

# PERFORMANCE OF WASTE-BASED SLOW-RELEASE FERTILIZER ON CREEPING BENTGRASS PUTTING GREEN TURF

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Sponsor: Rothsay

## OBJECTIVE

The objective of this research project was to determine the performance of the sponsor's fertilizer product on creeping bentgrass putting green turf on a high sand rootzone.

Data collected included the duration and strength of the color response following applications of the tested products, shoot growth rate, turf quality, uniformity, and density, and resistance of the turf to disease and drought stress.

## EXPERIMENTAL DESIGN / METHODS

The treatments consisted of the sponsor's product at the recommended rate and program, as well as industry standard controlled release products at 250 kg actual N ha<sup>-1</sup> yr<sup>-1</sup> and split over 5 monthly applications (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 putting green on the USGA green at the Guelph Turfgrass Institute (mowing at 4 mm, irrigation to prevent stress) (Figure 1). Treatments were replicated five times in a randomized complete block design. Treatments were applied from June 6, June 20, July 7, August 4, and September 1, 2006 according to the recommended program.

Color response of the turf to treatments

Table 1. Treatments

Treatment	g actual N m <sup>-2</sup> per application <sup>1</sup>
1 Rothsay Renew 9-3-3	5.0
2 Milorganite 6-2-0	5.0
3 Sustane 4-6-4	5.0
4 Control	—

<sup>1</sup>Applied 06/06, 06/20, 07/07, 08/04, 09/01



Figure 1. Plot area on creeping bentgrass putting green turf.

was assessed regularly, both visually and using instrumental color (full spectrum colorimeter, Spectrum CM1000 chlorophyll meter, and Greenseeker normalized difference vegetation index [NDVI] meter). Uniformity of the color response was assessed visually. Plots were also rated for turf quality, density and uniformity. Clippings were collected, dried and weighed to determine shoot dry matter accumulation per unit area. Other stresses were measured as they occurred (disease, weed, drought). Spring greenup will be assessed in April 2007. An anecdotal photographic record of the experiment was kept.

All measurements were analysed by appropriate statistical analyses (general linear models).

## RESULTS

*Visual ratings: Color, quality, uniformity, density.* All treatments, including the control, exhib-

ited acceptable functional features when rated visually once the fertilizer treatments had been applied (Table 2). Some significant differences were observed in the plots. The three fertilizer treatments had similar ratings on many dates, usually better than the control when the differences were significant. Again, when differences among the fertilizers were significant, generally the Rothsay and Milorganite treatments were superior to the Sustane treatment, especially later in the season.

*Instrumental color and chlorophyll index data.*

There were significant differences among treatments in full spectrum color parameters on some dates (Table 3). Generally, only the lightness and hue angle parameters of the full spectrum color readings are meaningful in turf evaluation. The Sustane treatment was darker than the other two treatments on one date (July 11, after 3 applications), but not on other dates. Hue angle (“greenness”) showed the most consistent pattern, especially later in the season, with all three fertilized treatments significantly greener than the control. After three applications (July 11), the Rothsay and Milorganite treatments were slightly greener than the Sustane treatment.

The two chlorophyll meters measure very similar parameters in the turf, namely a ratio of

absorbed vs reflected light at a reference wavelength and at a wavelength at which chlorophyll absorbs (in the case of the Spectrum chlorophyll meter, 800 and 740 nm respectively). The patterns of treatment effects on chlorophyll index/NDVI and by inference chlorophyll content and nitrogen fertility status were very similar between the two sets of data (Tables 4 and 5, Figures 2 and 3). All fertilized plots had significantly higher chlorophyll index readings than the control by two weeks after the first treatment, and where there were significant differences among the fertilizer treatments, the order was generally Rothsay > Milorganite > Sustane. On most dates, the Rothsay treatment had significantly higher chlorophyll index than either Milorganite or Sustane. The NDVI reading showed less difference among the fertilized treatments, though generally the patterns were the same.

