Early Season Control of Dollar Spot on Wisconsin Fairways

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Last month at the American Phytopathological Society meetings in Minneapolis, MN, I had the pleasure to play a round of golf with several turfgrass pathologists from around the country. Since my foursome, with the notable exception of Dr. Kerns, hacked the ball all over the course we got to see nearly every shot from every angle as if we were preparing for a major championship (though I doubt Tiger practices shots 50 yards off the tee box). Large fairways were a common theme on this course but one hole in particular had a massive fairway that stretched several hundred yards from side to side and served as a double fairway for the next hole coming back the opposite direction. While visually dramatic, I couldn't stop thinking about how long it takes to mow that fairway or how expensive it must be to control disease on that fairway.

Which brings us to a problem seen at most golf courses these days; the increasing demands for high quality fairway turf in an era of flat or declining budgets. Its one thing to maintain two acres of putting green turf to near perfection, but it's another thing entirely to maintain 15 to 25 acres of fairway turf to near perfection. The number one blemish on most high quality Wisconsin fairways in a given summer will be dollar spot (*Sclerotinia homoeocarpa*), which to completely control requires six to ten fungicide applications spaced 14 to 21 days apart beginning in June. Depending on the products used the annual cost of these applications will run in the tens of thousands of dollars, money most courses don't really have these days.

So how can we reduce our fairway dollar spot applications and still maintain high quality turf? As more of the basic biology of the dollar spot pathogen is discovered we should continue to reduce our reliance on fungicides, but in the interim the timing of our fungicide applications can have significant impact on the development of the pathogen. Unpublished research out of Michigan State University in the 1990's suggested that applying fungicides targeting dollar spot in the spring would delay the onset of dollar spot symptoms in the summer. This has been supported in published fungicide trials in Illinois, Connecticut, and Maryland within the past five years (McDonald and Dernoeden, 2006; Kaminski and Putman, 2007; Settle *et al*, 2007).

Rather than simply look at the effective length of different fungicides, Dr. John Stier, Dr. Jim Kerns, and myself wanted to look more broadly at the efficacy of different chemical classes for early-season dollar spot control. Specifically, the objectives of our study were to i) determine the type of fungicide most effective at delaying the onset of dollar spot symptoms ii) evaluate and compare efficacy of single fungicide applications to tank-mixes in an early-season dollar spot control program and iii) determine the approximate length of control and possible fungicide savings obtained with an early season application.

MATERIALS AND METHODS

The study was conducted at Milwaukee Country Club in River Hills, WI on a mature 'Penncross' creeping bentgrass (*Agrostis stolonifera* L.) fairway maintained at 0.5 inches. Experimental units measured three by five feet and were arranged in a randomized complete block design with four replications. Treatments were applied using a CO_2 - pressurized boom sprayer at 40 psi equipped with two XR Teejet 8004 VS nozzles. All fungicides were agitated by shaking and

Table 1. Fungicides and fungicide mixtures applied at Milwaukee CC in Milwaukee, WI on 3 May 2006 and 2 May 2007 for early season and conventional control of *Sclerotinia homoeocarpa* F. T. Bennett.

