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

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- Dollar spot forecasting by a logistic regression model had good accuracy for highly susceptible cultivars during 2015, but over-predicted during 2016.
- Good 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 one fungicide applications during 2015 and 2016, respectively, regardless of the initial fungicide application date.
- In contrast, threshold-based fungicide applications on 'Independence' creeping bentgrass resulted in a total of six or seven applications during 2015 and four or five applications during 2016, 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 existing 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. An accurate prediction of the onset of disease symptoms in highly susceptible cultivars occurred with the GDD model during 2015 but not 2016. A high risk of dollar spot was forecast by the logistic regression model one week before symptoms first appeared in highly susceptible cultivars during both years. Throughout the rest of the growing season, disease forecasting by the logistic regression model had good accuracy for highly susceptible cultivars during 2015, but over-predicted during 2016 (Figures 2 and 3). Disease forecasting on tolerant cultivars has not been accurate with either model in both years of this study.

The objectives of the second trial include evaluating the effect of pre-symptomatic (initial) timings for 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(s) on these cultivars may affect the total fungicide usage over a growing season when subsequent fungicide applications are 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. Initial fungicide application timings occurred (1) at the first appearance of disease symptoms (threshold-based; < 2 infection centers/8 square feet); (2) on May 20 (calendar-based); (3) when the logistic regression model reached a 20% risk index; or (4) at a GDD range of 20-30, 30-40, 40-50, 50-60, or 60-70 (base temperature15 C [60 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 and all fungicide applications used Emerald 70WG (boscalid, BASF) at 0.18 ounce/1,000 square feet. 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.

The initial fungicide application factor had minimal impact on long-term (May through November) control of dollar spot during 2015. Conversely, the factors of subsequent fungicide timing and bentgrass cultivar had a much greater impact on disease control. Excellent (< 1 infection center/8 square feet) long-term control of dollar spot was achieved for both cultivars when subsequent fungicide timing was based on either the logistic regression model or the calendar-based program. The logistic regression model reduced fungicide inputs by zero or one application during 2015 and one or two applications during 2016, depending on the initial fungicide timing, compared to the calendar-based program (nine applications) (Table 1). Good to excellent, long-term disease control was also achieved when subsequent fungicide timing was based on a threshold program, but the total fungicide input and the level of disease control depended on the cultivar and, to a lesser extent, the initial fungicide timing. Subsequent fungicide applications on Declaration plots that were threshold-based produced excellent disease control and resulted in only three and one fungicide applications during 2015 and 2016, respectively, regardless of the initial fungicide application date. In contrast, the threshold schedule for subsequent applications on Independence plots resulted in a total of six or seven applications during 2015 and four or five applications during 2016, depending on the initial fungicide timing (Table 1). Moreover, disease incidence occasionally surpassed the target threshold value on Independence plots and reached levels (up to 2.5 infection centers per 8 square feet) during the growing season that may not be acceptable at some golf courses (Figure 4). This research will be continued during 2017.