*Shoot growth estimated by tissue dry weight.*

Patterns in the clipping collection data (Table 6) were similar to the color and chlorophyll data. All fertilized treatments produced significantly more growth than the control by the middle of the season; The Sustane had a significant flush of growth after the first treatment (6/12), and the Rothsay treatment a similar flush by the time two applications had been made (7/04). The order of growth rate among the fertilized plots varied from

Table 2. Visual ratings of treated plots.

Treatment	05/25	06/08	06/16	06/23	06/29	07/06	07/14	07/25	08/01	08/11	08/22	08/28	09/14	09/26	10/06
<i>Color<sup>1</sup></i>															
Control	6.2	7.0	6.8	6.4 b	7.0 b	7.0 b	7.0 b	7.0 b	7.4	7.0 b	7.4 b	7.0 c	7.0 b	7.2 b	7.0 b
Milorganite	6.2	7.0	7.0	7.4 a	7.2 b	8.0 a	8.0 a	7.2 b	7.6	8.0 a	8.0 a	8.0 a	8.0 a	8.0 a	8.0 a
Sustane	6.0	7.0	7.0	7.4 a	7.4 ab	7.7 a	8.0 a	7.8 a	7.8	8.0 a	8.0 a	7.6 b	7.8 a	7.7 a	7.2 b
Rothsay	6.1	7.0	6.8	8.0 a	7.8 a	7.9 a	8.0 a	7.8 a	8.0	8.0 a	8.0 a	8.0 a	8.0 a	8.0 a	7.8 a
lsd p=0.05	NS	NS	NS	0.6	0.6	0.3	0.0	0.5	NS	0.0	0.4	0.4	0.3	0.4	0.4
<i>Quality<sup>1</sup></i>															
Control	6.2	6.6 ab	6.2 b	6.3 b	6.0 b	7.0	6.0 c	7.0 c	6.4	6.3 b	6.8 b	7.0 b	6.8 b	7.0 b	6.4 c
Milorganite	6.2	6.8 a	7.0 a	7.0 a	6.2 b	7.1	8.0 a	7.1 bc	6.6	7.2 a	7.4 ab	7.6 a	7.9 a	7.4 b	8.0 a
Sustane	6.0	7.0 a	6.8 a	6.9 a	6.4 ab	7.2	8.0 a	7.4 a	6.8	7.6 a	7.8 a	7.6 a	7.4 ab	7.2 b	7.2 b
Rothsay	6.1	6.2 b	6.2 b	7.0 a	6.8 a	7.4	7.6 b	7.3 ab	7.0	7.1 ab	7.8 a	8.0 a	8.0 a	8.0 a	7.8 a
lsd p=0.05	NS	0.6	0.5	0.3	0.6	NS	0.4	0.3	NS	0.8	0.6	0.5	0.6	0.5	0.6
<i>Uniformity<sup>1</sup></i>															
Control	6.2	6.6 ab	6.2 b	6.3 b	6.0 b	7.0	6.0 c	7.0 c	6.4	6.3 b	6.8 b	7.0 b	6.8 b	7.0 b	6.4 c
Milorganite	6.2	6.8 a	7.0 a	7.0 a	6.2 b	7.1	8.0 a	7.1 bc	6.6	7.2 a	7.4 ab	7.6 a	7.9 a	7.4 b	8.0 a
Sustane	6.0	7.0 a	6.8 a	6.9 a	6.4 ab	7.2	8.0 a	7.4 a	6.8	7.6 a	7.8 a	7.6 a	7.4 ab	7.2 b	7.2 b
Rothsay	6.1	6.2 b	6.2 b	7.0 a	6.8 a	7.4	7.6 b	7.3 ab	7.0	7.1 ab	7.8 a	8.0 a	8.0 a	8.0 a	7.8 a
lsd p=0.05	NS	0.6	0.5	0.3	0.6	NS	0.4	0.3	NS	0.8	0.6	0.5	0.6	0.5	0.6
<i>Density<sup>1</sup></i>															
Control	7.0	6.6 ab	6.2 b	7.4	6.0 b	7.0	7.0 b	7.0 c	6.4	6.4 b	7.2 b	7.0 b	6.8 b	7.0 b	6.4 c
Milorganite	7.0	6.8 a	7.0 a	8.0	6.2 b	7.4	8.0 a	7.1 bc	6.6	7.2 a	7.8 a	7.6 a	7.9 a	7.8 a	8.0 a
Sustane	7.0	7.0 a	6.8 a	7.8	6.4 ab	7.4	8.0 a	7.4 a	6.8	7.6 a	7.8 a	7.6 a	7.4 ab	7.6 a	7.2 b
Rothsay	7.0	6.2 b	6.2 b	8.0	6.8 a	7.6	8.0 a	7.3 ab	7.0	7.4 a	8.0 a	8.0 a	8.0 a	8.0 a	7.8 a
lsd p=0.05	NS	0.6	0.5	NS	0.6	NS	0.0	0.3	NS	0.7	0.5	0.5	0.6	0.5	0.6

