

## Entomosporium Leaf Spot Control on Red-Tip Photinia with Drench and Foliar Fungicides in the Landscape

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### INTRODUCTION

Entomosporium leaf spot, caused by the fungus *Entomosporium mespili*, is a common and damaging disease in nursery and landscape plantings of red tip photinia (*Photinia x fraseri* 'Birmingham') across the South. Indian hawthorn, flowering pear, loquat, and other photinia species such as *P. serrulata* and *P. glabra* are among the other common hosts for this disease (1, 5). Symptoms of this disease first appear in early spring as tiny circular, bright red spots on both the upper and lower surfaces of young expanding leaves, while leaf spots on the mature leaves have ash brown to gray centers with a distinctive deep red to maroon margin or border. Large purple to maroon blotches, much darker than the surrounding healthy tissue, may be found surrounding the leaf spots on heavily diseased leaves on photinia (Figure 1A). Light infections usually cause little more than cosmetic damage, while severe infections often result in the heavily spotted leaves falling to the ground, resulting in slowed growth and poor plant aesthetics (Figure 1B).

Protective fungicide treatments are often required to maintain the health and beauty of red tip photinia in the landscape. Effective control of Entomosporium leaf spot on photinia can be maintained with weekly to twice monthly foliar applications of fungicides such as Zyban WSB (thiophanate-methyl + mancozeb), Daconil Weather Stik® (chlorothalonil), and Eagle® 40W (myclobutanil) (2, 4, 10). When application intervals are extended beyond two weeks, the level of Entomosporium leaf spot control provided by fungicides such as Daconil Weather Stik 6F sharply declines (8).

While a commercial nursery has the personnel and equipment required to maintain a preventive foliar fungicide program for effective disease control, homeowners desire a less time-consuming means of controlling this disease.

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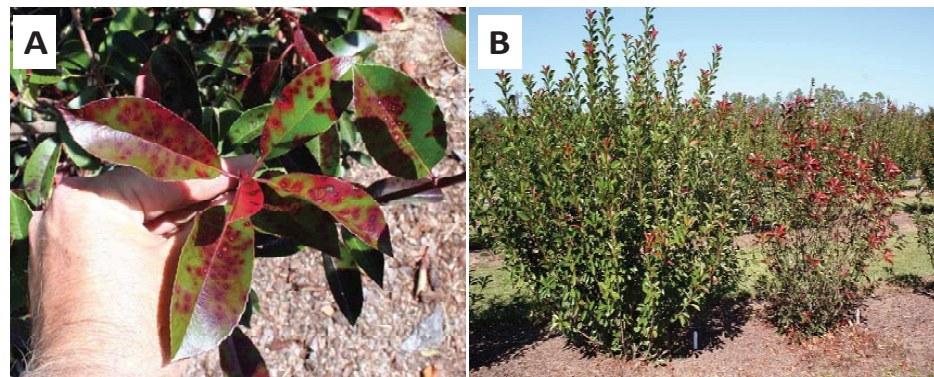


Figure 1A-B. Entomosporium leaf spot on red tip photinia with A) typical red to maroon border and blotches around the leaf spots on immature leaves and B) a fungicide-treated photinia (left) with little leaf spotting and early leaf drop compared with a badly leaf spot damaged photinia (right) that has shed all but the youngest leaves.

Bayer Advanced™ All-In-One Rose and Flower Care Concentrate (All-In-One) contains the systemic triazole fungicide tebuconazole and is formulated to be applied as a soil drench rather than a foliar spray for the control of leaf spot diseases and blights of flowers, shrubs, and trees. While expensive in terms of per plant application cost (\$1 per application per plant), this product is designed for use in small plantings to provide extended control of disease and/or insects in landscape plantings of vulnerable herbaceous and woody ornamentals.

Previous research has shown mixed results. Foliar applications of tebuconazole controlled Entomosporium leaf spot on photinia (2) but not black spot on rose (9) while drenches of several formulations of tebuconazole reduced the severity of black spot on established roses (6, 11, 12, 13). Compared with drenches of tebuconazole, foliar applications of Daconil Ultrex® (chlorothalonil) gave superior control of black spot (7). In addition, elevated drench rates of tebuconazole produced plant growth regulator symptoms, such as deep green leaf color, reduced leaf size, and shortening of the shoot internodes of tebuconazole-treated roses (11). These symptoms were previously associated with the extended use of high rates of triazole fungicides on container-grown photinia (2).

