

2008 Petro-Canada Product Evaluation Integrated Disease Management on Fairway Turf

Frank S. Rossi, Ph.D. and Mary C. Thurn
Department of Horticulture

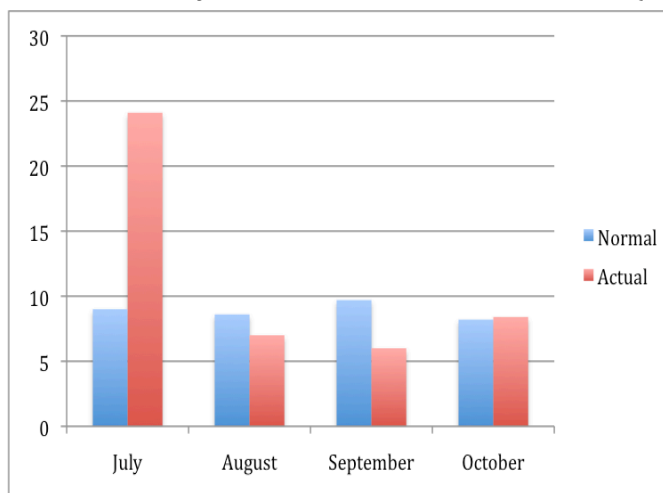
Objective

The objective of this study was to evaluate the potential of Petro-Canada experimental products to reduce reliance on traditional synthetic fungicides for disease management in golf course fairway turf.

Methodology

The study was established in a completely randomized design with three replications. The treatments included a control (fertilizer only) and nineteen rate/interval combinations of Petro-Canada products, Daconil, Banner, Emerald and Endorse. Initial treatments were made on July 4 and continued for 16 weeks (final regular treatment made on October 22). A final snow mold treatment was made on December 15, 2008 (snow mold data will not be discussed).

Treatments were applied to experimental plots (4' x 4') established at the Cornell University Turfgrass Research Center in Ithaca, NY on a mixed stand of creeping bentgrass/annual bluegrass (*Agrostis palustris*/*Poa annua*) soil-based fairway turf (pH=6.7).



The turf is mowed three times per week at 0.380" and clippings collected. Fertility program includes ammonium sulfate, iron sulfate and Primo plant growth regulator applied every 7-10 days. Annual nitrogen rate was 2.5 lbs per 1000 sq feet, iron is applied at 2-4 ounces per application and Primo at 0.125 ounces of product per 1000 square feet per application. Straight sand topdressing (pH 6.0) is applied every 14 days as straight sand, typically in conjunction with light vertical mowing or grooming. Precipitation was above normal in the early season and remained at or about normal and therefore supplemental irrigation was not required on a regular basis.

Golf traffic is simulated daily during the season using a modified traffic device with two 0.5 meter diameter rollers that spin at different speeds to create slipping motion. The rollers are fitted with SoftSpikes. The amount of spikes and passes used are designed to simulate 30,000 rounds of golf.

Chemical applications were made with a handheld CO₂ sprayer at 40 psi (276 kPa) fitted with TeeJet XR8015 nozzles calibrated to deliver 2 gallons (7.6 liters) of water per 1,000 ft² (92.9 m²).

Data were collected for turf quality, turf color, disease and clipping production. Data analysis was conducted using linear mixed models with compound symmetric covariance structure to assess over treatment effects when repeated measurements were made on the same experimental unit over time. Treatment differences at individual measurement events (where there was no rate x treatment interaction) were evaluated using analysis of variance and Fisher's protected least significant difference (LSD). The MIXED and GLM procedures in SAS/STAT software version 9.1 (SAS, Cary, NC) were used to perform the analyses.

