The Effect of Snow Cover and Anti-Transpirants on the Persistence of Snow Mould Fungicides

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Introduction

Snow moulds (Typhula blight and Microdochium patch) are among the most damaging diseases that turfgrass managers in Canada and many temperate climates manage on an annual basis. Preventing snow mould damage typically requires fungicide applications in the late fall that cost thousands of dollars. However, snow mould damage can still occur even when fungicides are applied, and this damage can cost golf facilities thousands of additional dollars in repair and lost revenue. While disease development on turf that has been treated the previous fall can occur for various reasons, one primary reason is likely due to premature degradation of snow mould fungicides. Recent research has shown that contact (chlorothalonil) and localized penetrant (iprodione) fungicides rapidly degrade following winter rainfall or snowmelt events and in response to temperatures exceeding 10°C. These degradation events leave the turf susceptible to snow mould development. However, it remains unclear how other fungicide classes that are fully absorbed into the plant persist on turf in extreme winter environments. In addition, the use of anti-transpirant products like Transfilm® are also common in many winter climates to protect the turf from desiccation. These chemicals have also been touted to prolong fungicide persistence and improve snow mould control, however no scientific data exists to back up these claims. The two objectives of this research are 1) to determine the rate of degradation of the fungicides chlorothalonil and propiconazole applied alone or as a mixture with an anti-transpirant under constant snow cover and in the complete absence of snow, and 2) to correlate the fungicide concentrations on the leaf blades sampled from the field with the level of disease symptoms present on creeping bentgrass plants inoculated with snow mould fungi incubated in a growth chamber.

Methods and Materials

2015-2016

Field trials were initiated during the winter of 2015-2016 at the OJ Noer Turfgrass Research and Education Facility in Madison, WI on a 'Penncross' creeping bentgrass plot maintained at fairway height. The experimental design is a split-plot, randomized complete block design with four replications and individual plots measuring 1.8 m by 1.8 m. The main plot is the presence or absence of snow and the split plot is the four fungicide treatments and the non-treated control.

The four fungicide treatments are a singular application of chlorothalonil, a singular application of propiconazole, and each fungicide mixed with an anti-transpirant. Chlorothalonil was applied as Daconil Ultrex® at the rate of 303 g/1000 m^2, propiconazole was applied as Banner MAXX® at the rate of 206 ml/100 m^2, and the anti-transpirant was applied as Transfilm® in a 5% concentration (v/v). All treatments were applied on November 20th, 2015, 24 hours before 12 cm of snow fell on the plots. One hour following the fungicide applications, one 10 cm diameter plug from each treatment plot was harvested and transported to the lab for fungicide residue analysis and a second plug was transported to a controlled environment chamber for disease inoculation and incubation. New plugs were sampled every 2 weeks throughout the winter until the final sampling on January 27th, 2016. Snow was removed from 'No Snow' treatments and placed on 'Snow' treatments within 24 hours of snow falling. Visual ratings of percent Microdochium patch and Typhula blight were taken following snowmelt in the spring. Concentrations of both propiconazole and chlorothalonil from the leaf blades of sampled plugs were determined using liquid chromatography/mass spectrometry (LC/MS) in the lab of Dr. Christy Remucal on the University of Wisconsin – Madison campus.

Samples collected from each plot that were designated for the controlled environment chamber were placed in a chamber with relative humidity greater than 95% and temperatures maintained between 5 and 10°C. Each plug was inoculated with an isolate of *Microdochium nivale* and incubated for 28 days. Disease severity on each plug was assessed by calculating the area of the diseased tissue and dividing by the area of the 10 cm diameter plug.

2016-2017

The 2016-2017 study was initiated on December 5th, 2016 and snowfall was placed on the snow-covered plots within 24 hours of the fungicide application. Significant snowfalls of 10 cm or more occurred 3 straight weekends in December. However, the weather pattern changed significantly in January with very warm conditions and multiple rain events occurring. The warm and wet January weather resulted in rapid declines in propiconazole concentration on both snow and no snow treatments (Figure 1) and subsequent increases in Microdochium patch severity on both snow and no snow treatments (Figure 2). Inclusion of Transfilm® did not alter the rate of decrease in propiconazole concentrations or the rate of increase in disease severity (Figure 1, 2).

