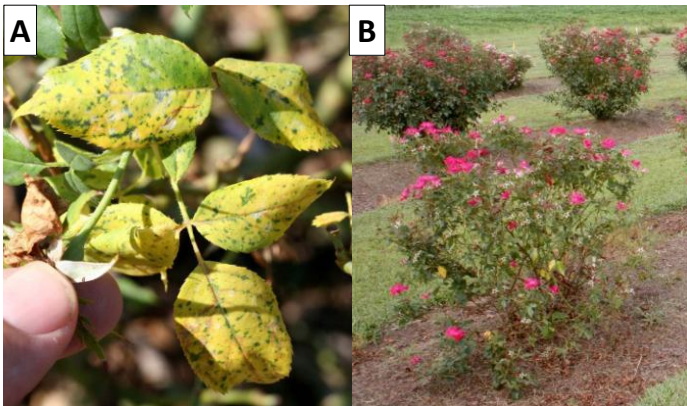
Rose selection	Disease reaction			Growth habit	Fragrance	Rose hips	Flower color
	Black spot	Cercospora leaf spot	Powdery mildew				
Coral Drift	HR	MS	R	Low, Spreading	no	no	Coral Orange
Ivory Drift	HR	R	HR	Low, Spreading	no	no	White
Peach Drift	HR	R	HR	Low, Spreading	no	no	Peach Apricot
Pink Drift	R	HR	HR	Low, Spreading	no	no	Deep Pink
Red Drift	HR	R	HR	Low, Spreading	no	no	Scarlet Red
Johann Strauss	S	HR	HR	Bush	apple	no	Pink
Eureka	S	HR	HR	Upright, spreading	light	no	Butter Yellow to Apricot Gold
Blushing Knock Out	HR	HR	HR	Bush	no	no	Light to Shell Pink
Pink Knock Out	HR	HR	HR	Bush	mild	no	Pink
Rainbow Knock Out	HR	S	MS	Bush	sweet juniper	no	Coral Pink
Double Knock Out	HR	HR	HR	Bush	no	no	Deep Red
Knock Out	HR	HR	HR	Bush	no	no	Red
White Meidiland	MS	HR	HR	Low, Spreading	no	no	White
Lady Elsie May	S	HR	HR	Bush	no	yes	Coral Pink
Easy Going	S	HR	HR	Upright	fruity	no	Golden Peachy Yellow
Julia Child	S	HR	HR	Bushy, Rounded	strong licorice	no	Butter Gold
Palmengarten Frankfort	HR	MS	HR	Low, Spreading	mild	no	Pink
About Face	S	HR	HR	Bush	fresh apple	no	Golden Orange
Belinda's Dream	MS	HR	HR	Upright	fruity	no	Medium Pink
Hot Cocoa	S	HR	HR	Bush	fruity	no	Russet
Baby Love	S	HR	HR	Upright	mild licorice	no	Yellow
Gourmet Popcorn	S	HR	HR	Bushy, Cascading	strong	no	Bright White
Lovely Fairy	HR	R	HR	Bushy, Cascading	mild apple	no	Deep Pink
Rabble Rouser	S	HR	HR	Bushy, Rounded	mild fruity	no	Yellow/Gold
Rockin' Robin	S	HR	HR	Bushy, Rounded	light	no	Red with white stripes
Be-Bop	S	HR	HR	Bushy, Spreading	light	no	Cerise with Yellow Eye
Home Run	R	R	HR	Bushy, Rounded	slight	no	Flame Red
Bonanza	MS	HR	HR	Bush	--	--	Yellow
Heart 'n' Soul	S	HR	HR	Rounded, spreading	mild apple	no	White-edged Lipstick Red
Pretty Lady	MS	HR	HR	Rounded	slight	no	Creamy White

Key to Disease Abbreviations: S = susceptible (require fungicide applications every 1 to 2 weeks), MS = moderately susceptible (monthly fungicide applications suggested), R = resistant (no fungicides needed), HR = highly resistant (no fungicides needed).