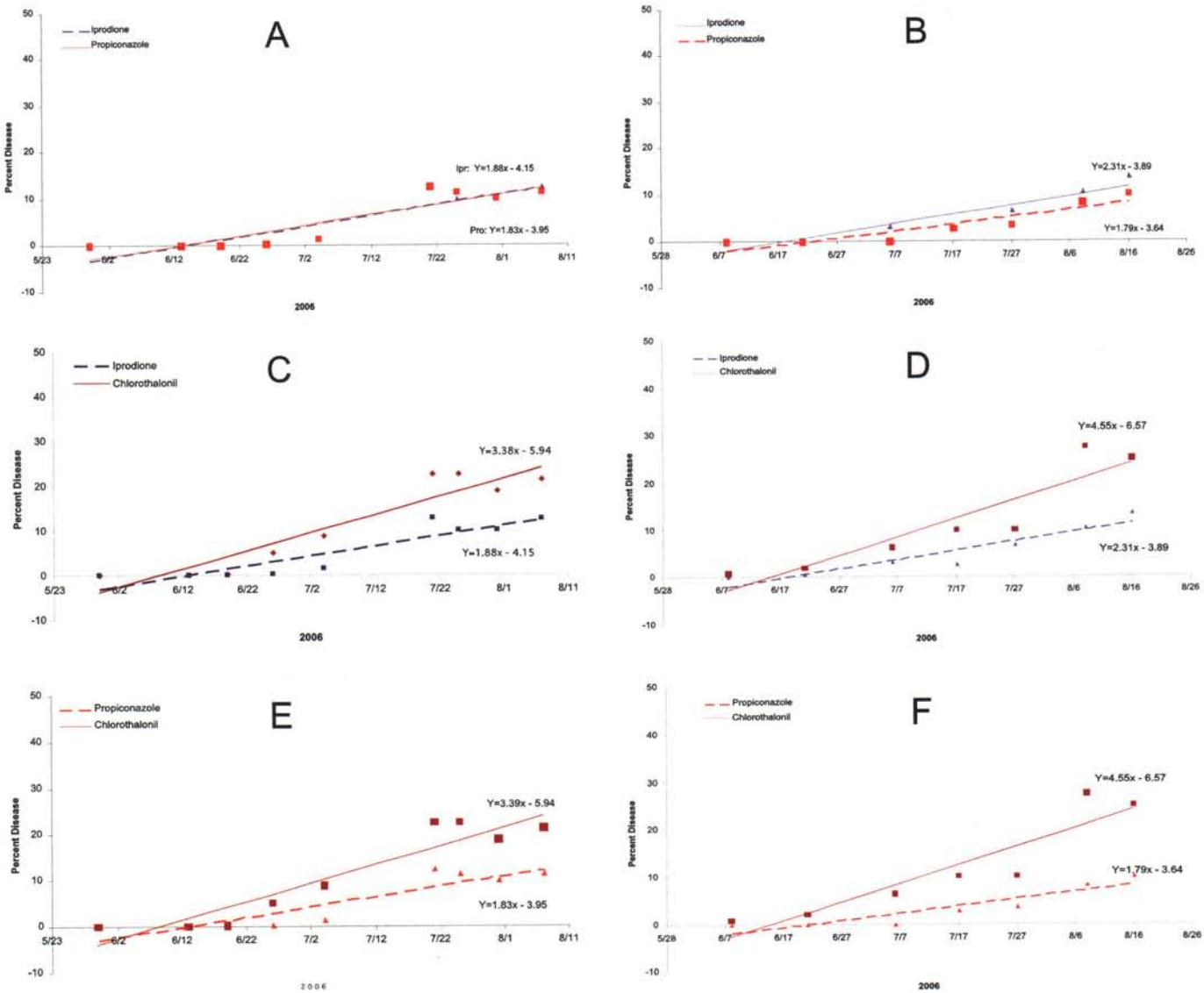
Fungicide	Brand Name	Rate[a]	Program
Propiconazole	Banner MAXX	1	Early-season[b]
Iprodione	Chipco 26GT	3.1	Early-season[b]
Chlorothalonil	Daconil Ultrex	12.6	Early-season[b]
Boscalid	Emerald	0.4	Early-season[b]
Propiconazole Iprodione	Banner MAXX Chipco 26GT	1 3.1	Early-season[b]
Propiconazole Chlorothalonil	Banner MAXX Daconil Ultrex	1 12.6	Early-season[b]
Propiconazole Chlorothalonil	Banner MAXX Daconil Ultrex	0.5 6.3	Conventional[c]

[a]calculated as kg active ingredient per ha
[b]applied once
[c]applied every 21 d beginning 31 May 2007

applied in the equivalent of 2 gallons of water per 1000 ft^2.