Table 1. Treatment list

Trt#	Product	Rate/1000 (oz/1000)	Interval (days)
1	Untreated, fertilizer only	-	-
2	Banner	0.5	21
3	Banner	1	21
4	Daconil	1	14
5	Daconil	2	14
6	Emerald	0.18	28
7	Endorse	4	14
8	PC2: Pack A	14.5	
	PC2: Pack B	1.8	
	Banner	0.5	21
9	PC2: Pack A	14.5	
	PC2: Pack B	1.8	
	Banner	1	21
10	PC2: Pack A	7.25	
	PC2: Pack B	0.91	
	Banner	1	21
11	PC2: Pack A	14.5	
	PC2: Pack B	1.8	
	Daconil	1	14
12	PC2: Pack A	14.5	
	PC2: Pack B	1.8	
	Daconil	2	14
13	PC2: Pack A	7.25	
	PC2: Pack B	0.91	
	Emerald	0.18	28
14	PC2: Pack A	7.25	
	PC2: Pack B	0.91	
	Endorse	4	14
15	PC1	8.7	14
16	PC1	17.4	14
17	PC1	22.5	14
18	PC1	8.7	
	Banner	0.5	21
19	PC1	8.7	
	Daconil	1	14
20	PC1	8.7	
	Emerald	0.18	28

Results

Turf Quality

Turf quality was assessed on 5 occasions using a scale of 1 to 9; where 1 = poor quality, 9 = excellent quality, and 6 = acceptable quality. There were significant differences among treatments on all rating dates and when averaged over the entire season.

Severe disease infestation significantly reduced turfgrass quality ratings in all treatments without adequate disease suppression treatments (Figure 1). The addition of the PC2 Pack A and B in treatments 8 through 14 demonstrated significant improvement in turfgrass quality when compared to the traditional chemical treatments, i.e., Banner, Daconil, Endorse, Emerald. In several cases especially with EPA classified “reduced risk” compounds such as Endorse and Emerald, the addition of the PC 2 product increased turfgrass quality from unacceptable (<6.0) to greater than 8 on two of the five rating dates.

In almost every case the addition of the PC products improved turfgrass quality except for the Daconil combinations where there appeared to be some phytotoxicity associated with the tank mix combination. The nature of this response is not fully understood at the time.

When averaged over the entire season turfgrass quality was the best for all treatment combinations with Banner. In fact, treatments 8-10 demonstrates the potential flexibility with formulation, rate and spray interval that is afforded with this combination. Furthermore the PC 1 combination with Banner as also among the highest rated treatments for turfgrass quality.

Figure 1. Treatment effects on turfgrass quality ratings

Treatment	17-Jul	24-Jul	22-Aug	1-Sep	17-Sep
1	5.2	3.1	1.0	1.0	1.0
2	6.2	5.7	5.6	5.5	5.9
3	6.8	5.8	5.9	5.3	5.6
4	5.2	5.4	5.4	5.1	5.7
5	5.8	6.1	6.3	6.2	6.3
6	7.0	6.4	6.6	5.8	6.1
7	6.2	5.0	4.9	4.8	5.1
8	7.2	7.6	8.0	7.7	8.6
9	7.5	7.6	8.0	7.9	8.7
10	7.4	8.3	8.5	7.9	9.0
11	6.5	6.6	6.8	6.5	6.8
12	7.1	6.4	6.6	6.1	6.4
13	6.8	8.2	8.4	5.7	6.1
14	6.6	8.1	8.4	6.5	7.0
15	6.1	6.2	6.2	5.6	5.9
16	5.8	5.9	5.9	6.5	6.7
17	5.7	5.9	5.8	6.8	7.2
18	6.9	6.3	6.5	7.1	7.6
19	5.5	5.9	5.9	5.6	5.9
20	6.6	6.7	6.7	5.6	6.0
LSD (p=0.05)	0.7	0.3	0.4	0.4	0.4

Figure 2. Treatment effects on season-long turfgrass quality ratings

Trt																					
10	8.2	a																			
9	7.9	a																			
8	7.8	a	b																		
14	7.3		b	c																	
13	7.1		b	c	d																
18	6.9			c	d	e															
11	6.6				d	e	f														
12	6.5					e	f	g													
6	6.4						f	g	h												
20	6.3						f	g	h	i											
17	6.3						f	g	h	i											
16	6.1							g	h	i	j										
5	6.1							g	h	i	j										
15	6.0								h	i	j										
3	5.9									i	j										
2	5.8										j	k									
19	5.8										j	k									
4	5.3											k	l								
7	5.2												l								
1	2.3																				m
(p=0.05)																					
<i>Turf quality averaged across all rating dates; means followed by the same letter are not significantly different</i>																					

Dollar Spot

Incidence of dollar spot was evaluated on three occasions by estimating the percentage of the plot affected by disease. There were significant differences among treatments on all rating dates and when averaged over the entire season.