An unknown leaf yellowing and early leaf shed on some Knock Out roses

Introduction: In 2008, a distinctive yellowing or chlorosis of the leaves in the inner canopy of several Knock Out varieties in Brewton, AL. Numerous small circular to irregular green spots with an uneven or feathery edge appeared on the yellowed leaves (Figure 1A), which eventually were shed (Figure 1B). Leaf yellowing and premature defoliation appeared to progress from lower stems near the base of the plant upward through the plant canopy towards the shoot tips. Symptoms intensified from the July through early fall in 2008 and 2009 on several Knock Out series roses. Similar symptoms have been seen in plantings of Knock Out roses over the past two years in Auburn.

Figure 4. Leaf yellowing (A) and early leaf shed on the Knock Out rose.



The original Knock Out rose is a landscape phenomenon across the South. In addition to a cascade of bright red blooms, this cultivar has proven highly resistant to black spot and *Cercospora* leaf spot in Alabama (1). The Knock Out rose is one of the few no-(fungicide) spray roses for southern landscapes. Pink Knock Out, Blushing Knock Out, Rainbow Knock Out, Double Knock Out and the recently released Yellow Knock Out roses reportedly share the desirable horticulture and disease resistance characteristics of the original Knock Out rose. In Tennessee (2), Pink Knock Out showed a high level of resistance to both black spot and *Cercospora* leaf spot. In a previous study, Hagan *et al.* (1) noted that leaf canopy on Knock Out, however, was not as dense as other disease resistant

shrub roses. Since neither black spot nor *Cercospora* leaf spot was observed in this study (1), the premature leaf shed and sparse canopy was attributed to chlorothalonil phytotoxicity or heat stress. This study was initiated to further study the disease resistance of the Knock Out series roses as well as assess their sensitivity to retail fungicides such as Immunox Multi-purpose Fungicide and Disease Control along with the commercial fungicides Daconil Ultrex and Compass 50W. All of the above fungicides have activity against both black spot and *Cercospora* leaf spot.

Plant Management: On 14 February 2008, bare-root roses were transplanted into raised beds in a Benndale (A) sandy loam soil on 8 foot centers with 13 feet between rows. Prior to planting 600 lb/A of 5-10-15 analysis fertilizer plus 40 lb/A of minor elements was incorporated. After a drip irrigation system was installed, beds were mulched with aged pine bark. Plants periodically received applications of a complete fertilizer. Pre-emergent weed control was obtained with one or two applications of Surflan + Gallery. Sedgehammer and Fusilade were applied as needed to control escaped yellow nutsedge and grasses, respectively. The experimental design was a randomized complete block with five three-plant replicates. The study consisted of a split plot with four replications with rose variety as the main plot and fungicide programs and non-fungicide treated control as the split-plot treatments. Fungicides were applied at 4-week intervals with a CO₂-pressurized sprayer (Table 2). *Cercospora* leaf spot (CLS) intensity was visually rated during the growing season using a modified 1 to 10 Florida leaf spot rating scale where 1 = no disease, 2 = very few leaf spots in

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canopy, 3 = few spotted leaves in lower and upper canopy, 4 = some leaf spotting and $\leq 10\%$ defoliation, 5 = spotted leaves noticeable and $\leq 25\%$ defoliation, 6 = spotted leaves numerous and $\leq 50\%$ defoliation, 7 = spotted leaves very numerous and $\leq 75\%$ defoliation, 8 = numerous spots on few remaining leaves and $\leq 90\%$ defoliation, 9 = very few remaining leaves covered with leaf spots and $\leq 95\%$ defoliation, and 10 = plants defoliated. Significance of treatment effects was tested by analysis of variance and means were separated using Fisher's least significant difference (LSD) test ($P=0.05$).

