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The fertilzer/disease link

How nitrogen source, rate and timing application method effect creeping bentgrass quality and dollar spot

Dollar spot (*Sclerotinia homoeocarpa*) is a major problem on high maintenance turfgrasses such as bentgrass (*Agrostis palustris* Hudollar *spot*), annual bluegrass (*Poa annua*), Kentucky bluegrass (*Poa pratensis* L.) and perennial ryegrass (*Lolium perenne* L.).

Foliar and granular fertilization programs were compared on bentgrass performance and dollar spot incidence at various nitrogen rates and application frequencies. The granular fertilizer source consistently resulted in lower color ratings than the foliar sources. Good to excellent color responses didn't always result in acceptable dollar spot suppression; however, foliar fertilization consistently resulted in less dollar spot than comparable granular treatments. Foliar sources provided dollar spot suppression for at least 70 to 80 days and 154 days without fungicide at 0.25 of a pound of N/M weekly (every seven days) in 2004 and 2005, respectively.

This research suggests foliar feeding with sufficient nitrogen can reduce dollar spot severity and potentially result in less fungicide use.

PREMISES AND OBJECTIVES

Dollar spot continues to be problematic on high maintenance turfgrasses such as bentgrass, annual bluegrass, Kentucky bluegrass and perennial ryegrass. As such, golf course superintendents reportedly spend more money on fungicides to control dollar spot than for any other turfgrass disease (Vargas, 1994).

Superintendents managing bentgrass fairways are reporting more intense dollar spot pressure and increased difficulty in dollar spot control. Many reasons for these problems have been hypothesized, including resistance in field populations of *S. homoeocarpa* to chemicals, lower nitrogen fertility programs, fungicide interactions and plant growth regulator use.

Chlorothalonil has been used as a standard contact fungicide for dollar spot management throughout the years. Recently, chlorothalonil use by golf courses has been restricted to a certain seasonal limit. This restriction has significantly influenced superintendents' fungicide-usage programs and their chemical family alteration strategies for dollar spot management.

The purpose of this research project was to:

1. Reiterate previous Ohio State research about the effects of nitrogen fertilization rate, (light rates vs. traditional heavier rates), frequency (seven-day vs. 14-day application schedule) and application method (foliar feed vs. granular feed) on bentgrass quality and dollar spot severity; and
2. Determine the latter interactions on dollar spot incidence, fungicide efficacy, reduced fungicide rates and extended fungicide application intervals.

Table 1. Fertilizer rates, frequencies and timings

N rate		Frequency	Total N / month	
lb N/M	kg N/ha		lbs N/M	kg N/ha
0.175	8.6	weekly	0.70	34.4
0.25	12.2	weekly	1.0	48.8
0.35	17.1	biweekly	0.70	34.4
0.50	24.4	biweekly	1.0	48.8
Untreated check	– – –	–	–	–

Fertilizer treatments received either no fungicide, half rate or full rate "predisease" applied at 30-day intervals beginning May 11, 2004 and May 26, 2005.

MATERIALS AND METHODOLOGY

This study was conducted in 2004 and 2005 at the Ohio Turfgrass Foundation Research and Education Facility at The Ohio State University in Columbus, Ohio. The study was a randomized complete block design with three replications. The creeping bentgrass cultivar was 'Lopez'.

Four fertilizers (three liquid and one granular), four nitrogen rates and two timing frequencies were used (Table 1). The granular

fertilizer Tee Time 20-4-12 (The Andersons) was applied using a drop spreader. The liquid and water-soluble fertilizers were applied using a CO_2 pressurized sprayer using two flat-fan nozzles calibrated to deliver two gallons per 1,000 square feet.

Tee Time is a granular fertilizer containing 1 percent polymer – coated ammoniacal nitrogen – and 19 percent urea nitrogen with 12 percent of the urea as microprilled sulfur-coated urea. Bulldog 28-8-18 is a dry, water-soluble fertilizer with 2.1 percent ammoniacal nitrogen, 5.4 percent nitrate nitrogen and 20.5 percent urea nitrogen for liquid/foliar feeding.