The objective of the present study was to compare the effectiveness of drench treatments of All-In-One for the control of Entomosporium leaf spot of photinia in a simulated landscape planting with twice monthly foliar applications of the following home retail fungicide products: Bayer Advanced™ Disease Control for Roses, Flowers & Shrub Concentrate; Immunox® Multipurpose Fungicide; RosePride® Disease Control Concentrate; and Daconil Weather Stik® 6F, the commercial standard.

## MATERIALS AND METHODS

**Plant culture.** In spring 2004, ‘Birmingham’ red-tip photinia (*Photinia x fraseri*) were transplanted from #1 containers into a Benndale fine sandy loam soil ( $\leq 1$  percent OM) at the Brewton Agricultural Research Center in Brewton, Alabama. They were planted on 6-foot centers with 10 feet between rows. A drip irrigation system was installed at planting and plants were watered as needed. Prior to planting, soil fertility and pH were adjusted according to the results of a soil fertility assay. In February of each year, aged pine bark was evenly distributed around the base of each plant. In late March, 1.7 ounces of 16N-4P-8K analysis fertilizer or equivalent was evenly distributed around the base of each plant. Pre-emergent weed control was obtained with a broadcast application of 2 quarts per acre of Surflan (oryzalin) + 1.0 pound per acre of Gallery (isoxaben) on January 30, 2006, February 1, 2007, and March 6, 2008. Escape weeds were hoed or pulled by hand.

**Fungicide comparison.** The experimental design was a randomized complete block with six single-plant replicates. Drenches of a 1 quart solution of All-In-One Rose and Flower Care Concentrate (tebuconazole at a rate of 0.6 g ai per liter), an insecticide (imidacloprid at 0.1 g ai per liter), and a 9N-14P-9K analysis fertilizer were mixed at a rate of 8 fluid ounces of product per gallon of water and poured in a 1-foot circle around the base of each plant at four-week intervals between January 4 and July 5, 2006, January 12 and July 11, 2007, and January 17 and June 23, 2008.

Foliar sprays of the following fungicides were applied to individual plants: Bayer Advanced™ Disease Control for Roses, Flowers & Shrub Concentrate (tebuconazole) at 0.75 fluid ounce per gallon; Immunox® Multipurpose Fungicide (myclobutanil) at a rate of 1 fluid ounce per gallon; RosePride® Disease Control Concentrate (triforine) at 0.5 fluid ounce per gallon; and Daconil Weather Stik® 6F (chlorothalonil) at 0.24 fluid ounce per gallon. These foliar sprays were applied to drip using a CO<sub>2</sub>-pressurized sprayer with a hand-held wand with a single adjustable hollow cone nozzle at approximately two-week intervals during the above time period. Fertilization rates for the foliar fungicide-treated photinia were not adjusted to account for the fertilizer component of the All-In-One Rose and Flower Care Concentrate application.

**Disease assessment.** Severity of Entomosporium leaf spot was rated using a modified Florida peanut leaf spot scoring system (3) where 1 = no disease, 2 = light leaf spotting in the lower canopy, 3 = light leaf spotting in the lower and upper canopy, 4 = light to moderate leaf spotting with  $\leq 10$  percent defoliation, 5 = noticeable leaf spotting in upper canopy with  $\leq 25$  percent defoliation, 6 = heavy spotting with  $\leq 50$  percent defoliation, 7 = heavy spotting with  $\leq 75$  per-

cent, defoliation, 8 = numerous spots on few remaining leaves with  $\leq 90$  percent defoliation, 9 = very few remaining leaves heavily spotted with  $\leq 95$  percent defoliation, and 10 = plants defoliated (100 percent). Disease ratings were recorded on March 22, May 17, and June 6, 2006; April 2, April 23, May 18, and July 3, 2007; and April 24, May 29, and July 3, 2008.

Area under disease progress curves (AUDPC) for Entomosporium leaf spot was calculated for each year from the leaf spot data (15). Analysis of variance using PROC GLM procedure in SAS (14) indicated that the year effect was not significant, so AUDPC data were pooled over years. In contrast, the year effect on Florida leaf spot values recorded in May of each study year was significant so subsequent analyses were separated by year. All statistical analyses on Florida leaf spot and AUDPC values were done on rank transformations of data. For presentation, data are back transformed to AUDPC or Florida leaf spot values. Means were separated using Fisher’s protected least significant difference (LSD) test ( $P \leq 0.05$ ).

