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Bentgrass Tolerance, Disease Predictive Models and Fungicide Timing to Control Dollar Spot on Fairway Turf

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Executive Summary Points**:**

- Dollar spot forecasting by a logistic regression model had good accuracy for highly susceptible cultivars during 2015, early-2016, and 2017.
- Moderate to excellent, season-long disease control was achieved when subsequent fungicide timing was based on a threshold program, but total fungicide inputs and the level of disease control depended on the cultivar and, to a lesser extent, the initial fungicide timing.
- Fungicide applications on 'Declaration' creeping bentgrass that were threshold-based produced excellent disease control and resulted in only three and four to five fungicide applications during 2015 and 2017, respectively, depending on the initial fungicide timing.
- In contrast, threshold-based fungicide applications on 'Independence' creeping bentgrass produced moderate disease control and resulted in a total of six or seven applications during 2015 and six to nine applications during 2017, depending on the initial fungicide timing.

This research project is organized into two field trials. The objectives of the first trial include evaluating dollar spot (caused by the fungus *Sclerotinia homoeocarpa* F.T. Bennett) incidence and disease progress on six bentgrasses that vary in tolerance to dollar spot disease; and assessing the reliability of two weather-based models for predicting dollar spot epidemics on those cultivars and species. Six bentgrass cultivars ['Independence', 'Penncross', 'Shark', '007' and 'Declaration' creeping bentgrass (*Agrostis stolonifera*), and 'Capri' colonial bentgrass (*A. capillaris*) (Figure 1)] that vary in tolerance to dollar spot were evaluated for disease incidence every two to five days and compared to a growing degree day (GDD) model for predicting the onset of disease symptoms and a logistic regression model for predicting season-long disease activity.

Results from Trial 1:

The onset of disease symptoms in highly susceptible cultivars occurred at 73-, 27-, and 92-GDD during 2015, 2016, and 2017, respectively; whereas, disease onset occurred at 79-, 140-, and 112-GDD for moderate and low susceptibility cultivars. The logistic regression model reached a 20% risk index (the point at which the model was designed to predict visual symptom expression) at 7-, 7-, and 21-d before disease onset in highly susceptible cultivars during 2015, 2016, and 2017, respectively; whereas, a 20% risk index occurred at 11-, 29- and 28-d before symptoms developed on moderate and low susceptibility cultivars. The logistic regression model accurately forecasted disease progress in susceptible cultivars throughout 2015, early-

2016, and 2017 (Figure 2). Disease progress in moderate and low susceptibility cultivars was less responsive to the risk index; however, periods of disease incidence did occur during high risk. Interestingly, disease recovery often occurred when the risk index declined sharply, albeit greater than 20%.

The objectives of the second trial include evaluating the effect of pre-symptomatic (initial) timing of fungicide application on dollar spot incidence and disease progress on a susceptible and a more tolerant bentgrass cultivar; and determining the extent that pre-symptomatic fungicide application may affect total fungicide usage on each cultivar over a growing season when subsequent fungicide applications were based on either a disease-threshold or a predictive-model. Treatments in this trial were arranged as factorial combinations of bentgrass tolerance to dollar spot, initial fungicide application timing, and subsequent fungicide timing. Declaration (more tolerant) and Independence (susceptible) were the cultivars used for the bentgrass tolerance factor. Eight initial fungicide application timings were evaluated: at the first appearance of disease symptoms (threshold-based; (< 3 infection centers m^{-2}); on May 20 (calendar-based); when the logistic regression model reached a 20% risk index; or at a GDD ranges of 20-30, 30-40, 40-50, 50-60, or 60-70 (base temperature 15 °C [59 °F] starting April 1). Subsequent fungicide timings were based on the logistic regression model, or on a disease threshold, or were withheld completely to assess long-term effects of initial fungicide timings. All possible combinations of initial and subsequent fungicide timings were applied on both cultivars. Fungicide applications used Emerald 70WG (boscalid, BASF) at 0.18 ounce per 1,000 square feet from May 2015 to July 2017, or a tank mix of Curalan (vinclozolin, BASF) and Secure (fluazinam, Syngenta) at 1 ounce and 0.5 fluid ounce per 1,000 square feet, respectively, from Aug 2017 to Nov 2017. Threshold-based plots were monitored as often as daily for dollar spot incidence. The number of applications to threshold- and model-based plots were recorded each year.