ACLF 20-2-1 and HPF 19-1-1 (Agro-Culture Liquid Fertilizers) are liquid fertilizers also designed for liquid/foliar feeding composed of urea, nitrate and ammoniacal nitrogen with micronutrients.

The nitrogen rates were 0.175 of a pound of nitrogen per 1,000 square feet and 0.25 of a pound of nitrogen per 1,000 square feet applied every seven days, and 0.35 of a pound of nitrogen per 1,000 square feet and 0.5 of a pound of nitrogen per 1,000 square feet applied every 14 days.

Chlorothalonil (Daconil Ultrex) was split across the fertilizer source/rate/timing treatments as no-fungicide, half rate (1.625 ounces per 1,000 square feet), and full rate "predisease" (3.25 ounces per 1,000 square feet), resulting in 54 total treatments. Applications were made on about a 30-day treatment schedule beginning May 11 and ending Sept. 14, 2004, and again on May 26 and ending Sept. 30, 2005.

Additionally, on April 27, 2005, a preseason preventive rate of chlorothalonil was applied as a blanket application to the entire study. This preseason application was designed to bring all plots to 0 percent prior to 2005 treatments.

Mowing was performed three times a week (Monday, Wednesday and Friday) using a Toro 3100 triplex mower with a bench setting of 0.5 inch, and clippings were removed. The site was irrigated regularly to prevent wilt. Insecticide

Table 2. Dollar spot severity as affected by nitrogen source, rate and application frequency

			% Dollar Spot					
Fertilizer source	N rate (kg ha^{-1}	Timing	Aug. 2, 2004			Sept. 22, 2005		
			No fungicide	Half	Full	No fungicide	Half	Full
Tee Time	8.6	7 day	56.7	33.3	20	25	21.7	11.7
ACLF	8.6		20	16.7	10	21.7	20	8.3
Bulldog	8.6		8.3	10	5	16.7	11.7	8.3
HPF-N	8.6		18.3	15	11.7	16.7	11.7	6.7
Tee Time	12.2	7 day	46.7	31.7	18.3	28.3	28.3	18.3
ACLF	12.2		1.7	1.7	0	11.7	8.3	3.3
Bulldog	12.2		0	0	0	1.7	1.7	0
HPF-N	12.2		1.7	0	0	6.7	1.7	1.7
Tee Time	17.1	14 day	46.7	21.7	23.3	33.3	25	18.3
ACLF	17.1		21.7	20	13.3	28.3	25	16.7
Bulldog	17.1		26.7	13.3	8.3	21.7	13.3	10
HPF-N	17.1		28.3	16.7	18.3	20	18.3	11.7
Tee Time	24.4	14 day	30	20	16.7	26.7	25	16.7
ACLF	24.4		20	10	6.7	25	18.3	10
Bulldog	24.4		18.3	8.3	3.3	1.7	0	0
HPF-N	24.4		21.7	6.7	6.7	10	8.3	3.3
Unfertilized	–	–	46.7	35	26.7	30	25	18.3
			LSD (0.05) 10.52			LSD (0.05) 12.56		

applications were made for cutworms, white grubs and black turfgrass ataenius. Preemergent herbicide was applied each year in April.

Dollar spot ratings were taken during active dollar spot period. Dollar spot was active in May and June and again in late July through September 2004 and August and September 2005. Dollar spot was rated subjectively as an estimate of percent plot infected with no visible disease and total dollar spot cover.

Turfgrass color ratings were taken biweekly using a scale of one to nine with one representing poorest color, six representing just acceptable and nine representing best (dark green).

Clippings were harvested on Sept. 13, 2004, and Sept. 20, 2005, by making a single pass down the center of each nitrogen treatment with a commercial walk-behind greensmower. Clippings were bagged, dried at 149 F for 72 hours and analyzed for total nitrogen content of clippings (percent by weight) using the standard Kjeldahl method.