Propiconazole, iprodione, chlorothalonil, boscalid, and tank mixes of propiconazole with iprodione and propiconazole with chlorothalonil were all applied once on 3 May 2006 at an approximate growing degree day 50 (GDD 50) rating of 140 (Table 1). Growing degree days for each day were calculated by averaging the high and low temperature for each day and subtracting the mean from 50. Official high and low temperatures were measured by the National Weather Service at Milwaukee's Mitchell International Airport approximately 20 miles south of Milwaukee CC (www.nws.noaa.gov). Propiconazole was applied as Banner MAXX® at the label rate of 2 fl oz per 1000 ft^2. Iprodione was applied as Chipco 26GT® at the label rate of 4 fl oz per 1000 ft^2. Chlorothalonil was applied as Daconil Ultrex® at the label rate of 5 oz per 1000 ft^2. Boscalid was applied as Emerald® at the label rate of 0.18 oz per 1000 ft^2. The tank mix of propiconazole and iprodione was applied at the label rate of 2 and 4 fl oz per 1000 ft^2, respectively. The tank mix of propiconazole and chlorothalonil was applied at the label rate of 2 fl oz and 5 oz per 1000 ft^2, respectively. Untreated plots were used as negative controls to determine the ini-

Fig. 1a. Linear regressions of dollar spot development on creeping bentgrass fairway turf treated with different types of fungicides several weeks before annual symptom development in Milwaukee, WI. A. iprodione vs propiconazole 2006; B. iprodione vs propiconazole 2007; C. iprodione vs chlorothalonil 2006; D. iprodione vs chlorothalonil 2007; E. propiconazole vs chlorothalonil 2006; F. propiconazole vs chlorothalonil 2007.



tial appearance of dollar spot and provide information on the degree of dollar spot symptoms during the growing season. The entire experiment was repeated in 2007 and the same treatments were applied once on 2 May 2007 at an approximate GDD of 140. A conventional dollar spot program of propiconazole at 1 fl oz per 1000 ft^2 tank mixed with chlorothalonil at 2.5 oz per 1000 ft^2 was included as a positive control in 2007 and applied first on 31 May when symptoms were first observed and reapplied every 21 d until 2 Aug.

Disease severity (0-100%) was visually estimated for each treatment by the golf course superintendent and his staff at weekly intervals until early August when all fungicides no longer provided adequate control (>10% diseased turfgrass). Regression analysis and comparison of regression lines for each treatment was performed using Statistix (Statistix 8.0, 2003, Analytical Software, Tallahassee, FL). Analyses compared the regression line slopes of each treatment to determine differences in disease development as a function of time. Elevation differences between regression lines were compared to determine differences in the amount of disease control between fungicides and/or untreated turf. Significant differences among years were present, thus data from 2006 and 2007 were analyzed separately. All 32 data points (eight rating dates and four replications) in 2006 and 28 data points (seven rating dates and 4 replications) in 2007 were used to calculate the regression for each treatment. Each treatment's mean disease severity rating was calculated and used to create regression graphs.

