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Impact of Application Rate, Treatment Interval, and Placement on the Control of Phytophthora Shoot Blight on Annual Vinca with Azoxystrobin[1]

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Abstract

Drenches and directed sprays of two rates of azoxystrobin (Heritage 50W) were evaluated at 2- and 4-week intervals for the preventative control of Phytophthora shoot blight (*Phytophthora parasitica*) in a simulated landscape planting of annual vinca (*Catharanthus roseus*). 'Tropicana Rose' and 'Pacifica Punch' annual vinca were planted in May 1998 and April 1999, respectively, adjacent to beds known to be heavily infested with the causal fungus *P. parasitica*. Regardless of application rate and fungicide placement, the survival rate of plants was often higher when treated with azoxystrobin on a 2-week rather than on a 4-week schedule. Fungicide placement appeared to have little impact on the efficacy of azoxystrobin for the control of Phytophthora shoot blight. In 1998, survival rates of 85 and 90% for 'Tropicana Rose' were obtained with directed sprays of 0.35 (9.6 oz/100 gal) and 0.7 gm a.i./liter (19.2 oz/100 gal), respectively, of azoxystrobin applied on a 2-wk schedule as compared with a 10% survival rate for the unsprayed control. Overall, directed sprays of 0.7 gm a.i./liter (19.2 oz/100 gal) of azoxystrobin applied at 2-week intervals gave the best protection from Phytophthora shoot blight. Among the azoxystrobin drench treatments, 10.7 gm a.i./100 m^2 (0.7 oz/1000 ft^2) applied at 2-week intervals had the highest survival rate in both years.

Index words: *Phytophthora parasitica*, chemical control, disease control, strobilurin fungicide, Heritage 50W, Aliette T/O, fosetyl-Al.

Species used in this study: annual vinca (*Catharanthus roseus* (L.) G. Don) 'Tropicana Rose' and 'Pacifica Punch'.

Significance to Nursery Industry

In recent years, Phytophthora shoot blight has been responsible for widespread and devastating stand losses in landscape plantings of annual vinca across Alabama. Protective fungicide treatments are among the options for preventing disease outbreaks in both the greenhouse and the landscape. Azoxystrobin (Heritage 50W™), when applied on a 2-week schedule at a rate considerably above those on the product label, partially protected annual vinca from attack by *P. parasitica*. However, the level of control of Phytophthora shoot blight provided by azoxystrobin was unacceptable for highly visible landscape plantings of annual vinca.

Introduction

Annual vinca or Madagascar periwinkle (*Catharanthus roseus* (L.) G. Don), which is a colorful, sun-loving, and drought-tolerant plant native to Madagascar, is among the most popular and widely grown summer annuals in landscapes across Alabama and adjoining southern states. Initially, this heat-tolerant summer annual was considered to be relatively free of damaging diseases. Although Phytophthora shoot blight was first identified in perennial plantings of vinca in California (2), this disease has quickly emerged throughout the Southeast as a common and often destructive disease in landscape plantings of this popular summer annual (8, 10, 11, 12). In Alabama, this disease has also been diagnosed in flats of annual vinca collected from production greenhouses and retail outlets (8). Recently, Phytophthora shoot blight has also appeared in plantings of annual vinca in Hawaii (12). While *Phytophthora parasitica* Dast. is the primary causal pathogen of shoot blight in the Southeast, three *Phytophthora* species, including *P. parasitica*, *P. meadii*, and *P. palmivora*, were isolated in Hawaii from diseased annual vinca (12). Although several cultivars of annual vinca demonstrated moderate to high levels of resistance in several field trials in California (1), their survival rate to Phytophthora-incited diseases as compared with other summer annuals in Alabama field studies has been very poor (3, 6, 7).

Until recently, fosetyl-Al (Aliette T/O™) was the only fungicide registered for the control of Phytophthora shoot blight on annual vinca. Simone and Jones (11) noted that fosetyl-Al, when applied as a foliar spray alone at 2.4 and 4.8 gm a.i./liter (2.5 and 5.0 lb/100 gal) or tank-mixed at 1.2 gm a.i./liter with 2.4 gm a.i./liter (2.5 lb/100 gal) of mancozeb (Fore 80W™), gave effective disease control on container-grown annual vinca. In Alabama, fosetyl-Al, when applied bimonthly to bed-grown 'Grape Cooler' annual vinca at 2.4 gm a.i./liter (2.5 lb/100 gal) of spray volume, gave better protection from Phytophthora shoot blight than did registered rates of copper sulfate pentahydrate (Phyton 27™), metalaxyl (Subdue 2E™), metalaxyl + mancozeb (Pace 77W™), and chlorothalonil (Daconil 2787 4F™) (4). Under ideal weather patterns for disease onset and spread in 1998, fosetyl-Al, when applied at 2.4 and 4.8 gm a.i./liter (2.5 and 5.0 lb/100 gal) alone or tank-mixed with 4.8 gm a.i./liter (5.0 lb/100 gal) of mancozeb, failed to control Phytophthora shoot blight on field-grown 'Peppermint Cooler' annual vinca (5).