Results and Discussion: Leaf yellowing and premature loss of those yellowed leaves was first noticed on the Knock Out and Blushing Knock Out in early July in both study years. Upon closer examination of symptomatic plants, numerous small circular to irregular green spots or 'green islands' with an uneven or feathery edge appeared on the yellow leaves, which eventually were shed (Figure 1A). While the symptoms superficially resembled those of black spot, no fungal mycelia or fruiting bodies were associated with the 'green islands'. Leaf yellowing and premature defoliation progressed from lower stems near the base of the plant upward through the plant canopy towards the shoot tips (Figure 1B). In both years, symptoms intensified between the first observation of damage in July and early fall.

Knock Out rose varieties differed in the level of leaf yellow and premature leaf loss. At the September 2008 rating date, Knock Out and Blushing Knock Out, as indicated by defoliation ratings of 4.0, suffered 30% premature leaf loss (Table 1). Similarly high defoliation levels were noted in September on these same varieties in 2009. Pink Knock Out suffered significantly less defoliation in 2008 but not in 2009 when compared with Knock Out and Blushing Knock Out. In both years, defoliation levels on Double Knock Out were noticeably lower compared with the above varieties but higher than Rainbow Knock Out, which never displayed the symptoms associated with this disorder.

When averaged across all varieties, the level of premature defoliation on 24 September 2008 was higher for the non-fungicide treated control than the Disease Control- and Immunox-treated roses but similar to those treated with Daconil Ultrex and Compass 50W (Table 2). In 2008, defoliation levels were similar for all fungicide treatments and non-fungicide treated control on Pink Knock Out and Double Knock Out but not for Blushing Knock Out and Knock Out (data not shown). While the defoliation ratings for the Immunox-treated Pink Knock Out roses were lower than the non-fungicide treated control and Compass 50W-treated roses, the Disease Control-treated plants had lower ratings compared with the Daconil Ultrex-, Immunox-, and non-fungicides treated controls. In 2009, defoliation ratings for all fungicide treatments and the non-fungicide treated controls were similar.

Diseases observed were *Cercospora* leaf spot and a zonate leaf spot caused by a *Phomopsis* sp. Black spot was not observed during the growing season. When disease levels were relatively low in 2008, Rainbow Knock Out proved in 2009 to be highly susceptible to *Cercospora* leaf spot. In 2008, all fungicides treatments were equally effective when compared with the non-fungicide treated control in preventing the development of *Cercospora* leaf spot on Rainbow Knock Out (data not shown). While all fungicides reduced *Cercospora* leaf spot intensity in 2009, Immunox gave better disease control than Daconil Ultrex (Table 3). The level of disease control obtained with Compass 50W and Disease Control was similar to that noted with Immunox and Daconil Ultrex.

With the notable exception of the highly susceptible Rainbow Knock Out, Knock Out series roses have a high level of resistance if not near immunity to *Cercospora* leaf spot. All are highly resistant to immune to black spot. Results of this study confirm recent observations in Tennessee (2) that Pink Knock Out is highly resistant to both of the above diseases. In contrast, the leaf yellowing and premature defoliation attributed to an unknown disorder, which began in early to mid-summer, continued through early fall. While Pink Knock Out, Knock Out, and to a lesser extent Blushing Knock Out were most sensitive, some leaf yellowing and early leaf loss was also seen on Double Knock Out. Rainbow Knock Out was not affected by this disorder. In an adjacent shrub roses planting at the same location, symptoms similar to those described here were found on the several Knock Out series rose cultivars but not any of the other roses (data not shown) as well as in a landscape planting of Knock Out roses on the campus of Auburn University. In Tennessee, Mynes et al. (2) may have noted but not recognized this disorder in a simulated landscape planting of Pink Knock Out rose. While they reported little if any black spot or *Cercospora* leaf spot development on this cultivar, a low level of premature and possibly not disease-related defoliation was reported.

