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A Demonstration Trial of Biofungicides with Efficacy for Controlling Dollar Spot in Turfgrasses

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ABSTRACT

A demonstration trial of biofungicides with efficacy for controlling dollar spot in turfgrasses was conducted. Biofungicides are biologically based products that have fungistatic or fungitoxic activity. The biofungicide product consists of a biological organism that may be fungal or bacterial in nature. Biofungicides may be broad-spectrum, targeting several fungi that cause turfgrass diseases. The biofungicides included in the demonstration trial were EcoGuard™, TurfShield®, and ZeroTol™.

All three biofungicides were effective in controlling dollar spot in Starkville, Mississippi, during the spring and fall of 2004. EcoGuard treatments applied on a 7- or 14-day interval or alternated with Daconil Ultrex (chlorothalonil) reduced dollar spot symptoms by 92%, 66%, and 95%, respectively. TurfShield treatments, alone (28-day interval) or in rotation with Daconil Ultrex (14-day interval) reduced dollar spot symptoms 78% and 85%, respectively. ZeroTol treatments, alone (7-day interval) or alternated with Chipco 26019 (iprodione) (7-day interval), resulted in 88% or 87% reduction in dollar spot symptoms, respectively.

Chemical fungicides, Chipco 26019 or Daconil Ultrex, when used alone (14-day interval) reduced dollar spot symptoms 90% and 89%, respectively. Over the course of the evaluation period, dollar spot symptoms increased 44% in the untreated control plots, indicating that dollar spot was highly active during the demonstration period. Phytotoxicity was not observed and turfgrass quality was not compromised in the biofungicide-treated plots.

INTRODUCTION

Dollar spot is a ubiquitous disease that affects virtually all turfgrass species and all turf situations (from home lawns to putting greens) (1, 3). In Mississippi, dollar spot may occur year-round if environmental conditions are favorable. The causal organism, *Sclerotinia homoeocarpa*, infects foliar tissue, which results in circular, straw-colored, blighted patches 2–3 inches in diameter on closely mowed turfgrass. Patches frequently coalesce to create large areas of blighted turfgrass. In turf situations where the mowing height is greater than 1.5 inches, blighted patches can be up to 10 inches in diameter and irregular in pattern (1, 3). Fungal activity commences at 60° F with peak growth and infection occurring between 70° and 80° F coupled with the relative humidity greater than 85% within the turf canopy. Many isolates of *S. homoeocarpa* are virulent at temperatures greater than 90° F (1, 3). Some isolates of *S. homoeocarpa* have been identified as resistant to conventional fungicides such as Chipco 26019 (2).

Dollar spot is managed to some extent through cultural practices, and conventional fungicides are routinely applied

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in preventive spray programs. However, there is a niche for biofungicides in the disease management programs of turfgrass. A typical spray program at a mid-level golf course will include the alternating use of different chemical groups of fungicides applied every 7 to 10 days to prevent or reduce disease incidence. A spray program incorporating biofungicides can reduce chemical input, which is both environmentally and economically beneficial and may reduce the development of fungicide resistance among isolates of the dollar spot fungus.

The biofungicides included in the demonstration trial were EcoGuard, TurfShield, and ZeroTol. EcoGuard is a bacterium-based biofungicide with *Bacillus lichenformis* as the active ingredient. TurfShield is a fungal-based product containing *Trichoderma harzianum.* ZeroTol, for which the active ingredient is hydrogen dioxide, is a disinfectant that cleanses the plant. Treatments also included two standard conventional fungicides: Chipco 26019 (iprodione), which is in the family dicarboximide; and Daconil Ultrex (chlorothalonil), which is in the family nitrile.

This biofungicide demonstration trial had two objectives: (1) Demonstrate the efficacy of EcoGuard, TurfShield, and ZeroTol biofungicides for controlling dollar spot on a Tifgreen bermudagrass putting green; and (2) Demonstrate the efficacy of EcoGuard, TurfShield, and ZeroTol biofungicides alternated with conventional fungicides to reduce chemical input and fungal resistance while maintaining acceptable disease management of dollar spot in a Tifgreen bermudagrass putting green.