Plots treated with chlorothalonil also saw rapid increases in disease severity in the controlled environment chamber, with no impact of snow cover or the inclusion of Transfilm® (Figure 3). Chlorothalonil analysis is difficult using LC/MS because of the difficulty to ionize the molecule, and as of this writing the analysis method had not yet been perfected. However, once the method has been completed the samples collected during both 2015-2016 and 2016-2017 will be analyzed immediately.

There was no disease observed in the field plots, indicating that field conditions were not conducive for snow mould development.

2017-2018

The 2017-2018 study was initiated on December 8th, 2017, though the forecasted snow that was to arrive that night only resulted in approximately 2 cm of snow. Minimal amounts of snow fell on the experimental plot in the first several weeks after application, and the plots were mostly clear of snow throughout December. Snow fell on the plots in late December and early January and was promptly removed from the non-snow plots after each snowfall, but a prolonged warm spell began on January 9th and lasted for approximately 5 days. This melted the snow, and a large rain event (2.5 cm) occurred on January 22nd and the final sampling was collected on Fenruary 1st.

Two cores were taken from each plot every two weeks between December 8th and February 1st (5 sampling dates). The propiconazole results showed that there was a large drop in concentration on all samples in the first two weeks after the application, which is mostly likely the result of normal weather processes that occur after fungicides have been applied to turfgrass (Figure 1). The concentrations then stayed nearly equal for the next two (snow-covered) or four (non-snow) weeks until concentrations rapidly declined to below detectable levels. The growth chamber for both propiconazole and chlorothalonil provided similar results, with an increase in disease over the first two weeks, followed by no further increase over the next 2 to 4 weeks, followed by rapid increases in disease over the final two weeks.

The method for chlorothalonil detection has been finalized, and the 3-year backlog of samples is currently being processed for analysis in the coming several months.

Fall 2018 Update

The method for chlorothalonil analysis was finalized as stated earlier but the LC-MS machine need significant repairs over the summer, which took approximately one month to repair. Now that the repairs have been made we will resume analyzing the chlorothalonil-treated samples.

Spring 2018 Update

The chlorothalonil method was finalized last fall and the LC-MS machine was repaired and ready for use in November of 2018. We have completed chlorothalonil analysis of the samples from 2015-2016 and found they followed an almost identical pattern to propiconaozle applied in 2015-2016 (Figure 4). The propiconazole results from 2015-2016 are presented in Figure 5 for comparison. There was a rapid drop off in the concentration of both chlorothalonil and propiconazole regardless of snow cover due to extremely warm temperatures and persistent rainfall in the weeks following the application in December of 2015. No difference was observed between snow and non-snow plots and in plots where Transfilm (TF) was added. The remaining chlorothalonil samples from 2016-2017 and 2017-2018 are scheduled for analysis through February and March of 2019.

Figure 1: Propiconazole concentration on creeping bentgrass leaves treated with propiconazole (Banner) and 'Transfilm' anti-transpirant (TF) and harvested from snow and non-snow covered plots at the OJ Noer Turfgrass Research Facility in Madison, WI in 2017-2018.

