Impact of Spring and Fall Fungicide Timings On The Development of Typhula Blight and Dollar Spot On Golf Course Turfgrass

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Over 70 different fungal diseases can adversely affect turfgrass planted as home lawns, golf courses, athletic fields, and other settings around the world (Smiley et al., 2005). Approximately 12 of these are severe enough to require routine or repeated fungicide applications, most often on creeping bentgrass (Agrostis stolonifera L.) in intensively-managed golf course settings (Latin, 2011). In temperate climates, the number of diseases that require routine fungicide applications on creeping bentgrass can be narrowed down to five or fewer. In climates similar to the Great Lakes region of the United States, the majority of fungicides applied to creeping bentgrass are applied to manage dollar spot (Sclerotinia homoeocarpa F.T. Bennett), Microdochium patch (Microdochium nivale (Fr.) Samuels & I. C. Hallett), and Typhula blight (Typhula incarnata (Fr.); T. ishikariensis Arsvoll and J.D. Smith). Reducing the overall number of fungicide applications required to manage just these three diseases could lead to a significant reduction in overall fungicide usage, providing environmental, toxicological, and financial benefits to the turfgrass manager.

Conventional fungicide programs to preventatively manage dollar spot, Microdochium patch, and Typhula blight in regions such as the Great Lakes can result in ten or more fungicide applications in a single growing season. Repeat fungicide applications can pose ecotoxicological risks if applied improperly and fosters a negative social profile of turfgrass management (Alavanja et al., 2005; Robbins et al., 2001). Routine fungicide applications also administer a substantial financial burden on most golf courses, with season-long protection of putting greens costing upwards of $10,000 (Vincelli and Dixon, 2003).

Previous research has demonstrated that early-spring fungicide applications made well before dollar spot onset can reduce initial dollar spot inoculum levels and delay dollar spot symptom development (Kaminski and Putman, 2007; Koch et al., 2009; McDonald and Dernoeden, 2006). Previous research has also demonstrated that fungicides applied to manage Typhula blight and Microdochium patch in the fall may reduce dollar spot development the following season, presumably due to a reduction in dollar spot inoculum the previous fall (Burpee et al., 1990; Landschoot et al., 2001). This research suggests that the impact of both fall and spring fungicide applications on the initial level of dollar spot inoculum may be significant, and could allow golf course superintendents to reduce fungicide usage the following growing season without sacrificing turfgrass quality. The primary objective of this study was to determine the impact of fall and spring fungicide applications on the development of dollar spot, Microdochium patch, and Typhula blight.

MATERIALS AND METHODS

The study was conducted on two plots maintained as either a golf course fairway or putting green at the O.J. Noer Turfgrass Research (OJN) and Educational Facility in Madison, WI. The study was initiated in the fall of 2008 and lasted through the summer of 2011, with the first disease ratings in spring 2009. The fairway study was conducted on mature creeping bentgrass (Agrostis stolonifera 'Penncross') maintained at a height of 0.5 inches on natural soil, and the putting green study was conducted on mature 'Penncross' creeping bentgrass maintained at a height of 0.14 inches and grown on a USGA-recommended root zone. In order to determine the cumulative effect of fungicide applications in subsequent years, the same experimental layout was used at each plot in each year of the study.

Treatments consisted of six different fungicide timings, a non-treated control (NTC), and a conventional fungicide program (CP). The six individual treatment timings were; one late fall application (LF), one late spring (LS); one late fall plus one late spring (LF/LS); one early fall plus one late fall (EF/LF); one early spring plus one late spring (ES/LS); and two fall plus two spring applications (2F/2S). Specific fungicide application dates are listed in table 1. The conventional program for both the fairway and putting green plots were provided by a local golf course superintendent and is listed in table 2.

The active ingredient boscalid (Emerald®) was used in the EF and LS applications because of its efficacy against dollar spot. The EF and LS applications were made once soil temperatures at a 2 inch depth reached 50 to 55°F for a five day period in the fall or spring of each year, respectively. A combination of the active ingredients iprodione (Chipco 26GT®) and chlorothalonil (Daconil WeatherStik®) were used for the LF and ES applications because of their efficacy against Microdochium patch and Typhula blight. The LF application was made 2 weeks prior to expected snowfall when 2 inch soil temperatures ranged from 34 to 40°C. The ES applications were made once the 2 inch soil temperature reached 46 to 54°F for a five day period each spring. All fungicides were applied at the full label rate using a CO2 - pressurized boom sprayer at 40 p.s.i. equipped with two XR Teejet 8004 VS nozzles. All fungicides were agitated by shaking and were applied in the equivalent of 2 gallons of per 1000 ft2.