Results from Trial 2:

Disease response to treatments was limited during 2016 due to unintended dollar spot suppression from the application of fludioxonil to control anthracnose. Cultivar and subsequent fungicide timing were the most important factors influencing disease progress during 2015 and 2017. Additionally, cultivar interacted with subsequent fungicide timing to influence the level of disease control and total annual fungicide inputs during 2015. Subsequent fungicide applications based on the logistic regression model and disease-threshold produced excellent disease control (< 3 infection centers m^{-2}) on Declaration; whereas, only the logistic-regression model based applications produced excellent disease control on Independence. Three and four to five threshold-based applications were made to Declaration plots during 2015 and 2017, respectively; whereas, six to seven and six to nine threshold-based applications were made to Independence over the same time period(Table 1). Moreover, disease incidence was occasionally unacceptable on Independence plots treated on a threshold-basis.

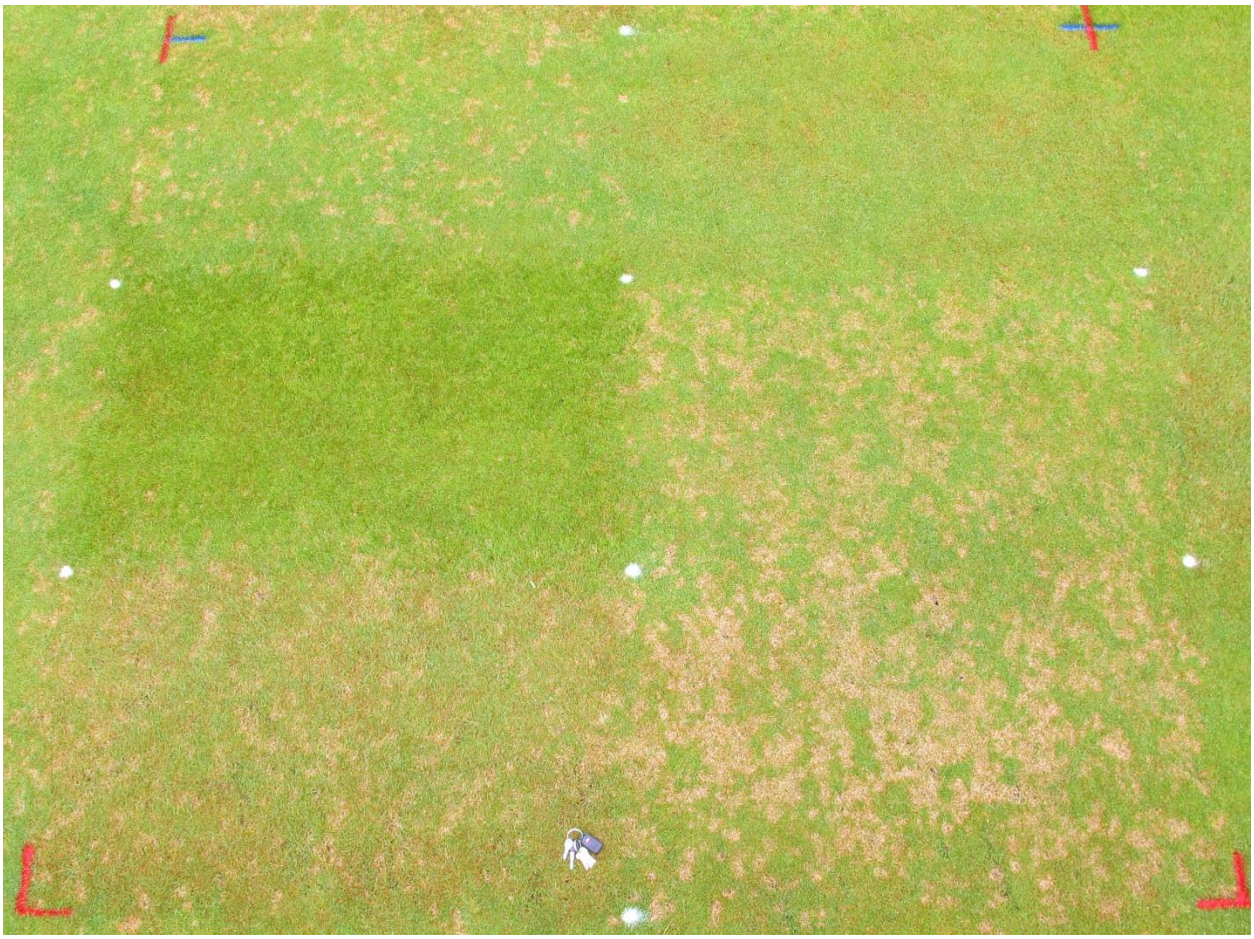

Figure 1. Bentgrass cultivars vary in their tolerance to dollar spot (clockwise from top left): 007, Declaration, Shark, Independence, Penncross and Capri. Photo: J. Hempfling