DOLLAR SPOT

Dollar spot severity is reported for the peak period in August 2004 and September 2005 (Table 2). Only one major outbreak of dollar spot occurred in 2005 (August, September and October).

All granular treatments resulted in consistently more dollar spot when compared to equivalent foliar treatments. Among the granular no-fungicide treatments, 0.5 pound N/M every 14 days resulted in the least amount of dollar spot and was the only granular no-fungicide treatment to exhibit a dollar spot reduction less than the unfertilized no-fungicide check.

All granular treatments with or without fungicide in 2004 and 2005 failed to provide levels of dollar spot control that would be acceptable among most golf course superintendents (Table 2).

Among the no-fungicide foliar treatments, all sources at 0.25 pound N/M every seven days consistently exhibited the least amount of dollar spot (see photo at right) and provided remarkable dollar spot suppression for 80 days and 154 days in 2004 and 2005, respectively. The no-fungicide 0.25-pound N/M treatment with all three foliar sources resulted in dollar spot suppression equivalent to the latter nitrogen rate with half- and full-rate fungicide. This clearly points to the importance of nitrogen rate, source, and application timing in nitrogen fertility and dollar spot interactions.

All the foliar treatments at 0.25 pound N/M every seven days in combination with half-rate fungicide resulted in less than 3 percent dollar spot in 2004, less than 10 percent dollar spot in 2005, and minimized peaks in dollar spot severity as compared with fertilizer treatments alone, and dollar spot control was equivalent to the full-fungicide rate.

At the foliar nitrogen rates of 0.175 of a pound N/M and 0.35 of a pound N/M every seven and 14 days, respectively, Bulldog was the only foliar source that consistently exhibited a trend toward acceptable dollar spot control at the half- and full-fungicide rates in 2004 and 2005.

All the foliar sources at 0.25 pound N/M every seven days consistently provided better dollar spot control than the foliar sources at 0.5 pound N/M every 14 days.

Finally, granular treatments had lower foliage nitrogen levels than the foliar treatments within the same rate/frequency programs with average foliar nitrogen contents of 5 percent in 2004. In 2004, all three foliar sources at the 0.25-pound N/M rate, which consistently resulted in the least dollar spot incidence among treatments, exhibited foliage nitrogen contents of 5.3 percent (Table 3).

In 2005, granular treatments again showed a trend for lower foliage nitrogen levels than the foliar treatments within the same rate/frequency programs. Foliage nitrogen levels in 2005 were on the average 0.5 to 1.0 percent higher than in 2004, which might reflect a buildup of residual nitrogen or conditions more conducive to nitrogen use efficiency (i.e. 2005 summer temperatures relative to 2004). The granular treatments (Table 3) in 2005 resulted in foliage nitrogen levels ranging from 5.56 to 5.9 percent. Dollar spot incidence was still significant at these latter foliage nitrogen levels suggesting factors other than foliage nitrogen content might be connected to higher dollar spot incidence with granular vs. foliar feeding.

TURFGRASS COLOR

Among all nitrogen source/rate and application frequency treatments, turfgrass color wasn't influenced by fungicide rate (i.e. zero, half and full) in either year. For example, the turfgrass color ratings for ACLF at each rate and frequency within any rating date were the same whether at zero, half or full rate of chlorothalonil. This trend was consistent within each fertilizer source/rate and frequency treatment throughout both seasons.

Within the granular treatments, initial green-up responses were significantly slower than any of the foliar treatments in 2004 and 2005. After green-up, seasonal color responses with all granular treatments were acceptable with color ratings ranging from six to seven in 2004 and six to 7.5 in 2005. The granular treatments within any comparative fertilizer rate and frequency consistently resulted in color ratings of one to three units less than foliar treatments. Within the granular treatments, the highest and most consistent turf color resulted with the 0.5-pound N/M rate biweekly.