## RESULTS AND DISCUSSION

On photinia, average Entomosporium leaf spot AUDPC values for the nontreated control and the All-in-One drench treatments were similar and were significantly higher compared with those from all of the foliar-applied fungicides (Figure 2). Among the foliar-applied fungicides, RosePride® Disease Control Concentrate provided poorer overall control of Entomosporium leaf spot

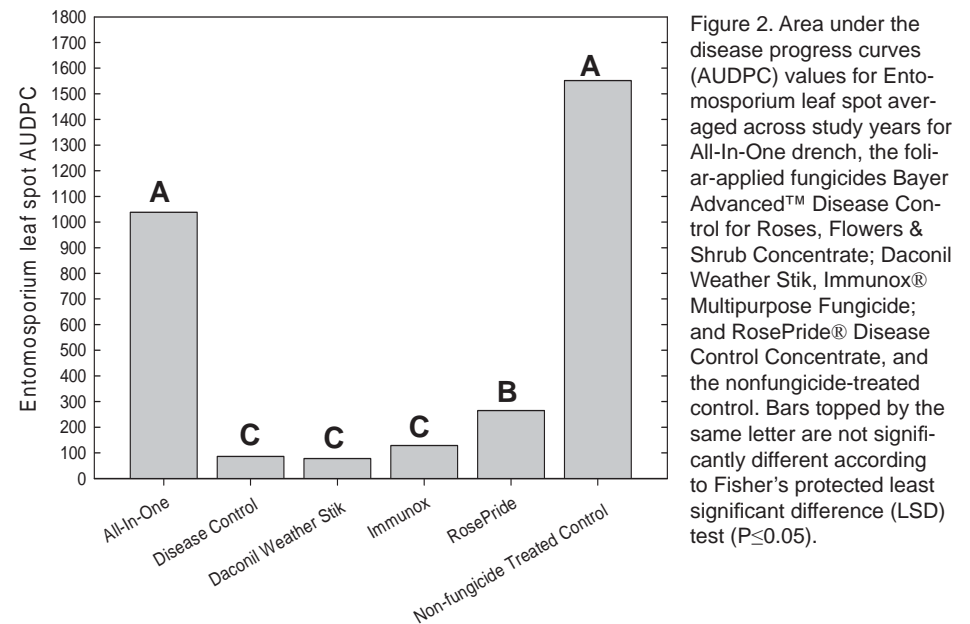


Figure 2. Area under the disease progress curves (AUDPC) values for Entomosporium leaf spot averaged across study years for All-In-One drench, the foliar-applied fungicides Bayer Advanced™ Disease Control for Roses, Flowers & Shrub Concentrate; Daconil Weather Stik, Immunox® Multipurpose Fungicide; and RosePride® Disease Control Concentrate, and the nonfungicide-treated control. Bars topped with the same letter are not significantly different according to Fisher’s protected least significant difference (LSD) test ( $P \leq 0.05$ ).

than Bayer Advanced™ Disease Control, Immunox® Multipurpose Fungicide, and Daconil Weather Stik®, which had equally low Entomosporium leaf spot AUDPC values.

While the pooled Entomosporium leaf spot AUDPC values clearly illustrate significant differences in fungicide efficacy, differences in the level of leaf spotting and premature defoliation attributed to this disease can be compared using the Florida leaf spot scale values recorded in May for the fungicide-treated and nonfungicide-treated photinia in each study year.

As indicated by disease ratings ranging from 5.0 in 2006 to 6.8 in 2007 (see table), the nontreated controls suffered from moderate to heavy leaf spotting as well as defoliation ranging from 25 to nearly 75 percent. In all study years, Entomosporium leaf spot ratings for the nontreated controls and All-In-One-treated photinia did not significantly differ.

The poor performance of All-In-One against Entomosporium leaf spot on photinia may be rate-related. In Texas studies, drenches of two formulations of tebuconazole, which were applied at the same rate as All-In-One at six-week intervals, proved equally (12) if not more effective (13) than weekly applications of Daconil Ultrex in controlling black spot on the hybrid tea rose ‘Peace’. In contrast, drenches of 2.7 and 5.4 fluid ounces of formulated tebuconazole per plant, applied at three- to four-week intervals, controlled black spot on ‘Christian Dior’ hybrid tea rose as effectively as weekly applications of Daconil Ultrex, while the recommended rate of All-In-One failed to check disease spread (6). In an earlier Alabama trial on a field-grown shrub rose, tebuconazole drenches at