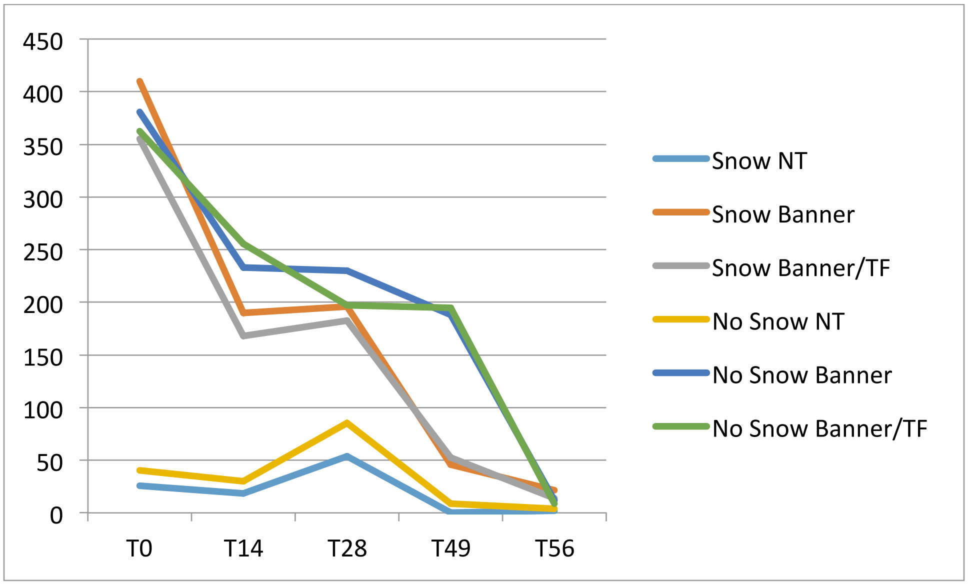

Figure 2: Microdochium patch severity on creeping bentgrass plugs treated with propiconazole (Banner) and an anti-transpirant (TF) and harvested from snow and non-snow covered plots at a controlled environment chamber in Madison, WI in 2017-2018.

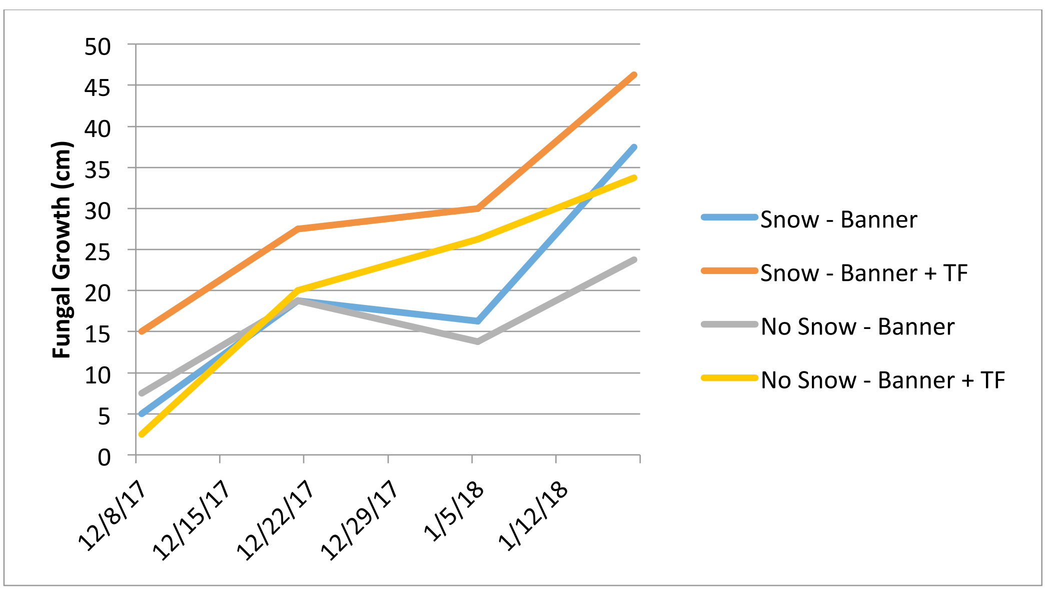

Figure 3: Microdochium patch severity on creeping bentgrass plugs treated with chlorothalonil (Daconil Ultrex) and an anti-transpirant (TF) and harvested from snow and non-snow covered plots at a controlled environment chamber in Madison, WI I 2017-2018.