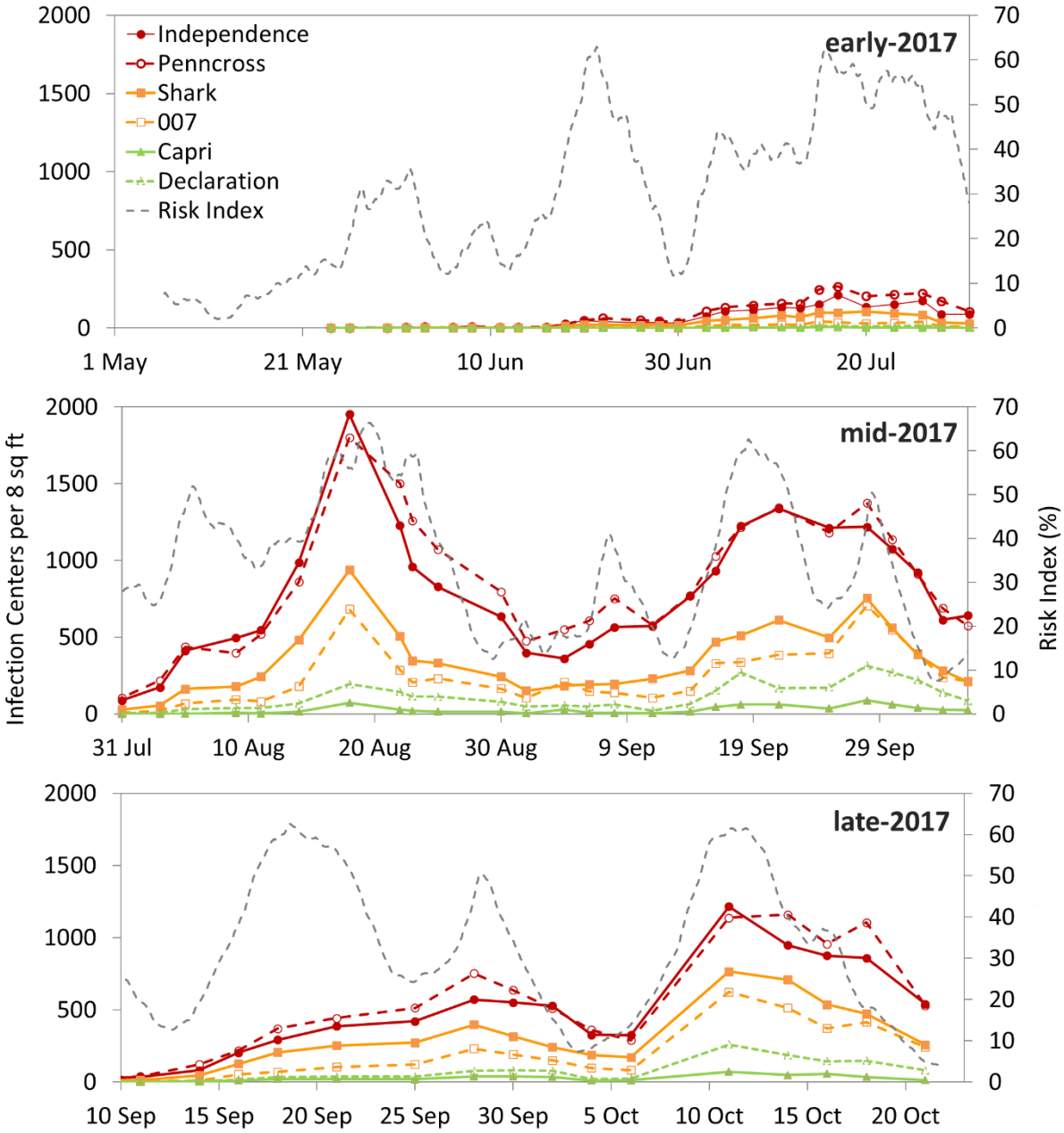

Figure 2. Number of dollar spot infection centers in high susceptibility (red lines), moderate susceptibility (orange lines), and low susceptibility (green lines) bentgrass cultivars and dollar spot risk index (gray dotted line) calculated using a logistic regression model during 2017.

Table 1. Total number of fungicide applications used to control dollar spot based on bentgrass cultivar and subsequent fungicide timings during 2015 and 2017.

	Declaration		Independence	
	2015	2017	2015	2017
	---------- Total Number of Fungicide Applications[†] ----------			
Calendar	9	9	9	9
Logistic	8 to 9	6 to 9	8 to 9	8 to 10
Threshold	3	4 to 5	6 to 7	6 to 9

[†] A range in the total number of fungicide applications indicates that the total number depended on the timing of the initial fungicide application.