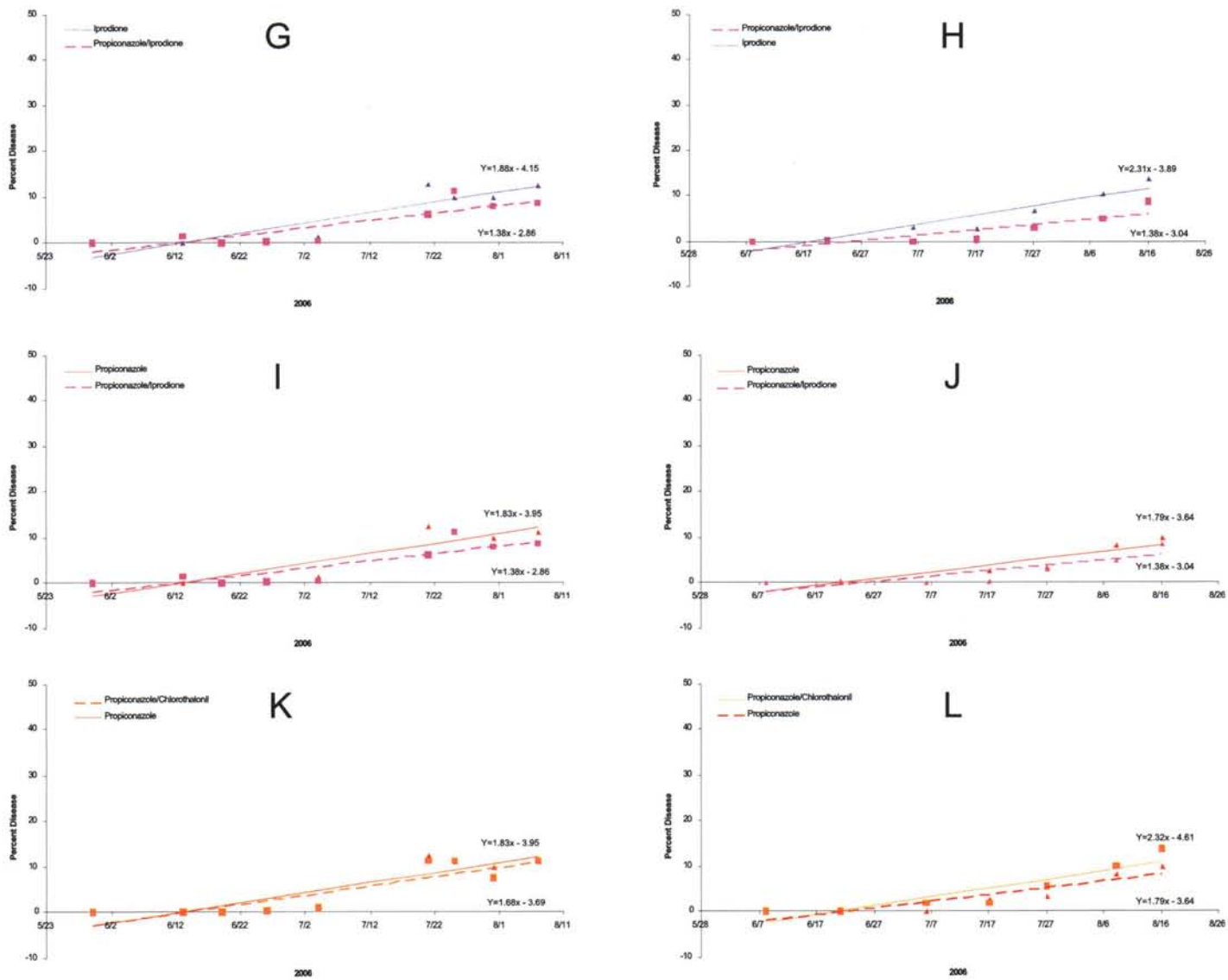


Fig. 1b. G. iprodione vs propiconazole/iprodione 2006; H. iprodione vs propiconazole/iprodione 2007; I. propiconazole vs propiconazole/iprodione 2006; J. propiconazole vs propiconazole/iprodione 2007; K. propiconazole vs propiconazole/chlorothalonil 2006; L. propiconazole vs propiconazole/chlorothalonil 2007. Fungicides were applied at label rates on 3 May 2006 and 2 May 2007 at 140 growing degree days.