Table 1. Application dates for each fungicide timing treatment in 2009, 2010, and 2011 at the OJ Noer Turfgrass Research Center in Madison, WI. Applications were made to the fairway and putting green plots at the OJ Noer on the same date.

	2008-2009	2009-2010	2010-2011
Non-treated Control			
Late Fall	11/23/08	11/12/09	12/2/10
Late Spring	5/15/09	5/19/10	5/13/11
Late Fall + Late Spring	11/23/08, 5/15/09	11/12/09, 5/19/10	12/2/10, 5/13/11
Early Fall + Late Fall	10/31/08, 11/23/08	10/20/09, 11/12/09	10/21/10, 12/2/10
Early Spring + Late Spring	4/17/09, 5/15/09	4/19/10, 5/19/10	4/7/11, 5/13/11
Both Fall + Both Spring	10/31/08, 11/23/08, 4/17/09, 5/15/09	10/20/09, 11/12/09, 4/19/10, 5/19/10	10/21/10, 12/2/10, 4/7/11, 5/13/11
Conventional Program	See Table 2.		

Table 2. Approximate dates of application, product, and product rate of the conventional program used on both fairway and putting green plots in 2009, 2010, and 2011 at the OJ Noer Turfgrass Research Facility in Madison, WI. Program was provided by a local golf course superintendent, and approximate application dates were the same in all 3 years.

Approximate Application Date	Product	Product Rate	Active Ingredient
June 1st	Emerald®	5.5 g/100 m^2	Boscalid.
June 28th	Daconil WeatherStik®	101.8 ml/100 m^2	Chlorothalonil.
July 12th	Daconil WeatherStik®	101.8 ml/100 m^2	Chlorothalonil.
July 19th	Daconil WeatherStik®	101.8 ml/100 m^2	Chlorothalonil.
July 26th	Daconil WeatherStik®	101.8 ml/100 m^2	Chlorothalonil.
August 2nd	Curalan®	30.5 g/100 m^2	Vinclozolin.
August 16th	Emerald®	5.5 g/100 m^2	Boscalid.
September 27th	Curalan®	30.5 g/100 m^2	Vinclozolin.
October 11th	Curalan®	30.5 g/100 m^2	Vinclozolin.
December 1st	Instrata®	295.7 ml/100 m^2	Chlorothalonil, Propiconazole, Fludioxonil.