Materials and Methods

A biofungicide evaluation was conducted on a Tifgreen bermudagrass putting green grown on native soil (pH 6.6) at the Rodney R. Foil Plant Science Research Center in Starkville, Mississippi. The Tifgreen was fertilized monthly with 0.5 pound of nitrogen (13-13-13 or 34-0-0) beginning in April and continuing through September 2004. The turf was maintained at 0.25-inch height by mowing three times per week. Fungicide treatments were arranged as plots (4x6 feet) in a randomized complete block design with four replications. The treatments were as follows:

Treatment	Rate (per 1000 ft²)	Spray interval (days)
EcoGuard	20 fl oz	7
EcoGuard	20 fl oz	14
EcoGuard alternated with Daconil Ultrex	20 fl oz / 3.25 oz	14
TurfShield	2 lb	28
TurfShield alternated with Daconil Ultrex	2 lb / 3.25 oz	14
ZeroTol	12 fl oz	7
ZeroTol alternated with Chipco 26019	12 fl oz / 2 fl oz	7
Chipco 26019	2 oz	14
Daconil Ultrex	3.25 fl oz	14
Untreated control (water)		

TurfShield is a granular material, and was applied using a drop-spreader at #3 setting to deliver 2 pounds per 1,000 square feet. All the other treatments were applied with a CO_2 backpack sprayer using a two-nozzle (11002 T-Jet) boom at 40 psi. Treatments were applied at a spray volume of 2 gallons of water per 1,000 square feet for EcoGuard treatments and the standard fungicides. However, treatments involving ZeroTol were applied (along with a nonionic surfactant (0.25% v/v) using a spray volume of 3 gallons of water per 1,000 square feet.

Initial fungicide applications of the early-season trial were made on May 17, 2004, and subsequent applications were made on 7-, 14-, or 28-day intervals through June. Late-season fungicide applications resumed September 7 and continued through October 2004. The plots received irrigation as needed. Dollar spot was incited on Tifgreen bermudagrass by a natural infestation of *Sclerotinia homoeocarpa*. Visual ratings of turfgrass quality and the number of infection centers per square foot were determined and recorded. Data was analyzed using the general linear model procedure of the Statistical Analysis System (SAS).

Results and Discussion

Symptoms of dollar spot first appeared approximately 2 days prior to the first fungicide application. In mid-June, the frequency and severity of symptoms increased due to favorable environmental conditions. During this period (June 17-25), turfgrass plots that were treated with EcoGuard, TurfShield, and ZeroTol resulted in significantly fewer infection centers as compared with the untreated control (Table 1). EcoGuard treatments applied on a 7- or 14-day interval or alternated with Daconil Ultrex (14-day interval) reduced dollar spot symptoms by 92%, 66%, and 95%, respectively. TurfShield treatments, alone (28-day interval) or in rotation with Daconil Ultrex (14-day interval), reduced dollar spot symptoms 78% and 85%, respectively. ZeroTol treatments, alone (7-day interval) or alternated with Chipco 26019 (7-day interval), resulted in 88% or 87% reduction in dollar spot symptoms, respectively. The Chipco 26019 or Daconil Ultrex treatments (14-day interval) reduced dollar spot symptoms 90% and 89%, respectively. Also during this period, dollar spot symptoms increased 44% from initial levels in the untreated control plots (Table 1).

Dollar spot severity was low during the late summer and early fall. However, symptoms began to appear in Tifgreen plots by mid-September. On the September 20 rating date, the conventional fungicide, Daconil Ultrex, had a significantly higher incidence of infection centers compared with the untreated control. EcoGuard applied on a 7-day interval was similar to Daconil Ultrex (14-day interval) and the untreated control. The values for the number of infection centers per square foot for all treatments were ≤ 1.3 (Table 1). On October 5, the number of infections centers increased to 1.5 in the TurfShield alternated with Daconil Ultrex (14-day interval) treatment, and by October 13, it was significantly higher than the untreated control (Table 1). There was also an increase in the number of infection centers for the EcoGuard treatment, applied on a 7-day interval, that was similar to the untreated control (Table 1). Overall, the remaining biofungicide treatments were effective in controlling dollar spot under these low levels of disease pressure.

Turfgrass quality (visual rating scale of 1–9, where 9 = best) was acceptable throughout the early- and late-season

Table 1. The effect of biofungicides for the control of dollar spot of bermudagrass, early- and late-season, 2004.