5.4 and 8.0 fluid ounces of formulated tebuconazole per plant made at six- and eight-week intervals gave equal to or sometimes better black spot control than weekly applications of Daconil Ultrex (11). Where black spot control on rose was often obtained with elevated drench rates of tebuconazole, however, deep green leaf color, noticeable chlorosis around the leaf margin, reduced leaf area, and shortening of the shoot internodes was occasionally noted (Hagan, personal observation). However, none of the above plant growth regulator symptoms such as those associated with multiple applications of high rates of tebuconazole on rose were seen on the All-In-One-treated photinia. In a preliminary 2005 trial, the growth index of the All-In-One-treated photinia exceeded that of the foliar fungicide treated and nonfungicide-treated photinia (Hagan, unpublished data). The higher growth index was likely due more to the All-In-One fertilizer component than to enhanced disease control.

RosePride® Disease Control Concentrate was not quite as effective in controlling Entomosporium leaf spot in each study year compared with Bayer Advanced™ Disease Control and Daconil Weather Stik®. As indicated by disease ratings ranging from 1.8 to 3.0, symptoms on the RosePride-treated photinia were restricted to a few scattered spots on the juvenile leaves at the shoot tips without premature defoliation. With the exception of 2007, the level of leaf spotting on the Immunox- and RosePride-treated photinia did not significantly differ. In all three years, photinia treated with Immunox® Multipurpose Fungicide, Bayer Advanced™ Disease Control, and Daconil Weather Stik® had equally low disease ratings. In one and two study years, no symptoms were observed on the Bayer Advanced™ Disease Control and Daconil Weather Stik-treated photinia, respectively. Previously, foliar applications of Daconil Ultrex or Daconil Weather Stik® (2, 4, 10) as well as commercial or experimental formulations that contained the same active ingredient as Immunox® Multipurpose Fungicide (myclobutanil) (2), RosePride® Disease Control Concentrate (triforine) (4), and Bayer Advanced™ Disease Control (tebuconazole) (2) demonstrated excellent efficacy for the control of Entomosporium leaf spot on container-grown photinia. While significant reductions in the growth of the container-grown photinia were observed with weekly applications of an experimental formulation of tebuconazole in a previous study (2), no noticeable reduction in shoot growth or other plant growth regulator symptoms typically associated with the use of a triazole fungicide were observed in this study on the Bayer Advanced™ Disease Control-treated photinia (Hagan, unpublished data).

**Comparison of All-In-One Soil Drench and Foliar-Applied Fungicides for the Control of Entomosporium Leaf Spot on Red Tip Photinia**

Treatment	—Application—		—Disease rating <sup>1</sup> —		
	Placement	Interval	2006	2007	2008
All-In-One 3.6 fl oz <sup>2</sup>	Drench	4 week	3.7 a <sup>4</sup>	6.8 a	4.8 a
Daconil Weather Stik 0.2 oz <sup>3</sup>	Foliar spray	2 week	1.0 c	1.0 c	1.5 c
Disease Control 0.75 fl oz <sup>3</sup>	Foliar spray	2 week	1.0 c	1.2 c	1.3 c
Immunox 1fl oz <sup>3</sup>	Foliar spray	2 week	1.3 bc	1.2 c	2.2 bc
RosePride 0.5 fl oz <sup>3</sup>	Foliar spray	2 week	1.8 b	2.3 b	3.0 b
<b>Nonfungicide treated control</b>	—	—	<b>5.0 a</b>	<b>6.8 a</b>	<b>6.2 a</b>

<sup>1</sup> Entomosporium leaf spot ratings were recorded on May 17, 2006; May 16, 2007; and May 29, 2008 using a modified 1 to 10 Florida peanut leaf spot rating system.

<sup>2</sup> All-In-One Rose and Flower Care Concentrate was poured over the soil surface in the root zone at a rate of 1 quart of drench solution per plant.

<sup>3</sup> Daconil Weather Stik, Bayer Advanced™ Disease Control for Roses, Flowers & Shrub Concentrate, Immunox® Multipurpose Fungicide, and RosePride® Disease Control Concentrate were applied to the foliage to drip.

<sup>4</sup> Means in each column that are followed by the same letter are not significantly different according to Fisher's protected least significant difference (LSD) test (P≤0.05).