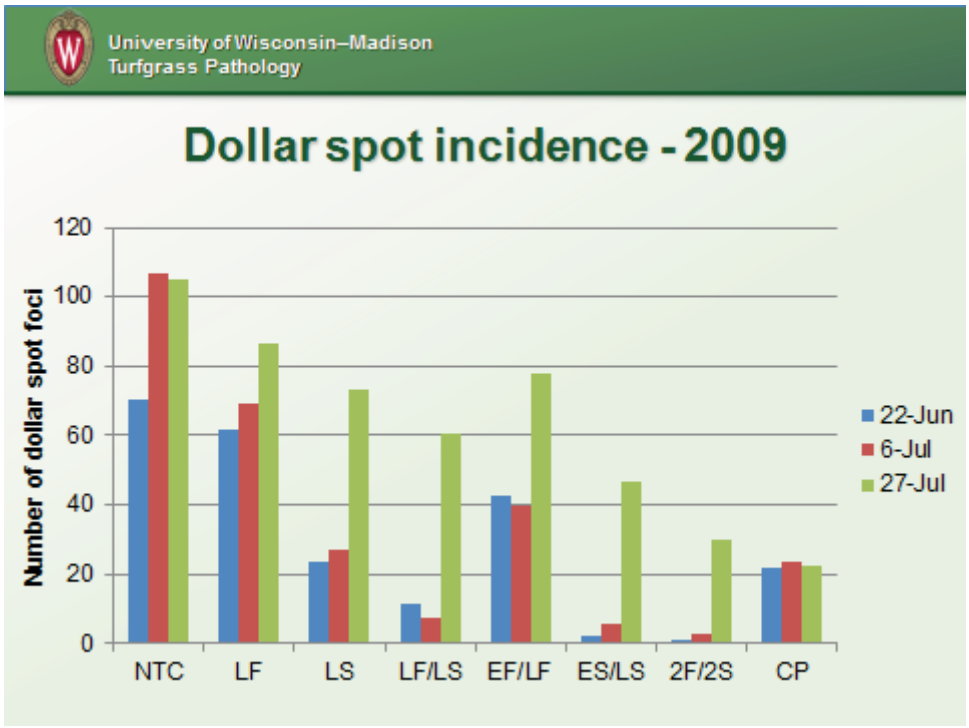

Figure 1: Number of dollar spot foci on putting greens at the OJ Noer Turfgrass Research Facility in Madison, WI during the summer of 2009. NTC – Nontreated control; LF – Late Fall; LS – Late Spring; LF/LS – Late Fall + Late Spring; EF/LF – Early Fall + Late Fall; ES/LS – Early Spring + Late Spring; 2F/2S – 2 Fall + 2 Spring; CP – Conventional Program.

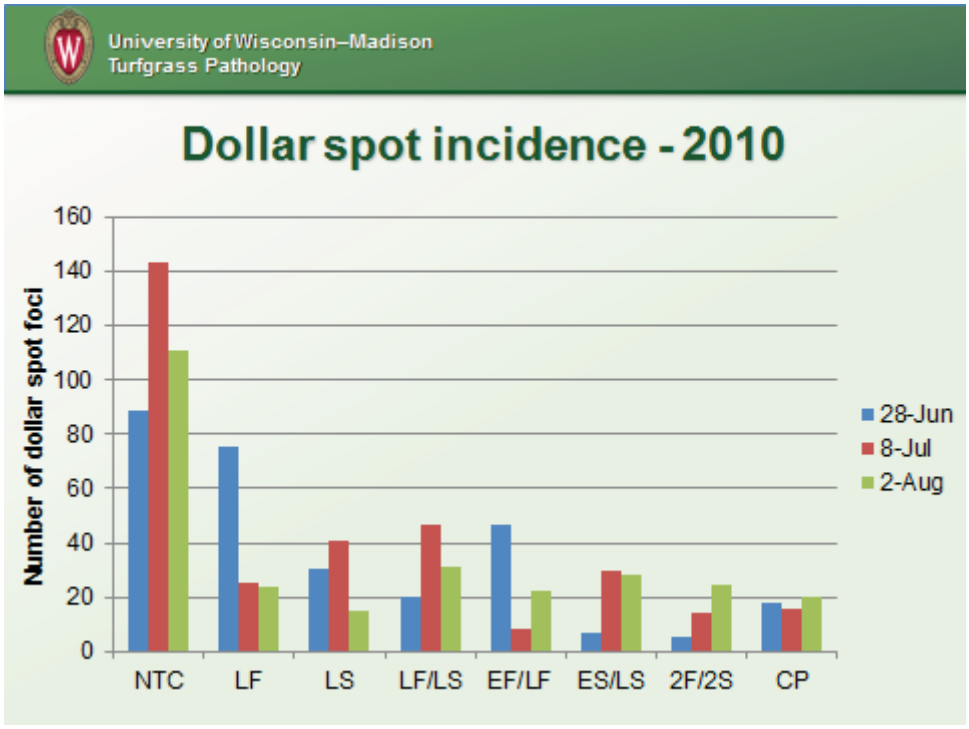

Figure 2: Number of dollar spot foci on putting greens at the OJ Noer Turfgrass Research Facility in Madison, WI during the summer of 2010. NTC – Nontreated control; LF – Late Fall; LS – Late Spring; LF/LS – Late Fall + Late Spring; EF/LF – Early Fall + Late Fall; ES/LS – Early Spring + Late Spring; 2F/2S – 2 Fall + 2 Spring; CP – Conventional Program.

Dollar spot severity was assessed by counting individual foci per plot every other week throughout the summer. Typhula blight and Microdochium patch severity were visually assessed each spring following snowmelt as a percent area of the plot affected. Mean disease severity from both putting green and fairway plots in all three years was assessed separately. Disease severity values were subjected to analysis of variance (ANOVA; PROC MIXED) and mean separations using the Waller-Duncan k-ratio t-test (k=100) in SAS (Version 9.1; SAS Institute, Cary, NC).