The disease incidence response was similar to the turfgrass quality response in that the addition of the PC2 product at a variety of rates and intervals consistently reduced disease incidence. Specifically, the combinations with Banner (treatments 8-10) at 21-day intervals reduced dollar spot by 95 to 100 percent when compared to Banner applied alone. Interestingly, dollar spot control with Emerald applied at 28-day intervals was slightly enhanced on two of the three rating dates when combined with PC2.

There are clear benefits associated with the use of the PC products for reducing rates and extending intervals with traditional chemical fungicides. The reduction in dollar spot averaged over the season show that there are a number of tank mix combinations worthy of further investigations.

Figure 3. Treatment effects on dollar spot incidence

Treatment	17-Jul	24-Jul	1-Sep
1	27.3	75.0	86.7
2	1.3	23.3	16.7
3	0.7	15.7	15.0
4	24.3	21.7	26.7
5	11.0	5.7	10.0
6	0.3	6.0	13.3
7	11.3	27.3	21.7
8	1.0	0.0	0.0
9	0.0	0.0	0.0
10	0.0	0.0	0.0
11	9.3	7.3	6.7
12	7.7	7.0	13.3
13	0.7	0.0	10.0
14	8.7	0.0	11.7
15	10.3	10.0	13.3
16	12.7	15.0	13.3
17	12.7	18.3	6.7
18	1.3	7.7	0.0
19	15.7	9.0	16.7
20	1.0	7.7	15.7
LSD (p=0.05)	7.2	5.1	4.1

Figure 4. Treatment effects on dollar spot incidence averaged over the entire season.

1	63.0	a			
4	24.2	b			
7	20.1	b			
2	13.8	c	d		
19	13.8	c	d		
16	13.7	c	d		
17	12.6	c	d		
15	11.2		d		
3	10.4		d		
12	9.3		d		
5	8.9		d	e	
20	8.1			e	
11	7.8			e	
14	6.8			e	
6	6.6			e	
13	3.6		e	f	g
18	3.0		e	f	g
8	0.3			f	g
9	0.0				g
10	0.0				g

Disease incidence averaged across all rating dates; means followed by the same letter are not significantly different.

Normalized Difference Vegetation Index (NDVI)

NDVI, a measure of live green vegetation that provides an objective measure of turfgrass density and color, was assessed on August 15 using an TCM 500 meter from Spectrum Technology. Three readings per plot were used to obtain an average value. There were no significant differences among treatments.

Figure 5. Treatment effects on NDVI measurements.

Treatment	15-Aug
1	0.721
2	0.736
3	0.733
4	0.726
5	0.740
6	0.731
7	0.739
8	0.730
9	0.741
10	0.736
11	0.747
12	0.737
13	0.733
14	0.743
15	0.728
16	0.715
17	0.698
18	0.723
19	0.728
20	0.740
LSD (p=0.05)	NS

Clippings

Clippings were collected on September 23. A strip was mowed down the center of the plot, clippings collected, dried and weighed (grams). There were significant differences among treatments.

There were slight increases in clipping production associated with the high rate of PC in combination with Banner (treatment 8) and Daconil (treatment 12). However there appeared to be a slight growth regulating effect associated with Emerald treatment in combination with PC1 and PC2 when compared to Emerald applied alone.

Figure 6. Treatment effects on turfgrass clipping production.

Treatment	23-Sep
1	1.3
2	2.0
3	2.7
4	1.3
5	2.3
6	1.9
7	1.8
8	3.3
9	1.5
10	2.0
11	2.3
12	2.9
13	0.9
14	1.1
15	2.4
16	2.0
17	2.2
18	2.5
19	1.2
20	1.4
LSD (p=0.05)	1.0

Summary

The evaluation of the PC products for use in an integrated disease management program demonstrated the potential for improved turfgrass quality while reducing the rate of traditional fungicides. Specifically treatment combinations with Banner and Emerald provided high quality, disease-free turf using extended intervals thereby not only reducing traditional fungicide rate but also labor and fuel costs associated with treating large acreage.

Additional research will be required to further understand the nature of the enhanced quality and growth responses that may allow for further reductions in nutrient use. Additionally, a more thorough assessment of reduced risk and biological product combinations would further enhance the environmental compatibility of disease management programs for fairway turf.