## SUMMARY

Bayer Advanced™ All-In-One Rose and Flower Care Concentrate (All-In-One) drench at label rates proved ineffective in reducing the severity of *Entomosporium* leaf spot on photinia (Figure 3A) when compared with the non-sprayed control (Figure 3B). While increasing the All-In-One drench rate may result in more effective control of *Entomosporium* leaf spot, the risk of plant growth regulator-related plant injury may be greatly increased. In contrast, the retail fungicides Bayer Advanced™ Disease Control (Figure 3C), Immunox® Multipurpose Fungicide (Figure 3D), RosePride® Disease Control Concentrate (Figure 3E), and as well as the commercial fungicide Daconil Weather Stik® (Figure 3F) gave superior disease control when applied every two weeks.

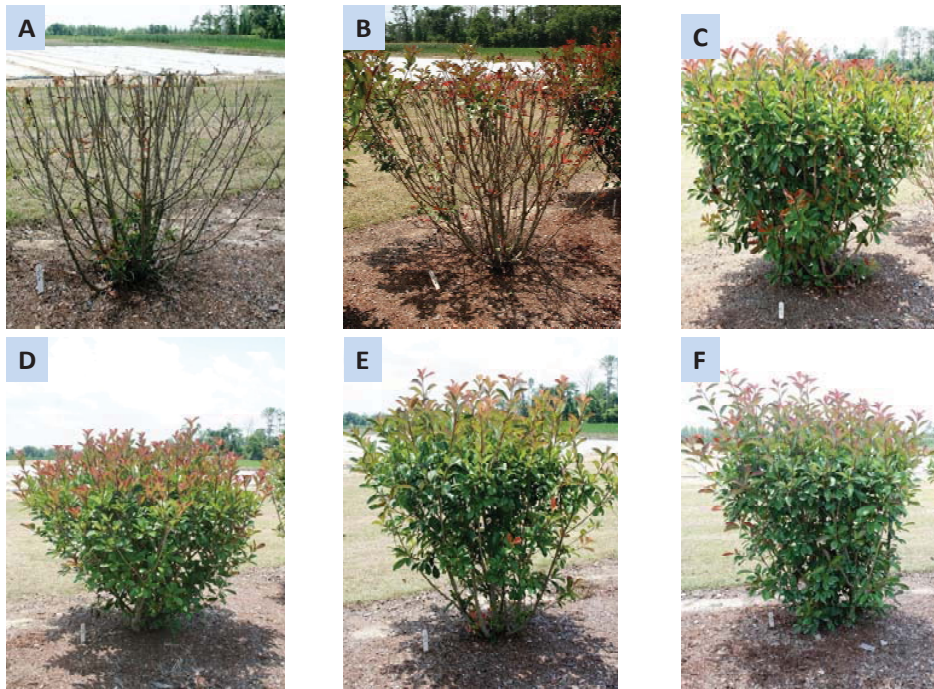


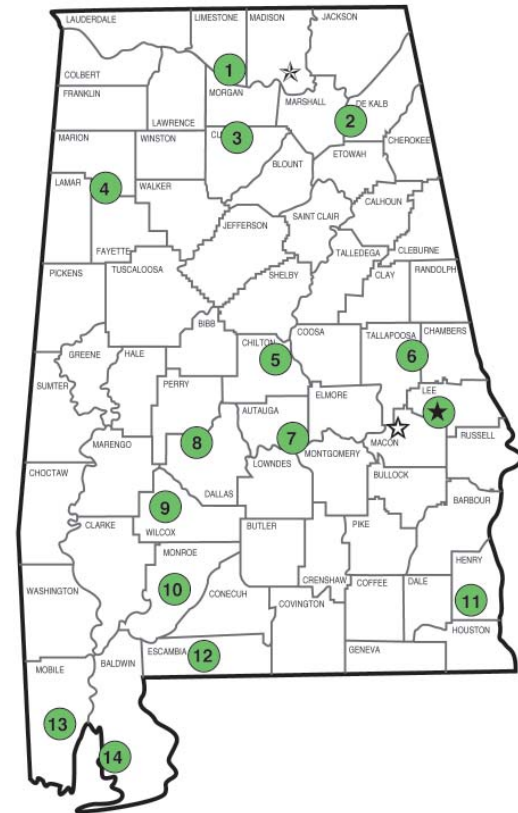
Figure 3. Photinia treated with A) All-In-One drench, B) Nontreated control, C) Bayer Advanced™ Disease Control, D) Immunox® Multipurpose Fungicide, E) RosePride®, and F) Daconil Weather Stik®.

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