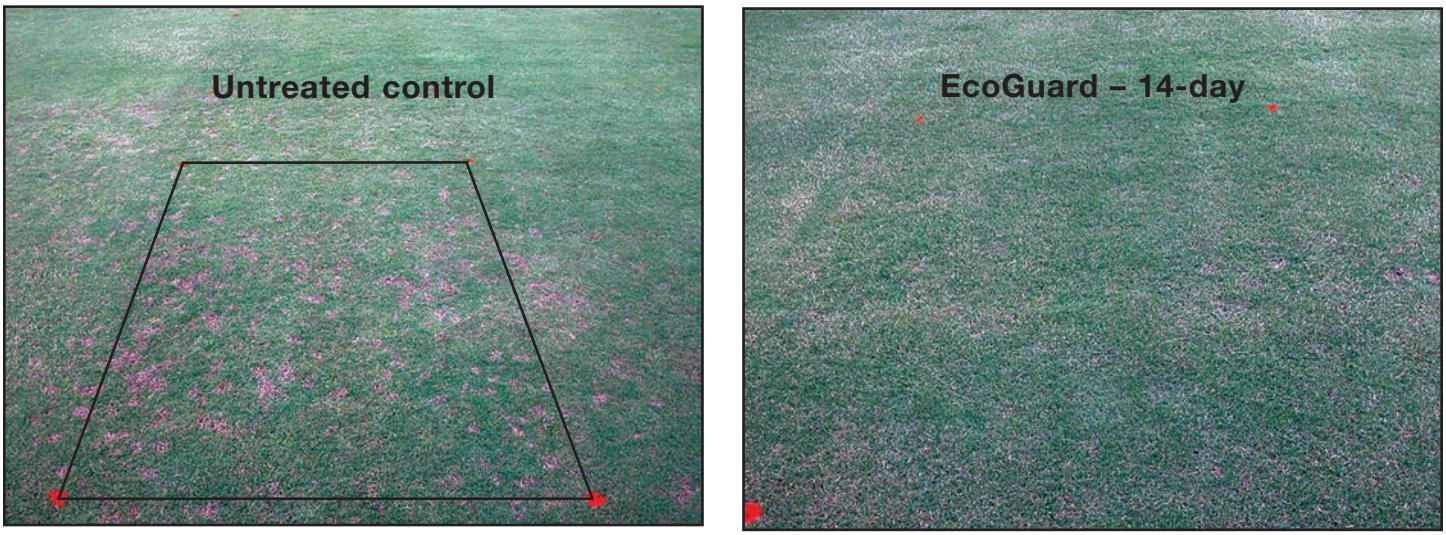
Treatment and rate per 1,000 sq ft[1]	Spray Interval (days)[2]	Dollar spot incidence (infection centers per square foot per plot)[3]								
		May 17	May 24	June 2	June 10	June 17	June 25	Sept. 20	Oct. 5	Oct. 13
EcoGuard SC 20 fl oz	7	12 c[4]	2 a	3 cd	4 a	2 b	0 c	0.8 ab	0.7 bc	2.4 c
EcoGuard SC 20 fl oz	14	13 bc	2 a	2 d	2 a	5 b	4 b	0.0 c	0.0 c	0.2 d
EcoGuard SC 20 fl oz *alt* Daconil Ultrex 82.5WGD 3.25 oz	14	20 a	6 a	7 bcd	2 a	5 b	0 ec	0.0 c	0.0 c	1.3 cd
TurfShield 1.15%G 2 lb	28	20 a	5 a	7 bcd	5 a	7 b	2 bc	0.0 c	0.1 c	1.2 cd
TurfShield 1.15%G 2 lb *alt* Daconil Ultrex 82.5WGD 3.25 oz	14	20 a	5 a	18 a	9 a	6 b	0 c	0.0 c	1.5 ab	6.8 a
ZeroTol 27F 12 fl oz + nonionic surfactant (0.25% v/v)	7	16 abc	3 a	6 bcd	2 a	3 b	1 bc	0.0 c	0.0 c	0.2 d
ZeroTol 27F 12 fl oz + nonionic surfactant (0.25% v/v) *alt* Chipco 26019 Flo 2SC 2.0 fl oz	7	15 abc	5 a	8 bcd	4 a	2 b	2 bc	0.0 c	0.2 c	0.0 d
Daconil Ultrex 82.5WGD 3.25 oz	14	18 ab	3 a	11 ab	4 a	3 b	1 bc	1.3 a	0.3 c	0.5 d
Chipco 26019 Flo 2SC 2.0 fl oz	14	20 a	2 a	8 bcd	4 a	5 b	4 b	0.3 bc	0.0 c	0.0 d
Untreated control	—	16 abc	4 a	9 bc	5 a	20 a	26 a	0.2 c	2.3 a	4.4 b