Azoxystrobin, which is marketed under the trade name Heritage 50W™, is one of the first of a new class of low-risk, environmentally compatible fungicides called strobilurins to be registered for use on ornamentals. Activity against an array of destructive foliar and soilborne plant pathogenic fungi, including *Pythium* and *Phytophthora*, is the most notable characteristic of this unique fungicide. Matheron and Porchas (9) have shown that azoxystrobin,

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which suppresses sporangium formation and motility of zoospores of *P. parasitica*, could be as effective in controlling *Phytophthora*-incited diseases as established fungicides. In a concurrent study, the unacceptable 50% survival rate for the azoxystrobin-treated vinca was significantly higher than those recorded for the other fungicide treatments (5). The objective of this study was to assess the impact of fungicide placement, application rate, and treatment interval on the efficacy of azoxystrobin for the control of Phytophthora shoot blight on annual vinca.

Material and Methods

Prior to planting, 440 kg/ha (400 lb/A) of 13–13–13 fertilizer was tilled into raised beds in a Benndale sandy loam soil at the Brewton Experiment Field in Brewton, AL (USDA Hardiness Zone 8a), which is located approximately 50 miles northeast of Pensacola, FL. The beds were adjacent to an area where plantings of annual vinca had been destroyed by *Phytophthora parasitica* in the previous three years. Annual vinca (*Catharanthus roseus*) 'Tropicana Rose' and 'Pacifica Punch', which were purchased from a local retail outlet in 6-plant cell packs, were planted on May 29, 1998, and April 26, 1999, respectively. For both trials, the experimental design was a randomized complete block with five 5-plant replications of each treatment. A drip irrigation system was installed immediately after plant establishment, and plants were watered as needed. At 2-week intervals, calcium nitrate was delivered through the drip irrigation system at a rate of 11 kg/ha (10 lb/A).

Each experiment consisted of 10 treatments, 9 fungicide and a non-sprayed control. In both trials, azoxystrobin [Heritage 50W™] (Syngenta, Greensboro, NC) was applied at 2- and 4-week intervals as a soil drench at 6.2 gm a.i./100 m^2 (0.4 oz/1000 ft^2) and 10.7 gm a.i./100 m^2 (0.7 oz/1000 ft^2) of bed area. Approximately 1 liter of fungicide suspension was applied to the foliage and the soil around the base of the 5 plants in each 0.09 m^2 (1 ft^2) plot. Directed sprays of azoxystrobin were also made to the foliage at 2- and 4-week intervals at rates of 0.35 gm a.i./liter (9.6 oz/100 gal) and 0.7 gm a.i./liter (19.2 oz/100 gal) of spray volume. Fosetyl-Al [Aliette T/O™] (Aventis CropScience, Raleigh, NC) was applied every month as a directed spray at a rate of 1.0 gm a.i./liter (1.1 lb/100 gal) of spray volume. A pump-up sprayer was used to apply all drenches and directed sprays. Fungicides were applied at the previously indicated rates and intervals beginning on May 30 and ending on August 24, 1998, and from April 27 until July 20, 1999. In 1998, plant survival was assessed on June 23, July 17, and August 5. In the following year, survival levels were determined on July 7. Only the data from August 5, 1998, and July 7, 1999, are shown in Table 1. Significance of treatment effects was tested by analysis of variance, and treatment means were compared with Fisher's protected least significance difference (LSD) test with a level of significance of $P = 0.05$.

Results and Discussion

In May and June 1998, unseasonably hot and dry weather conditions suppressed the onset and development of Phytophthora shoot blight on 'Tropicana Rose' annual vinca. On the June 23 rating date, the survival rate in the untreated control and in all fungicide treated plots ranged between 90% and 100% (data not shown). By July 17, significant stand losses were largely limited to the fosetyl-Al-treated annual vinca (data not shown).

With the return of seasonable rainfall and temperature patterns in late July and early August 1998, rapid and extensive disease development was observed. On August 5, all of the fosetyl-Al-treated annual vinca had succumbed to Phytophthora shoot blight. On the above date, the survival rate recorded for the non-sprayed control was 10% (Table 1). Although azoxystrobin did not completely prevent plant loss due to Phytophthora shoot blight, significant differences in the survival rate of annual vinca treated with directed sprays and drenches of this fungicide and the non-sprayed control were seen. When applied at 2-week intervals, a 90 and 85% survival rate was obtained with directed sprays of the 0.35 (9.6 oz/100 gal) and 0.7 gm a.i./liter (19.2 oz/100 gal) rates of azoxystrobin. On a 4-week interval, directed sprays of the 0.7 gm a.i./liter (19.2 oz/100 gal) but not the 0.35 gm a.i./liter (9.6 oz/100 gal) rate of azoxystrobin gave a similar level of disease control as this same fungicide applied at 2-week intervals.

In 1998, application interval had a significant impact on the efficacy of drenches of azoxystrobin against Phytophthora shoot blight. For both drench rates, plant survival levels were significantly higher at the 2-week than at the 4-week application interval (Table 1). The survival rate for vinca drenched with both rates of azoxystrobin at 4-week intervals was similar

Table 1. Comparison of directed and drench applications of two rates of azoxystrobin for the control of Phytophthora shoot blight on annual vinca.