In contrast to the report by Hagan *et al.* (1), damaged attributed to this unknown disorder was not linked with phytotoxicity to the fungicide chlorothalonil (Daconil Ultrex). The characteristic leaf bronzing and marginal leaf burn

associated with chlorothalonil use was not observed any of the Knock Out series roses. With few exceptions, defoliation ratings for all fungicide treatments and non-treated control in both years were similar for the four disease-resistant Knock Out series roses. The cause for this disorder is unknown. No sign of any plant pathogenic fungi or arthropod pest was associated with the yellowed, senescing leaves.

A lack of adaptability to the hot, humid summer weather patterns or macro/micronutrient deficiency are other possible explanations for the leaf yellowing and premature defoliation noted on Knock Out series roses in this and other sites in Alabama. Additional observations as well as leaf mineral assays will be conducted in an attempt of identify the cause of this unknown disorder in Knock Out series roses.

Summary: While Knock Out, Blushing Knock Out, and Pink Knock Out suffered the heaviest premature defoliation, a low level of canopy thinning was also seen on Double Knock Out. Little if any leaf yellowing and no premature defoliation was found on Rainbow Knock Out. Occurrence of the above disorder is not influenced by fungicide treatment. Of the five cultivars, Rainbow Knock Out proved to be highly and unacceptably susceptible to *Cercospora* leaf spot. In contrast, little if any leaf spotting attributed to this disease was noted on the other four cultivars. Black spot was not found on any Knock Out roses.

Literature Cited:

1. Hagan, A. K., M. E. Rivas-Davila, J. R. Akridge, and J. W. Olive. 2005. Resistance of shrub and groundcover roses to black spot, *Cercospora* leaf spot, and impact of fungicide inputs on the severity of both diseases. *J. Environ. Hort.* 23:77-85.
2. Mynes, J, M. Windham, A. Windham, Y. Li, W. Copes, and J. Spiers. 2007. 'No Spray' rose cultivars for the mid South. *Proc. Southern Nursery Assoc.* 52:300-302.

Table 1. Level of premature defoliation attributed to an unknown disorder on Knock Out series rose varieties in 2008 and 2009.

Knock Out Rose	% Premature defoliation ^z	
	2008	2009
Pink Knock Out	23 b ^y	24 a
Blushing Knock Out	30 a	28 a
Rainbow Knock Out	0 d	0 c
Double Knock Out	9 c	4 b
Knock Out	30 a	27 a

^zRatings were recorded in September 24, 2008 and on September 15, 2009.

^yMeans in each column that are followed by the same letter are not significantly different according to Fisher's least significant difference (LSD) test (P=0.05).

Table 2. Level of premature defoliation attributed to an unknown disorder as influenced by fungicide treatment when averaged across five Knock Out rose varieties in 2008 and 2009.

Fungicide and rate/100 gal	% Premature defoliation ^z	
	2008	2009
Bravo Ultrex 1.4 lb	20 ab ^y	18 a
Disease Control for Roses, Flowers & Shrub Concentrate 0.6 gal	14 b	15 a
Immunox Multi-purpose Fungicide 0.8 gal	15 b	15 a
Compass 50W 2 oz	19 ab	17 a
Non-treated Control	23 a	18 a

^zRatings were recorded in September 24, 2008 and on September 15, 2009.

^yMeans in each column that are followed by the same letter are not significantly different according to Fisher's least significant difference (LSD) test (P=0.05).

Table 3. Fungicides compared for the control of Cercospora leaf spot on 'Rainbow Knock Out' rose in 2009.

Fungicide and rate/100 gal	CLS intensity ^z
Bravo Ultrex 1.4 lb	4.8 b ^y
Disease Control for Roses, Flowers & Shrub Concentrate 0.6 gal	3.3 bc
Immunox Multi-purpose Fungicide 0.8 gal	2.8 c
Compass 50W 2 oz	3.8 bc
Non-treated Control	6.8 a

^zCercospora leaf spot (CLS) intensity was visually rated using a modified 1 to 10 Florida peanut leaf spot rating scale on 15 September 2009.

^yMeans in each column that are followed by the same letter are not significantly different according to Fisher's least significant difference (LSD) test (P=0.05).