[1]EcoGuard, Daconil Ultrex, and Chipco 26019 Flo were applied at 2 gallons of water per 1,000 square feet; ZeroTol was applied at 3 gallons of water per 1,000 square feet.
[2]Fungicidal treatments (early-season) were applied on May 17 (all treatments), May 24 (7-day treatments), June 1 (7- and 14-day treatments), June 7 (7-day treatments), June 14 (7-, 14-, and 28-day treatments), and June 21 (7-day treatments). Late-season treatments were applied on September 7 (all treatments), September 14 (7-day treatments), September 21 (7- and 14-day treatments), September 28 (7-day treatments), October 5 (7-, 14-, and 28-day treatments), and October 12 (7-day treatments).
[3]"Infection centers/square foot/plot" values represent the mean of three random samples per plot.
[4]Means followed by the same letter within columns are not significantly different according to Fisher's protected least significant difference test (P=0.1).

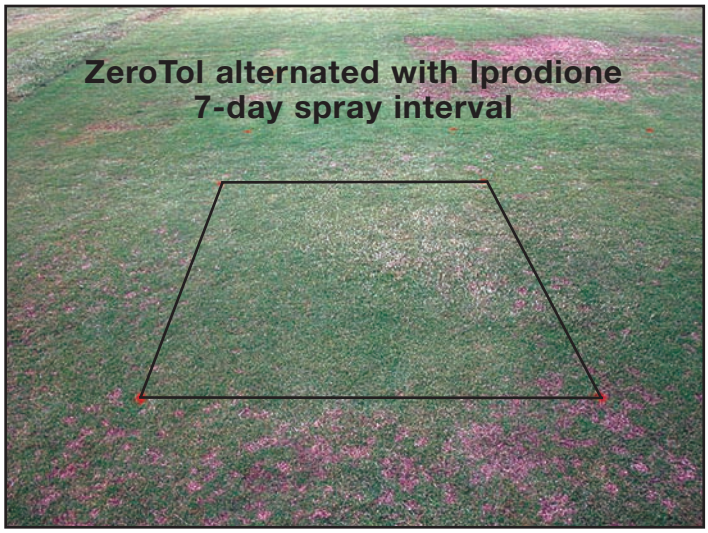
demonstration trial. However, when environmental conditions favored dollar spot development (June 17), turfgrass quality ranged from 4.8 for the untreated control to 6.3 for most biofungicide treatments. Turfgrass plots treated with EcoGuard and ZeroTol (7-day interval, respectively), EcoGuard alternated with Daconil Ultrex, TurfShield alternated with Daconil Ultrex, Daconil Ultrex, and Chipco 26019 (14-day interval, respectively) had significantly higher turfgrass quality ratings compared with the untreated control. Phytotoxicity was not observed in the biofungicide or conventional fungicide treatments.

Results of this biofungicide demonstration trial indicate that EcoGuard, TurfShield, and ZeroTol either alone or in rotation with conventional fungicides, were effective in controlling dollar spot of bermudagrass, even when dollar spot disease pressure was high during the spring. These biofungicides were as effective as the conventional fungicides, which indicates that they can be used successfully as alternative tools for disease management.

The environmental benefits of incorporating biofungicides into a dollar spot spray program are considerable, since they will reduce the need for conventional fungicide applications. Biofungicides are also safe for beneficial and nontargeted microbes and do not present any known, serious health hazards to pesticide applicators. EcoGuard, TurfShield, or ZeroTol are ideal tools for resistance management, IPM programs, and control of dollar spot in bermudagrass turf.



Dollar spot symptoms in an untreated control plot (left) and no dollar spot symptoms in the EcoGuard treatment (right) at Starkville, Mississippi, fall 2004.



A ZeroTol treatment surrounded by dollar spot symptoms in untreated alleys at Starkville, Mississippi, fall 2004.

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