RESULTS AND DISCUSION

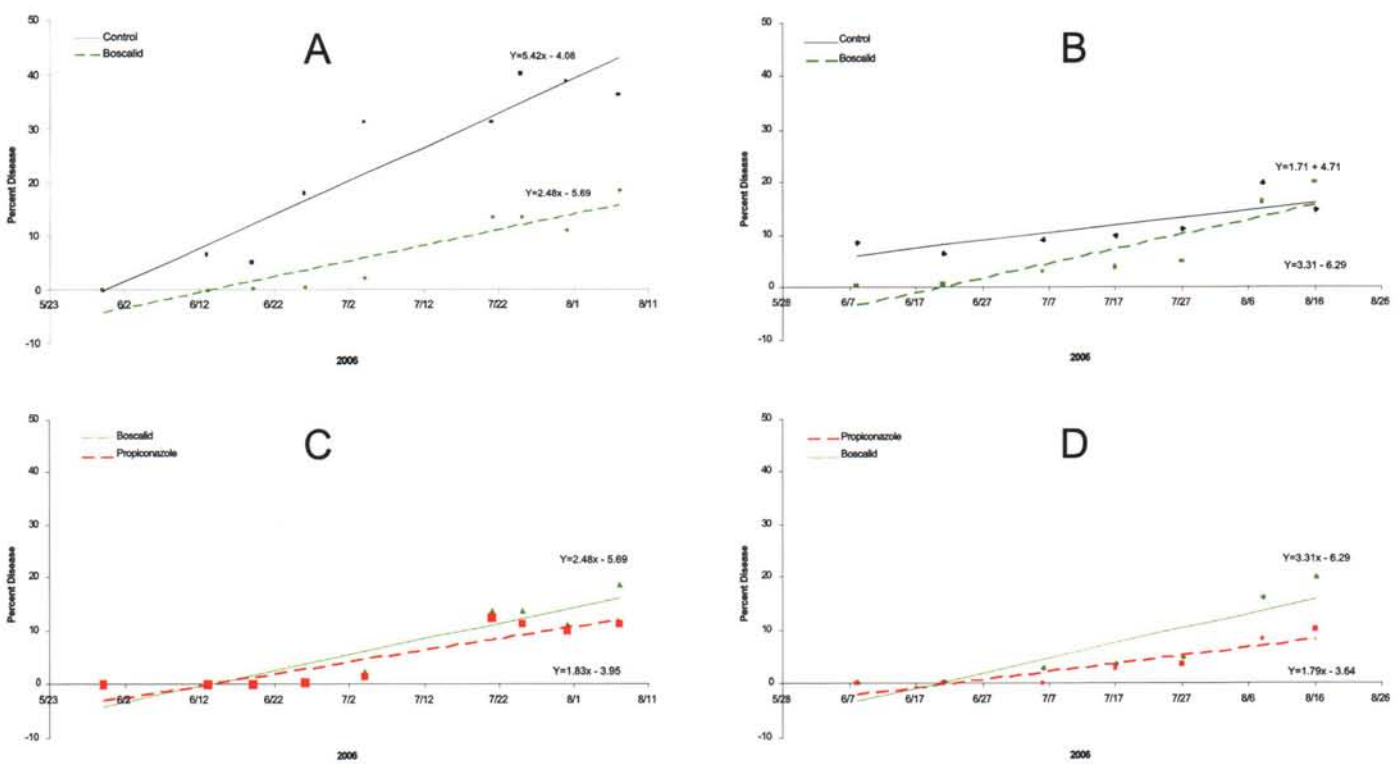
Dollar spot severity in the untreated controls (UTC) plots reached 40% by August 2006 but only 20% by August 2007, likely due to drier conditions in 2007. Dollar spot severity also progressed faster in 2006 than 2007. The amount of disease in the treated plots was fairly consistent across years, with maximum severity usually affecting approximately 10% of the turf area.

With the exception of chlorothalonil in 2007, all treatments significantly reduced disease severity compared with the UTC in both 2006 and 2007. While the UTC began to exhibit dollar spot symptoms in early June, chlorothalonil delayed symptom development until early July in 2006 and mid-June in 2007. Iprodione and propiconazole delayed symptom development in both years until early July. Iprodione and propiconazole applied together and propiconazole and chlorothalonil applied together also delayed symptom development until early July in both years. The delay of dollar spot symptom development led to reduced levels of percent dollar spot compared to the UTC throughout the season in all treatments except for chlorothalonil in 2007.

Though the level of dollar spot control in August with all treatments was unacceptable, the reduction in the treatment plots compared to the UTC was a full three months after the initial application. While labels for both propiconazole and iprodione state the maximum length of control from these products is 28 days, preventative applications prior to disease onset kept disease severity at or below 5% for at least five weeks. The nature of *S. homoeocarpa's* infection process through mycelial contact with surrounding tissue results in a linear increase in disease progression (Walsh *et al.*, 1999). Consequently we would expect that a reduction of initial *S. homoeocarpa* inoculum resulting from early season fungicide applications would decrease the rate of disease progression as well as the overall amount of disease development when compared to untreated areas.