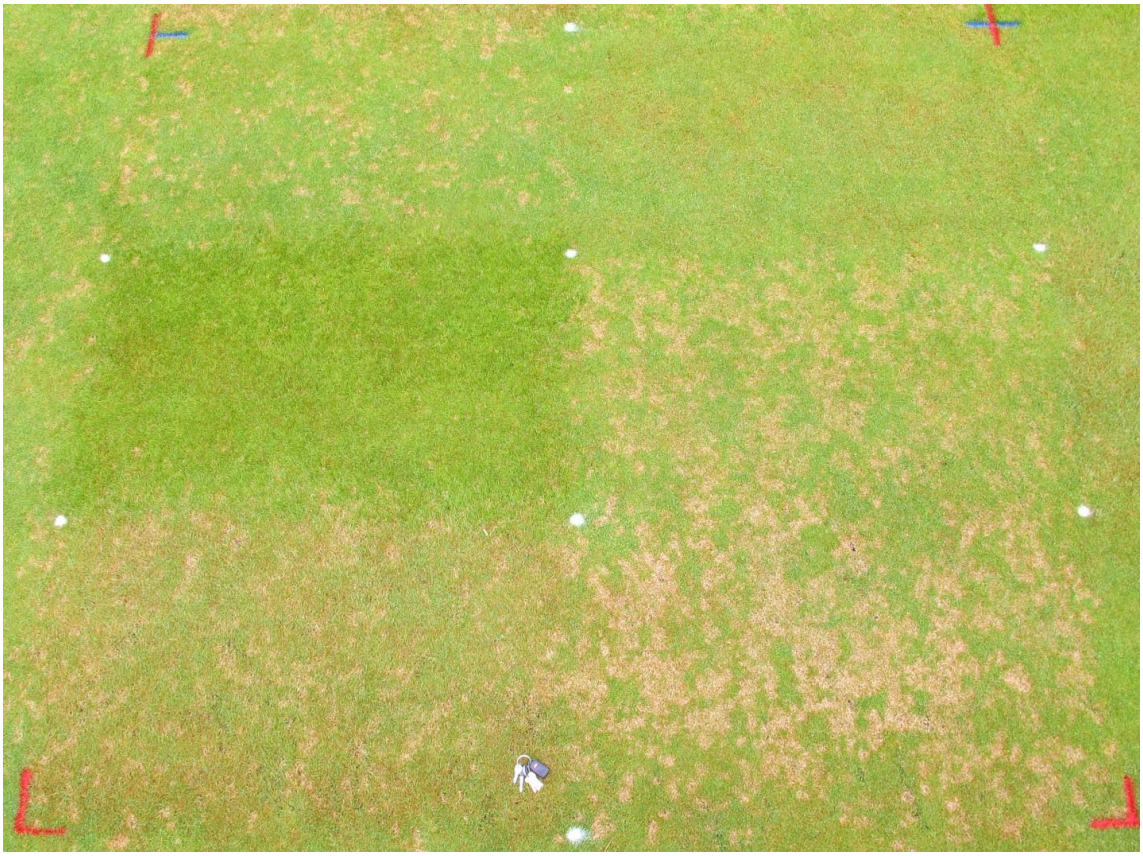

Figure 1. Bentgrass cultivars vary in their tolerance to dollar spot (clockwise from top left): 007, Declaration, Shark, Independence, Penncross and Capri. Photo by J. Hempfling

