

2016 Final Project Summary

Project Title: **Evaluation of Rolling Frequency and Fungicide Programs on Golf Course Fairways for Dollar Spot Control**

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Project Overview

The goal of this project was to comprehensively look at effects of fairway rolling on turfgrass quality and disease suppression and provide an overview of how superintendents can practically implement this practice. In 2015 and 2016, we examined the effect rolling frequency (0, 3, 4, and 6 times per week) on dollar spot severity and different fungicide spray programs (calendar, threshold and untreated) to determine potential fungicide reductions. We also examined the impact of rolling on soil compaction, clipping yield, root density and thatch. We feel these are some key agronomic factors that are important for superintendents when deciding if rolling programs can be adapted at their facilities. Furthermore, this information is crucial for superintendents to use when justifying the capital funds needed for such purchases.

Objectives:

1. Determine the affect of rolling frequency (0, 3X, 4X, and 6X per week) on the dollar spot severity.
2. Determine if using a threshold based spray schedule compared to a calendar based spray schedule can reduce fungicide applications.
3. Determine the before and after affect of rolling frequency (0, 3X, 4X, and 6X per week) on soil compaction, thatch level and root density.
4. Determine the affect of rolling frequency on clipping yield (dry weight).

Material and Methods

Location and Equipment

The field trial was conducted at the University of Massachusetts, Joseph Troll Turfgrass Research Center (South Deerfield, MA) on creeping bentgrass and annual bluegrass mowed three times per week at fairway height (0.5 inches). The soil type was a sandy loam and irrigation was provided as needed. A Smithco (Ultra 10) fairway roller was used and Smithco has been very accommodating and is willing to loan a roller each year. Rolling treatment frequencies and the application schedule is listed in Table 1. Frequencies were chosen in order to maximize dollar spot control with an attempt to fit into daily golf course maintenance schedules.

2015 Materials and Methods

The plot was fertilized with 17-0-17 (1.0 N/1,000 ft²) on 9 June and rolling treatments were applied from 8 June-2 October in 2015. Application dates, fungicide rate and application order are listed in Table 2. Fungicide schedules are listed in Table 2. The calendar based spray program was initiated at the same time as the rolling treatments and the threshold spray program was initiated when an average of 5-dollar spot infection centers were observed on threshold plots (all rolling frequencies). Over the course of the study, dollar spot was assessed on a weekly basis by counting infection centers (14 total ratings). We also calculated Area Under the Disease Progress Curve (AUDPC), which uses data from all rating dates and evaluates

season-long dollar spot severity. Turf quality was assessed on two rating dates. Dollar spot incidence was the main force in influencing turf quality ratings. Rolling frequency had little to no effect on turf quality for most of the study. Rooting density was assessed before rolling treatments were initiated (3 June) and towards the end the study (2 September). Soil penetrometer readings were taken at the conclusion of the trial (2 October) to evaluate rolling treatments on soil compaction. Clipping yields were collected (22 September) from a 10" x 10" area in the center of plots following mowing without baskets. The plots had not been mowed for 4 days prior. Soil cores (2 inch width) were taken at the conclusion of the study (2 October). All green tissue was removed and the remaining soil core was dried down and baked in a muffle furnace at 500°C to eliminate all organic matter. The difference in weight was compared to determine organic matter %. All data presented in this summary report were subject to analysis of variance (ANOVA) and Fisher's Protected LSD was used for mean separation. The study was analyzed as 3 (fungicide regime spray schedule) x 4 (rolling frequency) factorial.

Table 1. Rolling frequency treatments and application schedule.

	Mon	Tues	Wed	Thurs	Fri
3X Single	X	X		X	
4X Double ^z		X		X	
6X Double ^z	X	X		X	
Untreated					

^z Double rolled plots were rolled twice consecutively.

Table 2. 2015 Calendar and Threshold spray schedules and application dates.