RESULTS AND DISCUSSION

In general, dollar spot was less severe on the fairway compared to the putting green plot in both 2009 and 2010 and hence fairway results are not presented here. Optimal conditions for dollar spot development were more consistent in 2009 compared to the dry summer of 2010, resulting in increased dollar spot severity over the course of the summer. Dollar spot severity in 2011 was very low on both the fairway and putting green plots and consequently the results are not included here.

On the putting green plot in 2009, all fungicide treatments including the conventional fungicide program reduced dollar spot severity compared to the NTC at each rating date until 11 August (Figure 1). On the 22 June and 6 July dates, those treatments containing LS fungicide applications provided increased dollar spot suppression compared to those containing only fall fungicide applications. In addition, those treatments containing both an ES and LS application provided even greater dollar spot suppression compared to the LS application alone. The EF/LF treatment slightly reduced dollar spot severity on 22 June and 6 July compared to the NTC but was no longer distinguishable from the NTC by 11 August. The LF treatment did not suppress dollar spot compared to the NTC. The treatment containing all four fall and spring applications provided similar reductions in dollar spot development compared to the ES/LS treatment.

Minor amounts of dollar spot were present on the CP treatment prior to the initial application on 1 June, and minor to moderate dollar spot breakthrough continued to be observed with this program during periods of heavy disease pressure throughout the summer.

Results from the 2010 putting green plot mirrored those from 2009 (Figure 2). In general, treatments containing multiple springtime fungicide applications were more effective at delaying dollar spot than single springtime fungicide applications, which were more effective than only fall fungicide applications. Significant dollar spot reductions with all fungicide timing treatments were still being observed on the 2 August rating date when compared to the NTC, though dry conditions not conducive for dollar spot development in late July and August may have contributed to the low dollar spot levels.

All fungicide treatments reduced dollar spot severity on the OJN fairway in 2009 compared to the NTC on both the 22 June and 6 July rating dates (data not shown). As seen on the putting green plots, those treatments containing multiple springtime fungicide applications were more effective at delaying dollar spot onset compared to those with a single springtime application, which was more effective than fall fungicide applications. Dollar spot severity increased rapidly on all treated plots near the end of July, and no treatments reduced dollar spot severity compared to the NTC on the 27 July rating date. Dollar spot pressure was low in 2010 on the fairway plot, and no differences between fungicide treatment timings were observed.

Typhula blight and Microdochium patch were not observed on the putting green plots at OJN in 2009, 2010, or 2011. Typhula blight was observed on the OJN fairway plots following the winters of 2009-2010 and 2010-2011 (Figure 3). Only those treatments containing a LF fungicide application, including the CP, provided acceptable control of Typhula blight. Treatments containing only springtime fungicide applications did not impact Typhula blight development compared to the NTC.

The research presented here supports previous research that has demonstrated that fungicide applications targeting dollar spot made in late spring, well in advance of the traditional first fungicide application targeting dollar spot, can delay the onset of dollar spot incidence (McDonald and Dernoeden, 2006; Kaminski and Putman, 2007; Koch et al., 2009). Two springtime fungicide applications spaced four weeks apart, beginning when 2 inch soil temperatures reached 50°F, provided an increased level of dollar spot suppression well into July compared to a single application targeted at a soil temperature of 60°F. This suggests that initial dollar spot activity may occur 4 to 6 weeks ahead of symptom development, and that fungicide applications targeted for this period can reduce initial dollar spot inoculum and significantly delay and reduce dollar spot well into the summer months in the Great Lakes region.

In addition, our research partially supports past studies that have documented the impact of fall-applied fungicides on dollar spot development the following summer. Burpee et al. (1990) demonstrated that fall applications of triadimefon and propiconazole significantly reduced dollar spot severity the following summer, and Landschoot et al. (2001) showed that multiple fall applications of pentachloronitrobenzene (PCNB) at high label rates also reduced dollar spot development the following year. Our research did show that early fall fungicides applied when 5 cm soil temperatures were approximately 50 to 55°F did provide a minor reduction in dollar spot the following season. Our research did not observe an impact, however, of fungicides applied targeting Typhula blight and Microdochium patch when soil temperatures were approximately 34 to 40°C on dollar spot the following season. This suggests that fall fungicide applications made when the dollar spot fungus is actively growing in the fall can have a minor effect on dollar spot development the following year, though late fall fungicide applications made when the fungus is presumably dormant will not have a significant impact.

Although excellent results were achieved on golf course putting greens in our research, the small acreage and high value of golf course putting greens give superintendents little incentive to reduce fungicide applications on their putting surfaces.

