

## Dollar spot suppression and performance of fertility programs on creeping bentgrass fairway turf

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The objective of this research project was to determine the effects of the sponsor's fertilizer programs on dollar spot disease and general performance of creeping bentgrass putting green turf maintained at fairway height.

Data collected included the duration and strength of the color response following application(s) of the tested products, turf quality, uniformity, and density, and resistance of the turf to disease and drought stress.

### MATERIALS/METHODS

The trial included 7 treatments (fertility programs as per Table 1). An unfertilized check treatment was also included. Treatments were applied to 1 x 2 m plots of creeping bentgrass turf maintained as a fairway at the Guelph Turfgrass Institute (mowing at 9 mm, irrigation to prevent stress). Granular treatments were applied with hand shakers, foliar treatments (Protocal and Enfoss) were applied with a compressed air boom sprayer. Treatments were replicated four times

Table 1. Dollarspot disease suppression trial: treatments

Treatment	Date	Product	g m <sup>-2</sup>	Product	g m <sup>-2</sup>
Granular 1	Jun 2	Tru-prill 19-2-15	15.4		
	Jul 6	Tru-prill 19-2-15	15.4		
	Aug 11	Tru-prill 17-2-15	14.6		
	Sep 15	Tru-prill 17-2-15	14.6		
Granular 1 + biweekly A	Jun 2	Tru-prill 19-2-15	15.4	Protocal (biweekly)	1.27 ml m <sup>-2</sup>
	Jul 6	Tru-prill 19-2-15	15.4	Enfoss (biweekly)	0.88
	Aug 11	Tru-prill 17-2-15	14.6		
	Sep 15	Tru-prill 17-2-15	14.6		
Granular 1 + weekly A	Jun 2	Tru-prill 19-2-15	15.4	Protocal (weekly)	0.95 ml m <sup>-2</sup>
	Jul 6	Tru-prill 19-2-15	15.4	Enfoss (weekly)	0.68
	Aug 11	Tru-prill 17-2-15	14.6		
	Sep 15	Tru-prill 17-2-15	14.6		
Granular 1 + biweekly B	Jun 2	Tru-prill 19-2-15	15.4	Protocal (biweekly)	1.27 ml m <sup>-2</sup>
	Jul 6	Tru-prill 19-2-15	15.4		
	Aug 11	Tru-prill 17-2-15	14.6		
	Sep 15	Tru-prill 17-2-15	14.6		
Granular 1 + weekly B	Jun 2	Tru-prill 19-2-15	15.4	Protocal (weekly)	0.95 ml m <sup>-2</sup>
	Jul 6	Tru-prill 19-2-15	15.4		
	Aug 11	Tru-prill 17-2-15	14.6		
	Sep 15	Tru-prill 17-2-15	14.6		
Granular 2	Jun 2	N 47 U	6.2	PK 5-43	10.7
	Jul 6	N 47 U	6.2	PK 5-43	10.7
	Aug 11	N 47 U	5.2	PK 5-43	10.0
	Sep 15	N 47 U	5.2	PK 5-43	10.0
Granular 3	Jun 2	N 44 P	11.1	PK 5-43	10.7
	Jul 6			PK 5-43	10.7
	Aug 11			PK 5-43	10.0
	Sep 1	N 44 P	11.1		
	Sep 15			PK 5-43	10.0
Control	—	—	—	—	—





Figure 1. Plot area, June 10, 2009.

in a randomized complete block design (Figure 1).

Color response of the turf to treatments was assessed regularly using instrumental color (canopy reflectance). Plots were rated regularly for turf quality, density and uniformity. Dollarspot inoculum was added ( $5 \text{ g m}^{-2}$ ) on July 22, to ensure a source for dollarspot disease. Other stresses were measured as they occurred (disease, weed, drought). Spring greenup will be assessed in April 2010.

All data were analysed statistically using the SAS package of statistical software.

An anecdotal photographic record was kept of the progress of the trial.

## RESULTS

*Turf performance – canopy reflectance.* There were significant differences among the treatments for normalized-difference vegetation index on all measured dates (Table 2). By 7 days after the first application, the untreated control plots had significantly lower NDVIs than the treated plots, and that difference was maintained throughout the trial. The differences among the fertilizer/supplement treatments were small, though often

statistically significant. When the heavy dollar spot outbreak happened in late August, the NDVI values of all the treatments declined, indicating the effect of the dollar spot lesions on turf quality. The largest decline was in the two treatments with Protocol as the sole supplement. This was also the situation if the NDVI values were averaged across the season.