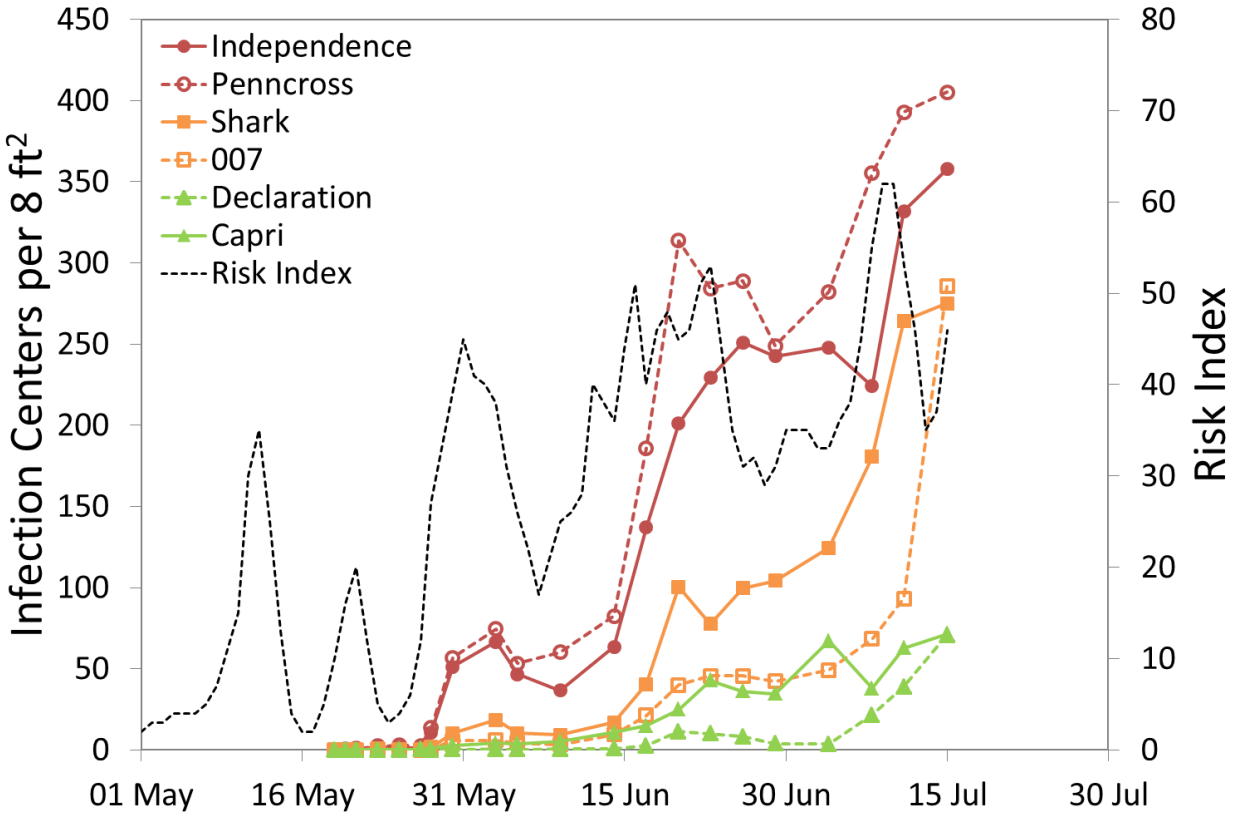

Figure 2. Number of dollar spot infection centers in highly susceptible (red lines), moderately susceptible (orange lines), and more tolerant (green lines) bentgrass cultivars and dollar spot risk index (black line) calculated using a logistic regression model during 2015.

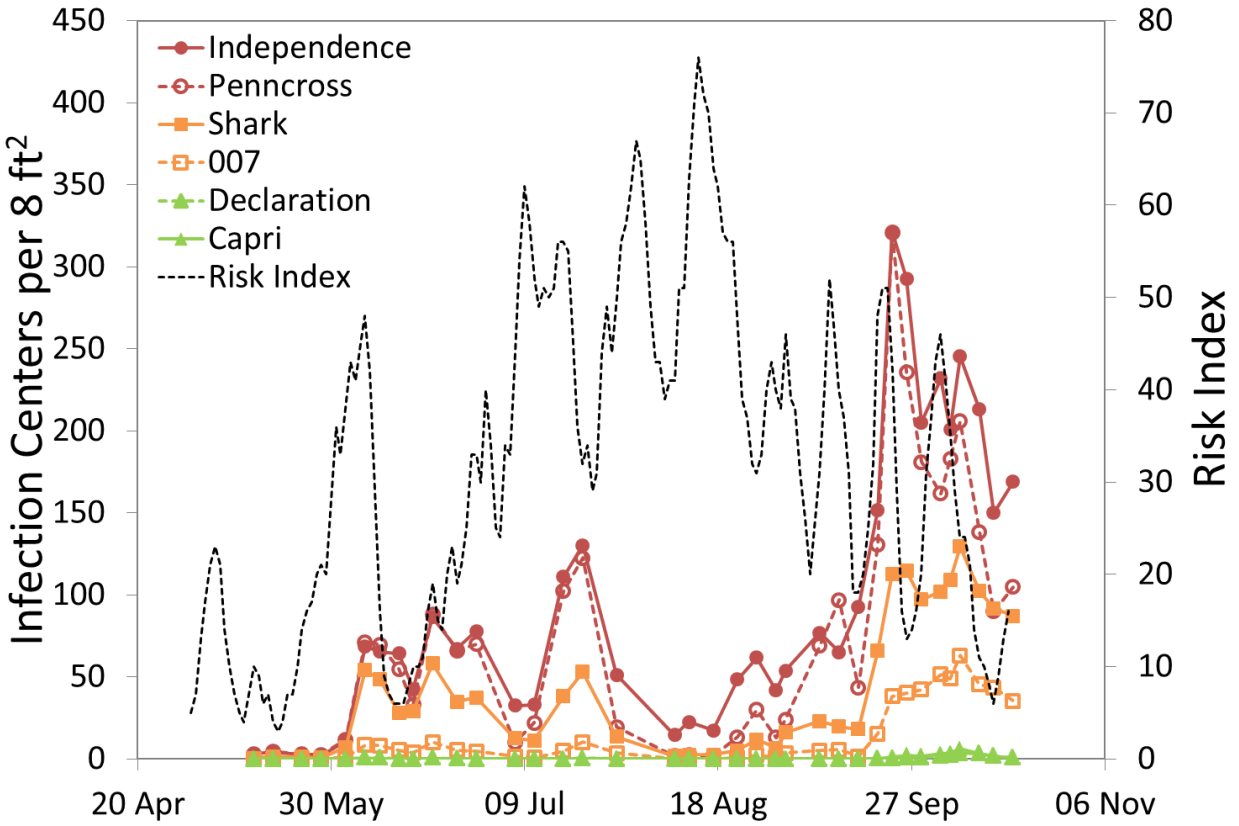

Figure 3. Number of dollar spot infection centers in highly susceptible (red lines), moderately susceptible (orange lines), and more tolerant (green lines) bentgrass cultivars and dollar spot risk index (black line) calculated using a logistic regression model during 2016.