Treatment and rate	Treatment interval weeks	Placement	% Survival 1998	% Survival 1999
untreated control	—	—	10[z]de	28bcd
azoxystrobin 6.2 gm a.i./100 m^2	2	Drench	70abc	24cd
azoxystrobin 6.2 gm a.i./100 m^2	4	Drench	30de	4cd
azoxystrobin 10.7 gm a.i./100 m^2	2	Drench	75ab	60ab
azoxystrobin 10.7 gm a.i./100 m^2	4	Drench	45bcd	8cd
azoxystrobin 0.35 gm a.i./liter	2	Dir. Spray	90a	36bc
azoxystrobin 0.35 gm a.i./liter	4	Dir. Spray	35cde	28bcd
azoxystrobin 0.7 gm a.i./liter	2	Dir. Spray	85a	80a
azoxystrobin 0.7 gm a.i./liter	4	Dir. Spray	70abc	0d
fosetyl-Al 1.0 gm a.i./liter	4	Dir. Spray	0e	0d
LSD (P = 0.05)	—	—	37	33

[z]Mean separation within columns was tested according to Fisher's Protected Least Significance (LSD) test (P = 0.05).

to that of the untreated control. When applied at 2-week application intervals, directed sprays and drenches of both rates of azoxystrobin were similar in their levels of disease control.

As was the case in the preceding year, an extended period of hot and dry weather in May and early June 1999 delayed the appearance of Phytophthora shoot blight. Due to the absence of symptoms, no disease ratings were taken in May or June. Typical symptoms of Phytophthora shoot blight were not seen until rain showers resumed in late June and early July. Overall, the level of disease control provided by the majority of the drenches and directed sprays of azoxystrobin were unacceptable. At both the 2- and 4-week treatment intervals, no significant differences in plant survival were noted between either the low rate of the drench or directed spray of azoxystrobin and the unsprayed control.

With an 80% survival rate, the directed spray of the 0.7 gm a.i./liter (19.6 oz/100 gal) rate of azoxystrobin when applied at 2-week intervals, gave the best control of Phytophthora shoot blight (Table 1). When applied at 2- and 4-week intervals, directed sprays of 0.35 g a.i./liter (9.6 oz/100 gal) of azoxystrobin, as well as monthly applications of the high rate of the same fungicide failed to protect vinca from attack by *P. parasitica*. In addition, the levels of plant survival recorded for the untreated control, fosetyl-Al and all of the azoxystrobin drench treatments were similar.

Application rate and treatment interval had a significant impact on the efficacy of azoxystrobin for the control of Phytophthora shoot blight on vinca, especially in the first year of this study. For both the drenches and directed sprays of this fungicide, the most consistent reductions in plant mortality were obtained with the higher application rate of azoxystrobin. Regardless of fungicide placement, the level of plant survival was higher in both 1998 and 1999 when applications of the high rate of azoxystrobin were made at 2-week rather than at 4-week intervals. Fungicide placement had relatively little impact on the efficacy of azoxystrobin for the control of Phytophthora shoot blight. At the low application rate and the 4-week treatment interval, poor survival rates were seen with directed applications and drenches of azoxystrobin. The failure of fosetyl-AL to improve plant survival was attributed to the use of half of the label rate of this fungicide. Fosetyl-AL, when applied in combination with mancozeb, has been shown to control Phytophthora shoot blight on container-grown annual vinca (11). Among all fungicide treatments tested in this study, directed applications of the 0.7-g a.i./liter (19.2 oz/100 gal) rate of azoxystrobin applied at 2-week intervals consistently gave the best control of Phytophthora shoot blight on annual vinca.

Although selected treatments of azoxystrobin significantly reduced *Phytophthora parasitica*-incited plant mortality, questions remain concerning the use of this fungicide to control this disease in landscape plantings of annual vinca. Given the failure of bimonthly directed applications of 0.35 g a.i./liter (9.6 oz/100 gal) of azoxystrobin to control this disease, the label rate of 0.036 to 0.145 g a.i./liter (1 to 4 oz/100 gal) for this fungicide is unlikely to slow shoot blight development on annual vinca. Of the experimental and registered fungicides screened in this and previous studies (4, 5, 11), all failed to completely prevent Phytophthora shoot blight-related plant death. In *P. parasitica*-infested soils, fungicides have typically given little if any protection from this aggressive shoot and root pathogen, and the transplants usually die within a week after establishment (Hagan, personal observation). In the greenhouse, preventative bimonthly directed sprays or drenches of azoxystrobin or other registered fungicides should prevent catastrophic outbreaks of Phytophthora shoot blight on vinca during the production, shipping, and sales cycle, as well as slow disease spread into landscape plantings of vinca. In the landscape, establishment of annual and perennial bedding plants, which are resistant to *P. parasitica*, is a much less expensive and more effective alternative to fungicides for controlling Phytophthora shoot blight on vinca (6, 7, 8).

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