The relationship between NDVI and number of dollar spot lesions (Figure 2), dollar spot ratings (Figure 3) and percent of plot area covered by dollar spot (Figure 4) showed a fairly strong association, indicating that NDVI is a useful estimator of the effect of dollar spot on turf quality.

*Dollarspot disease.* There was very little dollar spot across the treatments until about three weeks following inoculation on July 22. All of the plots developed a heavy dollar spot infection, with over 100 lesions per  $2 \text{ m}^2$  plot by the end of August (Table 3). The infection was present on both inoculated and uninoculated halves of each plot, indicating that there was natural disease pressure in the absence of inoculum; generally the disease pressure was stronger in the inoculated half of each plot (Figure 5). On the one date when there were significant differences observed among

Table 2. Canopy reflectance (normalized-difference vegetation index) in treated plots.

Treatment	06/02	06/05	06/08	06/09	06/11	06/12	06/15	06/16
Granular 3	0.539 d <sup>1</sup>	0.560 d	0.601 e	0.618 d	0.636 bc	0.635 b	0.650 a	0.588 c
Granular + weekly foliar A	0.546 bcd	0.566 cd	0.613 cd	0.629 bc	0.637 bc	0.639 ab	0.646 a	0.599 bc
Granular 2	0.568 a	0.603 a	0.640 a	0.650 a	0.655 a	0.649 a	0.649 a	0.619 a
Granular + biweekly foliar A	0.554 b	0.585 b	0.627 b	0.639 b	0.645 b	0.643 ab	0.649 a	0.604 ab
Granular 1	0.541 cd	0.574 bc	0.603 de	0.621 cd	0.623 d	0.624 c	0.632 b	0.587 c
Granular + weekly foliar B	0.550 bc	0.584 b	0.615 bc	0.624 dc	0.632 cd	0.624 c	0.635 b	0.596 bc
Granular + biweekly foliar B	0.555 b	0.573 bc	0.619 bc	0.629 bc	0.635 c	0.635 bc	0.642 ab	0.602 bc
Control	0.536 d	0.556 d	0.566 f	0.567 e	0.574 e	0.586 d	0.594 c	0.539 d
msd p=0.05	0.011	0.012	0.012	0.010	0.010	0.011	0.010	0.015
	06/18	06/22	06/23	06/25	07/02	07/08	07/10	07/14
Granular 3	0.632 a	0.631 a	0.626 a	0.656 a	0.689 a	0.616 b	0.689 a	0.655 c
Granular + weekly foliar A	0.626 abc	0.629 ab	0.624 a	0.653 a	0.681 c	0.628 a	0.681 c	0.670 ab
Granular 2	0.637 a	0.627 ab	0.625 a	0.652 ab	0.688 ab	0.630 a	0.688 ab	0.665 b
Granular + biweekly foliar A	0.628 ab	0.630 ab	0.625 a	0.653 a	0.687 ab	0.625 ab	0.687 ab	0.670 ab
Granular 1	0.608 d	0.613 c	0.609 bc	0.639 c	0.671 d	0.626 ab	0.671 d	0.665 b
Granular + weekly foliar B	0.616 cd	0.620 bc	0.608 c	0.649 ab	0.683 bc	0.625 ab	0.683 bc	0.667 b
Granular + biweekly foliar B	0.618 bcd	0.624 ab	0.618 ab	0.644 bc	0.685 abc	0.628 a	0.685 abc	0.674 a