Table 1. Total number of fungicide applications used to control dollar spot based on bentgrass cultivar and initial and subsequent fungicide timings during 2015 and 2016.

	2015						2016					
	Declaration			Independence			Declaration			Independence		
	Subsequent Fungicide Timing						Subsequent Fungicide Timing					
Initial Fungicide Timing	Calendar	Logistic Model	Threshold	Calendar	Logistic Model	Threshold	Calendar	Logistic Model	Threshold	Calendar	Logistic Model	Threshold
	Total Number of Fungicide Applications											
20-30 GDD	-	9	3	-	9	7	-	8	1	-	8	5
30-40 GDD	-	9	3	-	9	7	-	7	1	-	7	4
40-50 GDD	-	8	3	-	9	7	-	7	1	-	7	5
50-60 GDD	-	8	3	-	8	6	-	7	1	-	7	4
60-70 GDD	-	8	3	-	8	6	-	7	1	-	7	5
Logistic	-	8	3	-	9	7	-	8	1	-	8	4
Threshold	-	8	3	-	8	6	-	0	1	-	8	5
Calendar	9	8	3	9	8	6	9	7	1	9	7	4

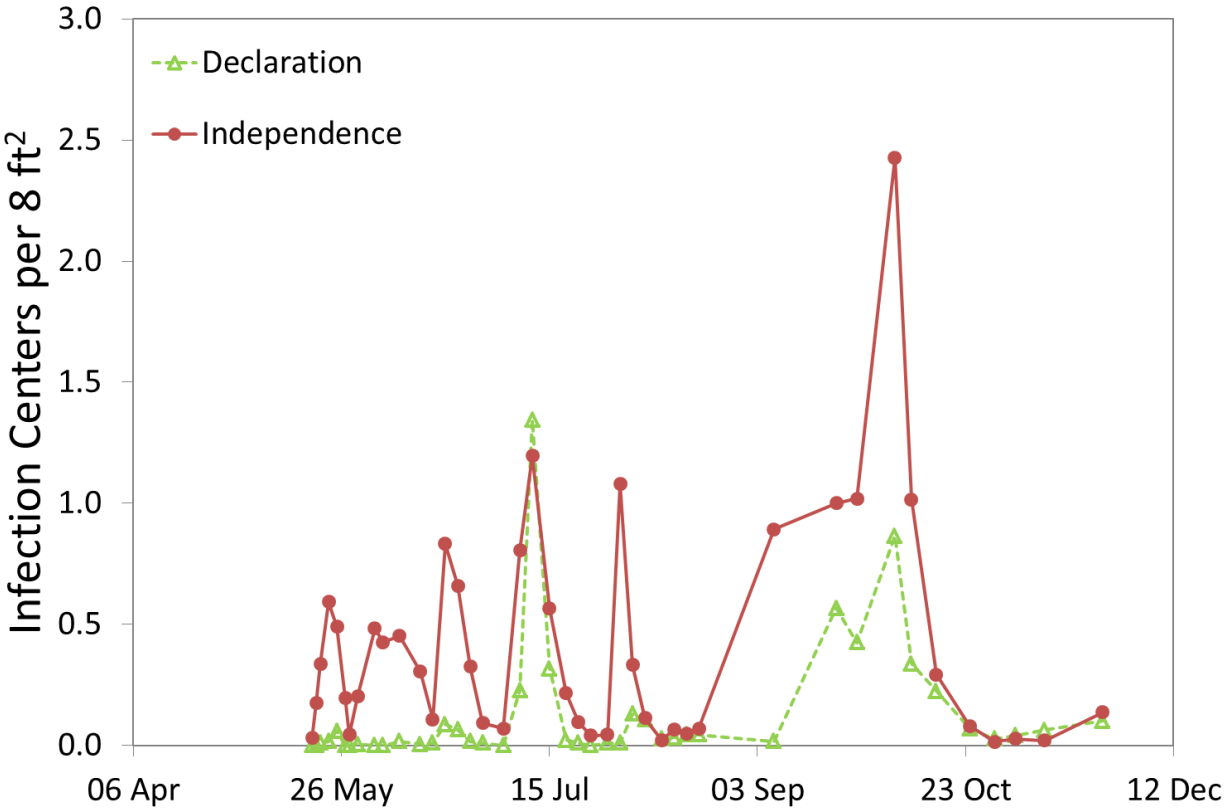

Figure 4. Number of dollar spot infection centers in highly susceptible ('Independence') and more tolerant ('Declaration') creeping bentgrass cultivars ~~having~~ using a subsequent fungicide timing based on a disease target threshold (< 2 infection centers/8 square feet) during 2015.