The foliar treatments consistently provided higher turf color than the granular treatments. All the foliar treatments provided good to excellent green-up responses. All the foliar treatments also provided good to excellent color responses throughout the season. The highest and most consistent turf color among all the foliar sources occurred at the 0.25-pound N/M weekly treatment with average seasonal ratings from 8.5 to nine.

This photo shows the differences among dollar spot severity of the 0.25-pound-nitrogen, seven-day foliar treatment (yellow box on the left) vs. 0.5-pound-nitrogen, 14-day foliar treatment (yellow box in the middle) and 0.5-pound-nitrogen, granular 14-day treatment (yellow box on right) with no fungicide and one-half-rate fungicide applied (red boxes).

Table 3. Effect of nitrogen rate, timing and application method on nitrogen content of creeping bentgrass foliage*

Treatment	Rate (lb N/M)	Timing	% Total N**	
			2004	2005
1. ACLF	0.175	7 day	5 efg	5.95 abcd***
2. HPF-N	0.175	7 day	4.8 fgh	5.94 abcd
3. Tee Time	0.175	7 day	4.7 gh	5.60 d
4. Bulldog	0.175	7 day	5.0 efg	5.92 abcd
5. ACLF	0.25	7 day	5.5 abc	6.38 a
6. HPF-N	0.25	7 day	5.3bcd	6.16 abc
7. Tee Time	0.25	7 day	4.7 gh	5.90 abcd
8. Bulldog	0.25	7 day	5.6 ab	6.13 abc
9. ACLF	0.35	14 day	5.1 def	5.75 cd
10. HPF-N	0.35	14 day	4.9 efgh	5.61d
11. Tee Time	0.35	14 day	4.6 h	5.56 d
12. Bulldog	0.35	14 day	5.2 cde	5.85 bcd
13. ACLF	0.5	14 day	5.6 ab	6.16 abc
14. HPF-N	0.5	14 day	5.8a	6.24 abc
15. Tee Time	0.5	14 day	5 defg	5.72 cd
16. Bulldog	0.5	14 day	5.7 ab	6.29 ab
17. Check	--	--	3.7 i	4.93 e
LSD			0.35	0.53

* Clippings collected on Sept. 13, 2004 and Sept. 20, 2005
** Nitrogen content determined by the Kjeldahl method
*** Numbers followed by the same letter aren't significantly different

CONCLUSIONS

A positive relationship exists between dollar spot control/suppression, nitrogen rate and application frequency with foliar nitrogen sources. Nitrogen rate and application frequency are important.

This research to date suggests dollar spot control/suppression is impacted by higher nitrogen rates (i.e. one pound N/M) than are typically being used by golf course superintendents. Foliar fertilization provides consistently superior dollar spot suppression than equivalent granular fertilization. Foliar fertilization every seven days results in better dollar spot control than foliar fertilization every 14 days (see photo on page 88).

It's also apparent that nitrogen source responses that produce acceptable color responses might not be sufficient monthly or seasonal totals to impact dollar spot suppression significantly. The nitrogen content of foliage among the various treatments suggests dollar spot suppression via nitrogen fertility requires foliage nitrogen levels at the upper end of the sufficiency range of 3 to 6 percent with a target of at least 5 percent or greater.

This research suggests foliar feeding with sufficient nitrogen can reduce dollar spot severity and potentially result in less fungicide use. The impact of foliar feeding on dollar spot severity might be related to a number of factors, including more efficient use of foliar-applied nitrogen, a simple dosage response relative to slow-release granulars, an interaction with the pathogen on the leaf surface, a physiological response because of the production of a chemical that suppresses the pathogen in or on the foliage or simply related to a critical nitrogen rate.

More research needs to be conducted about foliar feeding, foliar feeding efficiency, nitrogen rate and fungicide programming and plant growth regulator/foliar feeding responses. **GCI**

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