Control	0.571 e	0.584 d	0.577 d	0.607 d	0.663 e	0.621 ab	0.663 e	0.647 d
msd p=0.05	0.012	0.010	0.010	0.008	0.006	0.010	0.006	0.006
	07/15	07/17	07/22	07/27	07/30	08/04	08/11	08/14
Granular 3	0.647 d	0.654 d	0.634 d	0.672 d	0.648 d	0.660 d	0.654 b	0.619 d
Granular + weekly foliar A	0.663 ab	0.679 ab	0.669 a	0.690 a	0.671 a	0.682 ab	0.656 b	0.637 bc
Granular 2	0.660 bc	0.681 a	0.660 b	0.672 d	0.660 bc	0.683 a	0.670 a	0.647 a
Granular + biweekly foliar A	0.662 abc	0.678 abc	0.671 a	0.679 bc	0.658 c	0.678 bc	0.652 b	0.635 bc
Granular 1	0.658 c	0.675 bc	0.649 c	0.675 cd	0.654 cd	0.675 c	0.652 b	0.629 c
Granular + weekly foliar B	0.660 bc	0.673 c	0.660 b	0.681 bc	0.661 bc	0.674 c	0.651 b	0.638 abc
Granular + biweekly foliar B	0.666 a	0.682 a	0.671 a	0.683 b	0.668 ab	0.677 bc	0.649 b	0.642 ab
Control	0.636 e	0.646 e	0.625 e	0.656 e	0.639 e	0.656 d	0.639 c	0.610 d
msd p=0.05	0.005	0.006	0.008	0.007	0.008	0.005	0.009	0.010
	08/17	08/20	08/24	08/28	08/31	09/02	09/08	09/10
Granular 3	0.636 d	0.655 b	0.641 c	0.561 e	0.577 c	0.555 d	0.647 a	0.659 a
Granular + weekly foliar A	0.656 a	0.667 a	0.657 a	0.585 bcd	0.603 a	0.587 a	0.638 ab	0.639 b
Granular 2	0.655 ab	0.669 a	0.651 ab	0.597 a	0.610 a	0.585 ab	0.631 b	0.630 bc
Granular + biweekly foliar A	0.652 abc	0.667 a	0.659 a	0.589 ab	0.603 a	0.586 ab	0.641 ab	0.638 b
Granular 1	0.655 ab	0.672 a	0.659 a	0.586 abc	0.608 a	0.590 a	0.640 ab	0.636 b
Granular + weekly foliar B	0.650 c	0.665 a	0.655 ab	0.574 d	0.591 b	0.576 bc	0.617 c	0.625 c
Granular + biweekly foliar B	0.651 bc	0.669 a	0.646 bc	0.575 cd	0.592 b	0.566 c	0.608 c	0.615 d
Control	0.625 e	0.642 c	0.626 d	0.536 f	0.560 d	0.540 e	0.587 d	0.596 e
msd p=0.05	0.005	0.009	0.010	0.012	0.011	0.011	0.011	0.009
	09/11	09/14	09/17	09/22	10/06	10/14	10/21	Season mean
Granular 3	0.656 a	0.665 a	0.642 a	0.661 ab	0.481 a	0.451 a	0.438 ab	0.590 a
Granular + weekly foliar A	0.629 bc	0.637 b	0.608 bc	0.662 a	0.475 ab	0.445 abc	0.434 abc	0.590 a
Granular 2	0.621 cd	0.624 d	0.609 bc	0.654 b	0.481 a	0.450 ab	0.441 a	0.589 a
Granular + biweekly foliar A	0.632 b	0.634 bc	0.611 b	0.659 ab	0.467 ab	0.432 c	0.426 abc	0.588 a
Granular 1	0.628 bc	0.627 cd	0.603 c	0.646 c	0.472 ab	0.430 c	0.433 abc	0.588 a
Granular + weekly foliar B	0.617 de	0.619 d	0.603 bc	0.645 c	0.463 b	0.433 bc	0.424 bc	0.578 b
Granular + biweekly foliar B	0.611 e	0.618 d	0.594 d	0.638 d	0.462 b	0.429 c	0.421 c	0.574 b
Control	0.585 f	0.601 e	0.589 d	0.604 e	0.382 c	0.336 d	0.326 d	0.536 c
msd p=0.05	0.010	0.009	0.007	0.007	0.016	0.016	0.017	0.007