Calendar Spray Schedule

Spray Date	Fungicide	Rate (oz/M)	Interval
June 8	Torque	0.6	---
June 29	Chipco GT	4.0	21 days
July 20	Secure	0.5	21 days
Aug 10	Xzemplar	0.26	21 days
Aug 31	Chipco GT	4.0	21 days

Threshold Spray Schedule

Spray Date	Fungicide	Rate (oz/M)	Interval
July 17	Torque	0.6	
Aug 26	Chipco GT	4.0	40 days

Results

2015 Dollar Spot, Rolling Frequency and Fungicide Programs

Dollar spot was first observed on 6 July, but we did not observe any significant differences among rolling frequency treatments until 3 August. Overall, dollar spot severity was moderate in 2015 and slow to develop in the early portion of the season. In total, significant differences were observed in 9 of 14 rating dates and for AUDPC within the main effect rolling frequency (Supplemental Table 1). In general, less dollar spot was observed as rolling frequency

increased and the 6x/wk rolling treatment reduced dollar spot 66% compared to the non-rolled frequency for season long control (Supplemental Table 3). Significant differences were observed on every rating date and AUDPC among fungicide programs (Supplemental Table 2). With the exception of two individual rating dates, the threshold spray program was statistically similar to the calendar program. This is not surprising, since both rating dates the calendar program out performed the threshold program coincided with spray dates for the threshold program. Moreover, the threshold program required 3 less applications to achieve a statistically similar level of season-long control as the calendar program. Lastly, significant differences were observed among the frequency*fungicide program interaction on 9 of the 14 rating dates and for AUDPC (Supplemental Table 3). We were more interested in the frequency portion of the interaction, so rolling frequency was examined within each fungicide program (untreated, threshold and calendar). Of the rating dates that contained significant differences within the interaction, 9 of the 11 were observed among frequency within the untreated fungicide program and only 2 rating dates were observed in the threshold program. Simply put, the calendar and threshold programs reduced dollar spot so well, that there was little difference among the rolling frequencies. However, the abundance of statistically significant occurrences within the untreated allows us to determine exactly how much of an impact fairway rolling is having on dollar spot reduction. Overall, the 6x/wk rolling treatment reduced dollar spot significantly more than the 3x/wk on 6 of 10 rating dates and for season long control as well. The 6x/wk rolling treatment reduced dollar spot significantly more than the 4x/wk on 3 of 10 rating dates. We did have one rating date 40 days after the first application (Torque, 0.6 fl oz/1,000 ft²) in the threshold program in which we observed significant differences among rolling frequencies. The 6X/wk reduced dollar spot significantly more than the 3X/wk treatment and all rolling frequencies significantly reduced dollar spot more than the non-rolled (Figure 1).