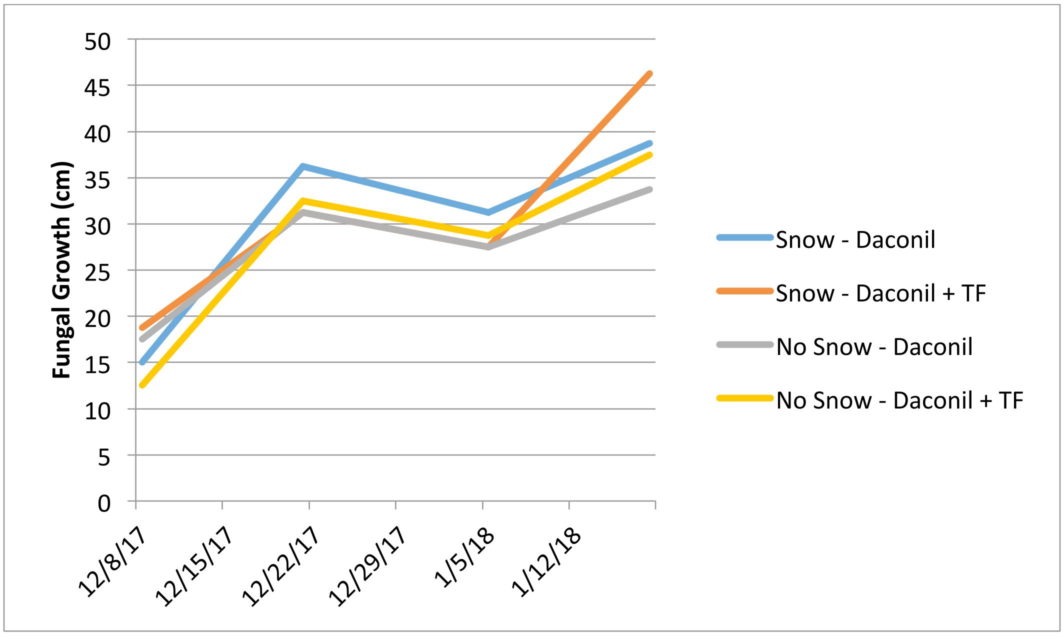

Figure 4: Chlorothalonil concentration on creeping bentgrass leaves treated with chlorothalonil (Daconil) and 'Transfilm' anti-transpirant (TF) and harvested from snow and non-snow covered plots at the OJ Noer Turfgrass Research Facility in Madison, WI in 2015-2016.

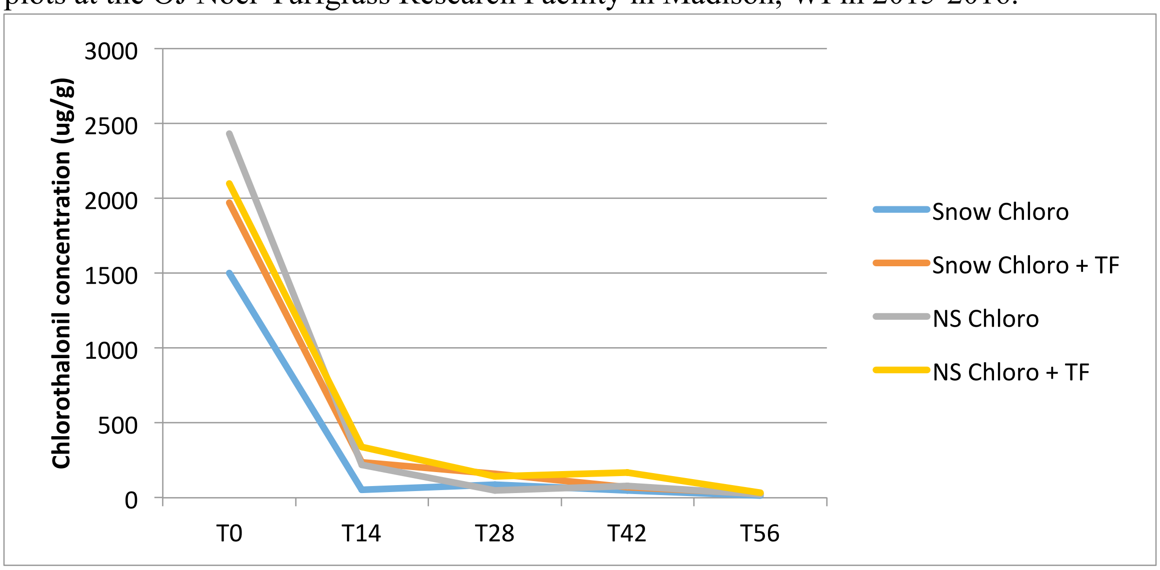

Figure 5: Propiconazole concentration on creeping bentgrass leaves treated with propiconazole (Banner) and an anti-transpirant (TF) and harvested from snow and non-snow covered plots at the OJ Noer Turfgrass Research Facility in Madison, WI in 2015-2016.