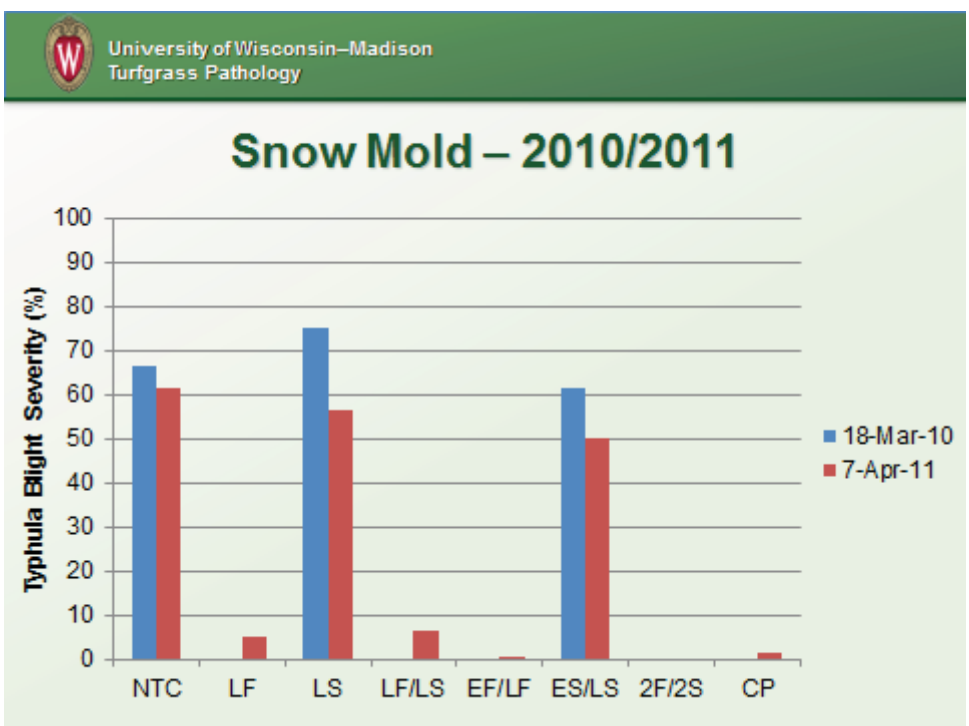

Figure 3: Typhula blight severity (%) on fairway plots at the OJ Noer Turfgrass Research Facility in Madison, WI following the winters of 2009-2010 and 2010-2011. NTC – Nontreated control; LF – Late Fall; LS – Late Spring; LF/LS – Late Fall + Late Spring; EF/LF – Early Fall + Late Fall; ES/LS – Early Spring + Late Spring; 2F/2S – 2 Fall + 2 Spring; CP – Conventional Program.

Fairways, however, encompass a much larger area of the golf course and elimination of even one fungicide application would result in significant financial savings. Spraying large acreages of fairways can also be time consuming, and the reduction of one or two fungicide applications in the summer months may free up valuable labor for other pressing golf course needs and reduce the fuel costs required to power the application equipment. With the large acreages fairways encompass, reducing pesticide applications to golf course fairways by one or two per year would also result in a significant reduction in pesticide exposure to the environment.

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CONCLUSION

The results presented here show that fall and spring fungicide applications can have a significant effect on the development of the primary diseases affecting golf course turfgrass in the Great Lakes region of the United States. The non-conventional timing that provided the greatest disease reduction with the fewest pesticide applications was the LF/LS timing. This treatment provided effective control of snow mold from the LF application while also significantly delaying the dollar spot epidemic as a result of the LS application. While EF and ES timings did appear to reduce or delay dollar spot incidence, the degree of additional control was minor and didn't appear to warrant the extra application. However, if fungicide applications are to be made during the EF and LF time frames, it is a good idea to apply a fungicide or mixture of fungicides that is efficacious against dollar spot.

In addition, reduced rates of fungicides may be able to be used once conventional applications resume in mid-summer because of the reduced dollar spot inoculum level and warrants further investigation. Along with the inclusion of proper cultural practices associated with integrated pest management, significant reductions in pesticide usage on large acreages of golf course turfgrass in the Great Lakes region of the United States can be achieved immediately without conversion to disease-resistant turfgrasses or sacrificing turfgrass quality. These reductions have both financial and environmental benefits that can aid superintendents in times of financial distress and lessen the environmental impact of golf course management.

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