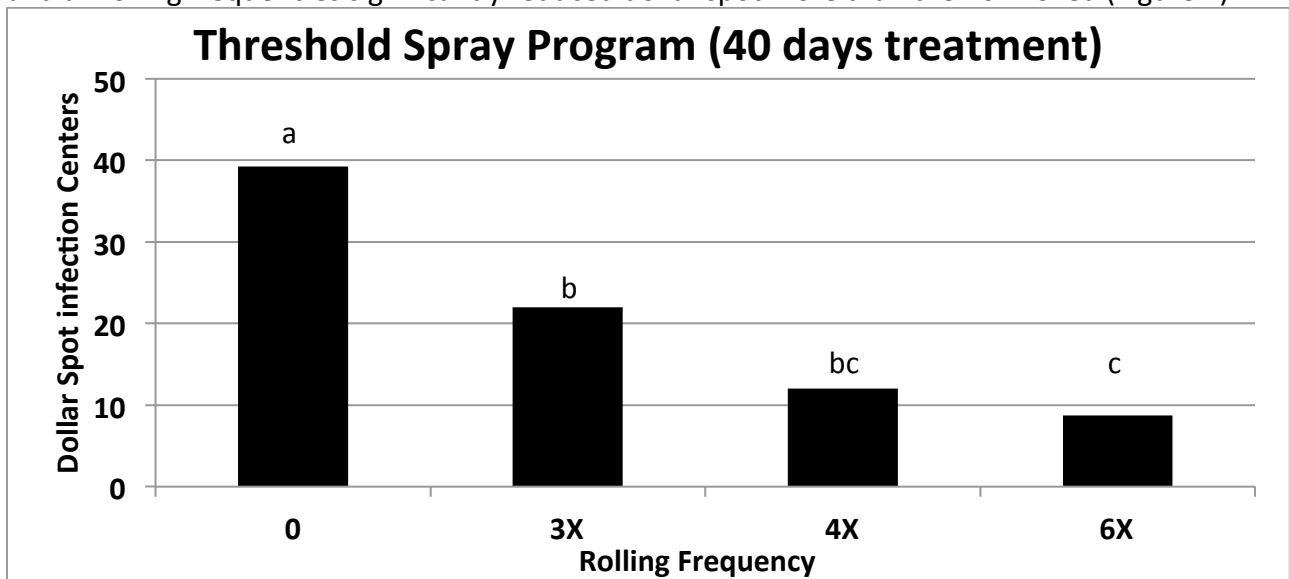


Figure 1. Dollar Spot infection centers 40 days after application of Torque (0.6 fl oz). Data collected on August 26, 2015.

2015 Turf Quality, Root Density, Compaction, Clipping Yields, Thatch

Significant differences in turf quality were observed on 2 October among rolling frequency for the threshold and calendar based spray programs. In both cases, the 6X/wk treatment had the lowest turf quality, however it was still at or above 6 for both fungicide programs (data not shown). Rooting density was assessed before rolling treatments were initiated (3 June) and towards the end the study (2 September). All treatments had similar root density levels during the 2 September sample date, thus indicating fairway rolling had no impact on turfgrass rooting. Soil penetrometer readings were taken at the conclusion of the trial (2 October) to evaluate rolling treatments on soil compaction. Soil penetrometer readings reported that the 4X/wk rolling treatments required the greatest effort to penetrate the soil and the 0X/wk, 3X/wk and 6X/wk were statistically similar. At the conclusion of the 2016 season, we plan to take soil samples and determine the bulk density at the conclusion of the study. Penetrometer readings were taken in an effort to non-destructively sample the plot. Clipping yields were collected (22 September) and a significant reduction in clipping yield was observed as rolling frequency increased. No significant differences in organic matter % between rolling frequencies were observed.

2016 Materials and Methods

The plot was fertilized with 17-0-17 (0.5 N/1,000 ft²) on 13 May and rolling treatments were applied from 2 June-15 September in 2016. Application dates, fungicide rate and application order are listed in Table 3. The calendar based spray program was initiated at the same time as the rolling treatments and the threshold spray program was initiated when an average of 5-dollar spot infection centers were observed on threshold plots (all rolling frequencies). Dollar spot was observed much earlier in trial (2nd week) and disease severity was much higher. Over the course of the study, dollar was assessed on a weekly basis by counting infection centers (13 total ratings) and calculated AUDPC for season-long dollar spot severity. Turf quality was assessed on two rating dates. Dollar spot incidence was the main force in influencing turf quality ratings. Rolling frequency did not decrease turf quality and slightly increased turf quality. Rooting density was assessed before rolling treatments were initiated (3 June) and towards the end the study (10 September). Undisrupted soil samples were collected after rolling concluded (10 November) and bulk density was determined. Soil organic matter in the top inch of the soil was determined to examine the effect of rolling on thatch degradation. All data presented from 2016 were analyzed using the same methods used for 2015 data.

2016 Dollar Spot, Rolling Frequency and Fungicide Programs

Dollar spot was first recorded on 8 June and began appearing earlier that week. This much earlier than the 2015 study and observations from other experiments suggest the timing of disease/rolling start date is critical. Overall, dollar spot incidence was limited in June and following turf recovery, extremely high dollar spot was observed from July until September. Significant treatment differences were only observed from rolling frequency for one rating date and the 3x/wk rolling treatment had significantly higher dollar spot than all other treatments (Supplemental Table 4). Significant differences were observed on 9 of 13 rating dates and AUDPC among fungicide programs (Supplemental Table 5). The threshold and calendar based

programs were statically similar on all rating dates. The threshold program required 2 less applications to achieve a statistically similar level of season-long control as the calendar program.