Using a penetrant fungicide was more effective at delaying dollar spot symptoms than a contact fungicide in both 2006 and 2007 (Fig. 1). Chlorothalonil was less effective than both iprodione and propiconazole at limiting dollar spot symptom development, which was expected due to the persistence in the plant of both these penetrant fungicides. There was no significant difference in dollar spot control between iprodione and propiconazole in 2006. Propiconazole and iprodione applied as a combination was more effective at delaying dollar spot development compared to iprodione in 2007 but not 2006 and in neither year compared to propiconazole. No differences were observed between treatments of propi-

Fig. 2. Linear regressions comparing boscalid and propiconazole, both acropetal systemic fungicides, on the rate of dollar spot severity in creeping bentgrass fairway turf in Milwaukee, WI. A. control vs boscalid 2006; B. control vs boscalid 2007; C. propiconazole vs boscalid 2006; D. propiconazole vs boscalid 2007. Fungicides were applied at label rates on 3 May 2006 and 2 May 2007 at 140 growing degree days.



conazole and the propiconazole/chlorothalonil combination (Fig. 1a & 1b).

Boscalid has been recommended for use in early season dollar spot applications in previous studies (Settle *et al.*, 2007). Boscalid significantly delayed the onset of dollar spot symptoms compared with the untreated control in both 2006 and 2007 (Fig. 2). Boscalid and propiconazole were equally effective at controlling dollar spot in 2006, but propiconazole was more effective at controlling dollar spot than boscalid in 2007 (Fig. 2). Boscalid, a relatively new active ingredient for the turfgrass market, has shown ability to control dollar spot populations with documented resistance to demethylation inhibitor fungicides such as propiconazole (Burpee *et al.*, 2006). Boscalid is considered to have a single-site mode of action, though, making the development of resistance by *S. homoeocarpa* in the face of repeated applications likely according to the Fungicide Resistance Action Committee website (www.frac.info). If propiconazole-resistant *S. homoeocarpa* has been documented or is suspected at a particular site, boscalid may provide more effective control of dollar spot for at least a period of time.

The conventional 21-day dollar spot fungicide program treatment initiated in 2007 provided nearly complete control of dollar spot throughout the entire growing season. The conventional program provided significant reductions in overall dollar spot symptom development when compared to the untreated control as well as the early season iprodione, propiconazole, and chlorothalonil treatments. Early season applications of iprodione, propiconazole, and chlorothalonil maintained similar levels of dollar spot suppression to that of the 21 d conventional program until 7 July for iprodione and chlorothalonil and 17 July for propiconazole.

An informal survey of eight Wisconsin golf course superintendents in 2007 revealed that most facilities can tolerate up to 5% dollar spot severity on their fairways before initiating a chemical control program (Koch, *unpublished data*). Using 5% disease severity as a threshold, the early-season use of systemic fungicides on golf course fairways can delay the initiation of a conventional dollar spot control program until mid-July. In our research a conventional fungicide program was defined as applications of propiconazole and chlorothalonil every 21 days, though in reality a traditional program can include a number of different fungicides applied at rates ranging from 14 to 28 days. Most Wisconsin golf course superintendents begin their dollar spot control programs in early June and an early season treatment could be expected to eliminate one or two annual fungicide applications without a significant reduction in turfgrass quality. A reduction of one

propiconazole and chlorothalonil combination applied at half rates to 34 acres of fairway would save one local superintendent $6,700, money that can be shifted to areas of course maintenance lacking attention (Koch, *personal communication*).

CONCLUSION

Our study showed significant delays in dollar spot symptom development compared to the untreated controls with all early season fungicide treatments. Penetrant fungicides like iprodione and propiconazole delayed symptom onset more than the contact fungicide chlorothalonil. Fungicide combinations were no more effective at controlling dollar spot than single active ingredients. Our research has shown that early season applications of fungicides targeting dollar spot well before symptom onset can effectively delay the onset of symptoms for several weeks and potentially eliminate one or two annual fungicide applications. Future research will be conducted by the University of Wisconsin to explore the optimal timing of an early-season fungicide application by refining existing growing degree day models, the amount of any fungicide reductions over a wider geographic range, and the possible cost savings obtained by using an early-season dollar spot control program.

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