<sup>1</sup> Normalized-difference vegetation index: mean of ~50 readings x 4 replicates; means within columns followed by the same letter are not significantly different (Tukey's HSD test, p=0.05)

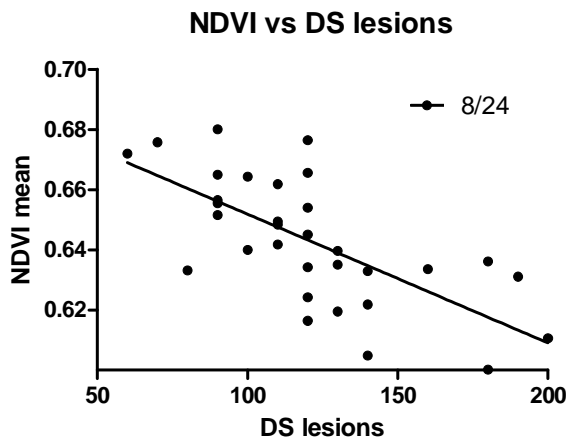


Figure 2. Association between NDVI and counts of dollar spot lesions. Correlation coefficient is 0.68.

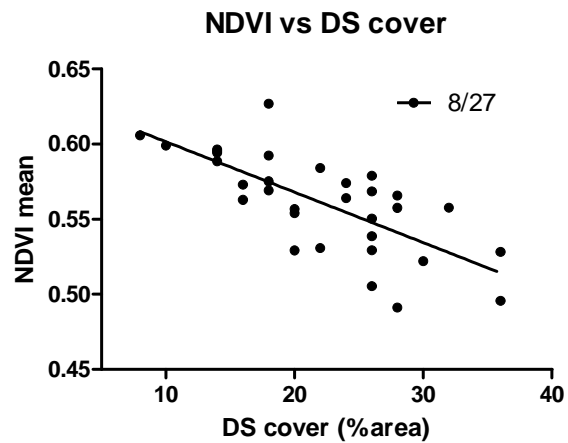


Figure 4. Association between NDVI and percent cover of plots by dollar spot lesions. Correlation coefficient is 0.72.

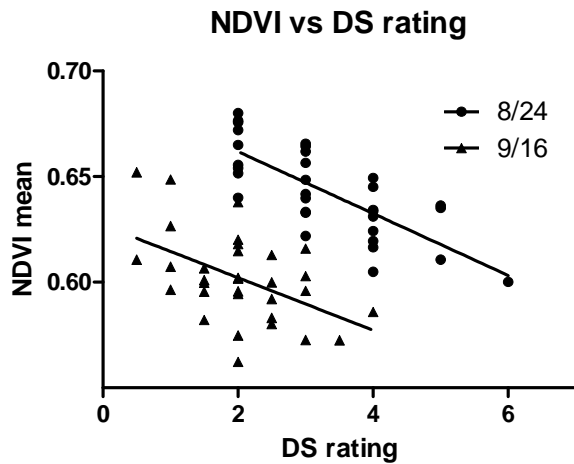


Figure 3. Association between NDVI and visual rating of dollar spot infection. Correlation coefficients are 0.75 (8/24) and 0.49 (9/16).

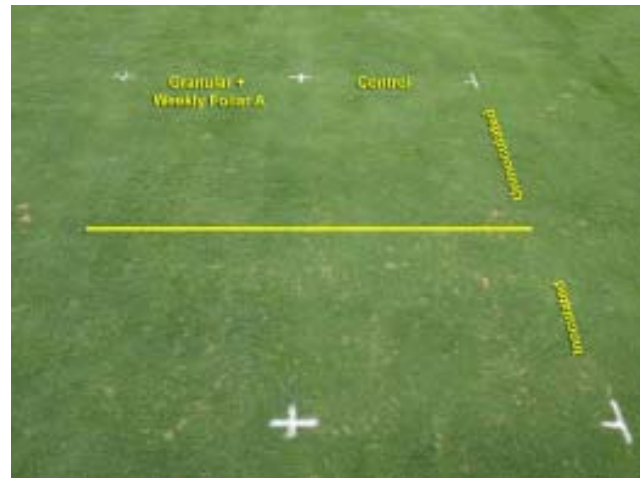


Figure 5. Dollar spot lesions on plots, August 18, 2009. Closer half of each 1x2m plot was inoculated with 5 g dollar spot inoculum, July 22, 2009.

Table 3. Dollar spot infestation in treated plots.

Treatment	06/30	07/17	08/11	08/25	08/17	08/27
	— lesions per plot —			percent cover		
Control	0.5 <sup>1</sup>	1.3	100.0	137.5	11.0 <sup>2</sup> a	27.5
Granular + weekly foliar A	2.0	1.0	70.0	102.5	2.0 b	14.5
Granular + biweekly foliar A	1.5	2.8	62.5	100.0	2.3 b	17.5
Granular + weekly foliar B	2.5	3.3	77.5	117.5	5.7 ab	25.5
Granular + biweekly foliar B	2.8	3.0	95.0	167.5	9.3 ab	26.0
Granular 1	2.0	3.8	85.0	120.0	3.3 ab	21.0
Granular 2	4.8	6.8	80.0	100.0	5.0 ab	23.0
Granular 3	2.3	4.0	85.0	120.0	8.7 ab	21.0
msd p=0.05	NS	NS	NS	NS	8.6	NS

<sup>1</sup>Count of lesions per plot. Mean of 4 replicates.

<sup>2</sup>Percent area determined by point quadrats: mean of 100 points x 4 replicates.

Means within columns followed by the same letter are not significantly different (Tukey's HSD test, p=0.05)

the treatments (Aug 17), all of the treated plots were less affected than the control, but only the treatments with Protocal + Enfoss were significantly lower than the control. These two treatments had the lowest level of infection overall, but all plots had unacceptable levels of infection.

### **DISCUSSION AND CONCLUSIONS**

There were consistent and significant differences among the treatments in turf quality as estimated by canopy reflectance. All of the treatments were significantly better than the untreated check on most dates. Within the fertilizer/supplement treatments the pattern was less consistent, though generally the two treatments with Protocal alone (“foliar B”) had lower quality.

There was a clear connection between turf quality

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