Table 3. 2016 Calendar and Threshold spray schedules and application dates.

Calendar Spray Schedule			
Spray Date	Fungicide	Rate (oz/M)	Interval
June 4	Torque	0.6	---
June 30	Chipco GT	4.0	26 days
July 19	Secure	0.5	19 days
Aug 5	Xzemplar	0.26	17 days
Aug 26	Chipco GT	4.0	21 days

Threshold Spray Schedule			
Spray Date	Fungicide	Rate (oz/M)	Interval
June 17	Torque	0.6	
July 5	Chipco GT	4.0	18 days
Aug 15	Secure	0.5	41 days

2016 Compaction, Turf Quality, Clipping Yields, Thatch

After the conclusion of the study, soil bulk density was measured from the threshold plots. No statistical differences were observed among rolling frequencies (Supplemental Table 6). A slight increase was observed between the 3X/wk and 6X/wk treatments compared to the untreated, however, these increases in soil bulk density are not likely to cause a biologically significant shift in soil structure. A significant increase in turf quality was observed on 27 July and all rolling frequencies had significantly higher turf quality. A similar increase in turf quality was also noted on 7 Sept, however the difference in turf quality was not significant (Supplemental Table 6). Clipping yields were not collected for all treatments, because preliminary testing determined that dollar spot incidence severely influenced clipping yield measurements. No significant differences in organic matter % between rolling frequencies were observed (Supplemental Table 6).

Conclusion

This two-year study yielded vastly different results for dollar spot control with fairway rolling. 2015 data indicated that rolling could reduce dollar spot by 65-40%, while 2016 data showed a minor reduction/increase. This was observed in concurrent studies in the New England area in 2016. However, Dr. Jung was on sabbatical in Japan and conducted two rolling studies in Japan and South Korea. He observed a similar dollar spot reduction to the 2015 study. The common tie between the successful 2015 study and Japan/South Korea was rolling timing. All successful studies began rolling 4-8 weeks before dollar spot was observed. In 2016, rolling was initiated less than 7 days before the first dollar spot infection was observed. Although this infestation was relatively low, it appeared to have some influence based on the data collected in July and August. Past observations suggest that beginning a rolling program in

early May would protect from any early season epidemics. The appearance of dollar spot in 2015 and 2016 differed by nearly roughly 5 weeks. We would like the opportunity to carry this study out for one more season in an attempt to reproduce the 2015 findings by adjusting the rolling start date.

Our analysis of fungicide programs suggests that fungicide usage can be reduced if a careful scouting and a threshold based spray program is used. This is not necessarily new information, but does offer some season-long data to compare the two approaches and amount of dollar spot that could be expected with a threshold based approach. Furthermore, careful monitoring of low nighttime temperatures, soil moisture and leaf wetness are important factors when considering a threshold based fungicide program on fairways.

Our results showed little impact on soil compaction despite rolling the 6X/wk 192 times over two years. Soil compaction was one of the main concerns superintendents had voiced prior to this work. Secondly, turf quality in 2016 was improved over the 2015 in rolled compared to non-rolled treatments, despite drought conditions and frequent high temperatures. We did not see any change in organic matter in the top inch of soil/thatch. We did see changes in the where the thatch layer was composed. Rolling pushed the thatch layer down into the soil and created a firmer surface. The UMass research center had fairly minimal thatch levels and we would like to further examine the potential for thatch reduction on golf courses with more substantial thatch layers. Clipping yield data in 2015 showed reduced clipping yields for rolling treatments. We were unable to test this again, due to high amounts of dollar infection in 2016.

Overall, we feel that this study shows good promise for reducing dollar spot, but requires further testing. The timing aspect in particular is very important in order make a sound recommendation. We would like to extend this project one more year to follow-up on the timing aspect and plan to submit another grant for one-year extension. Not only would this provide important information to superintendents, but also extending this project would generate enough data for the first scientific publication on fairway rolling.