FUNGICIDE USE ON DMI-RESISTANT DOLLAR SPOT

David Gilstrap[1], Joe Vargas, Jr[2], Oliver Schabenberger[1], and Rob Golembiewski[3]
[1]Crop and Soil Sciences, Michigan State University
[2]Botany and Plant Pathology, Michigan State University
[3]Horticulture and Crop Science, Montana State University

Damaging outbreaks of dollar spot can occur often on golf courses where turf quality is of utmost importance. Superintendents are now challenged by the fact that the causal organism, *Sclerotinia homoeocarpa*, has become resistant to three classes of systemic fungicides (4). Fungicide-resistant pathogens can completely or partially overcome the effects of single or repeated exposures to that particular or similar chemicals, which nearly always have systemic modes of action. A pathogen is cross-resistant when it is also resistant to the other fungicides within the same mode-of-action classification. In 1995, Michigan State University pathologists documented this phenomenon with one of the newest class of systemic fungicides, the demethylation inhibitors (DMIs)(3). This resistance is not total and complete as with the benzimidizoles, but results in reduced lengths of control as compared to the DMI label recommendations for application intervals, which can be as long as 28 days.

One site that has DMI-resistant dollar spot is Lochmoor Country Club in Grosse Point, Michigan, and from 1991 to 1996 it was the site of an extensive fungicide-research trial. The experiment was conducted on a mixture of creeping bentgrass (*Agrostis stolonifera* var. *Stolonifera* L.) and annual bluegrass (*Poa annua* L.) and was located on the fifteenth fairway. It was mowed two to three times weekly at one-half inch with clippings removed. The experiment was a randomized complete block design with three blocks. Each plot was 6 ft by 6 ft. The study included a variety of fungicides applied alone, in alternation with one another, and in different combinations (Table 1). A wide range of rates at various application intervals was evaluated. Our experimental objective was to identify fungicide strategies that were effective in managing dollar spot where DMI-resistant strains dominate the *S. homoeocarpa* populations. The findings have been published previously (2).

Samples were collected from the plot area prior to initial treatments and it was determined that the dollar spot pathogen population was resistant to DMIs. Just before and following each year's treatments we collected ten or less isolates from each plot. Each sample was isolated into pure culture and then grown on media with 0 and 2 µg/ml triadimefon. Relative-growth measurements were taken and modeled using a univariate repeated-measures analysis. The slopes associated with the estimated linear trends for each treatment showed the greatest increase in pathogen resistance occurred with DMIs alone followed in order by DMIs combined with non DMIs, a contact fungicide, and DMIs alternated with non-DMIs (Figure 1). The trends for a dicarboximide and an untreated control were not significant (Table 2).

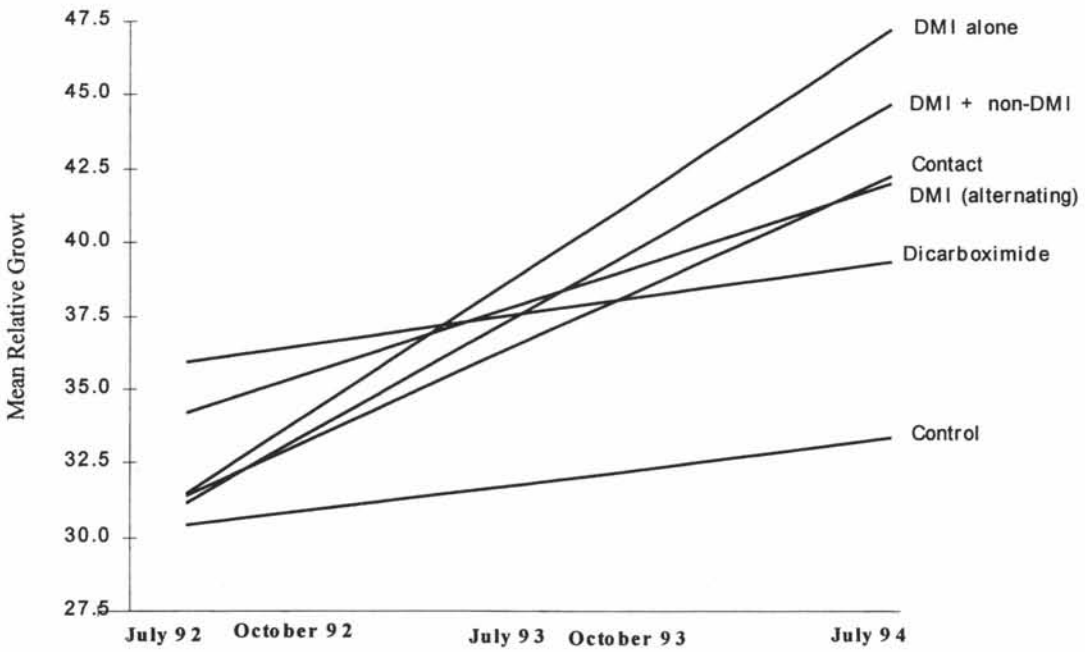
Fungicide resistance to DMIs continues to increase with additional applications of them. On the basis of the slopes generated by our model, resistance appeared to increase at the greatest rate when a DMI was used alone, followed in order by a DMI used with a non DMI and a DMI alternated with a non DMI. In other words, alternating a DMI with a non-DMI, specifically Daconil or Chipco, did not stop the increase in DMI resistance. Alternating did slow it down more than tank-mixing. The continued sole use of DMIs resulted in the greatest DMI resistance. DMI-fungicide resistance may not have increased when dicarboximides were used alone, but this practice has its own resistance problems (1). On the basis of this study, applying a contact fungicide only or discriminately with a dicarboximide appears to be the best strategy for managing DMI-resistant dollar spot.

Table 1. Treatments with fungicides, products, rates, and intervals.

Tmt No	Tmt name	Fungicide	Product	Rate / 1000 ft^2	Interval (days)
1	DMI alone	triadimefon -	Bayleton	1 oz	21
1	DMI alone	fenarimol	Rubigan	1.75 fl oz	21
1	DMI alone	propiconazole	Banner	1 fl oz	21
2	dicarboximide	iprodione	Chipco	2 oz.	21
3	contact	chlorothalonil	Daconil	6 fl. oz.	10
4	DMI + non-DMI	triadimefon + iprodione	Bayleton + Chipco	1 oz + 2 oz	21
4	DMI + non-DMI	triadimefon + chlorothalonil	Bayleton + Daconil	1 oz + 6 fl.oz.	21
5	DMI alt[a] non-DMI	triadimefon alt iprodione	Bayleton alt Chipco	1 oz alt 2 oz	21
5	DMI alt non-DMI	triadimefon alt chlorothalonil	Bayleton alt Daconil	1 oz alt 6 fl oz	21 alt 10
6 Control	Untreated	ñ	ñ	ñ	

[a]Alternating

Figure 1. Estimated linear trends by treatment.



Treatment	Slope estimate	P-value
DMI alone	0.64538	0.0001
Dicarboximide	0.140034	0.2792
Contact	0.446618	0.0007
DMI + non DMI	0.554969	0.0001
DMI alt non DMI	0.32051	0.0006
Control	0.1206	0.3509

The small size of the plots and the fact that there were no buffer strips between plots confounded this experiment. Migration of mycelia from DMI-treated plots into non-DMI-treated plots occurred as evidenced by the fact that the slope of the contact treatment also was upward and significant, even though clippings were removed during mowing. Beyond 1994, this confounded situation yielded insignificant data, and the experiment was halted after 1996.

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