<sup>1</sup>All visual ratings are on a scale of 0-10, with 10 being best and 6 being acceptable. Means within columns followed by the same letter are not significantly different (Fisher's protected LSD, p=0.05).



Table 3. Instrumental color readings of treated plots (Minolta CR310 colorimeter).

Treatment	05/25	06/14	07/11	08/11
<b>Lightness<sup>1</sup></b>				
Control	41.2 <sup>4</sup>	37.2 b	41.3 a	41.0
Milorganite	41.1	40.0 a	40.3 a	40.8
Sustane	40.8	37.2 b	38.6 b	40.6
Rothsay	41.6	38.9 ab	40.3 a	41.0
lsd p=0.05	NS	2.0	1.4	NS
<b>Chroma<sup>2</sup></b>				
Control	12.8	11.2	16.0 a	15.1
Milorganite	12.6	12.7	15.3 a	15.4
Sustane	12.3	11.3	14.0 b	15.2
Rothsay	13.1	12.1	16.0 a	15.8
lsd p=0.05	NS	NS	1.2	NS
<b>Hue angle<sup>3</sup></b>				
Control	100.8	118.7	117.2 c	119.6 b
Milorganite	105.0	119.1	121.1 a	122.3 a
Sustane	100.6	124.1	119.1 b	121.9 a
Rothsay	105.6	122.0	121.7 a	122.6 a
lsd p=0.05	NS	NS	1.2	1.7

<sup>1</sup> Lightness 0 (black) to 100 (white).

<sup>2</sup> Chroma (vividness or color saturation) 0 (grey) to 60 (fully saturated)

<sup>3</sup> Hue angle 0 to 360 degrees; in the range observed, lower values are yellower, higher are greener.

<sup>4</sup> Means of 5 readings x 5 replicates; means within columns followed by the same letter are not significantly different (Fisher's protected LSD, p=0.05)

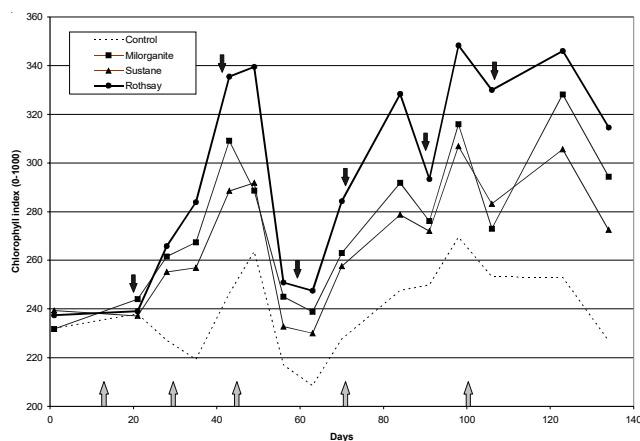


Figure 2. Chlorophyll index readings in treated plots. Grey arrows indicate treatment application dates. Black arrows are clipping collection dates.

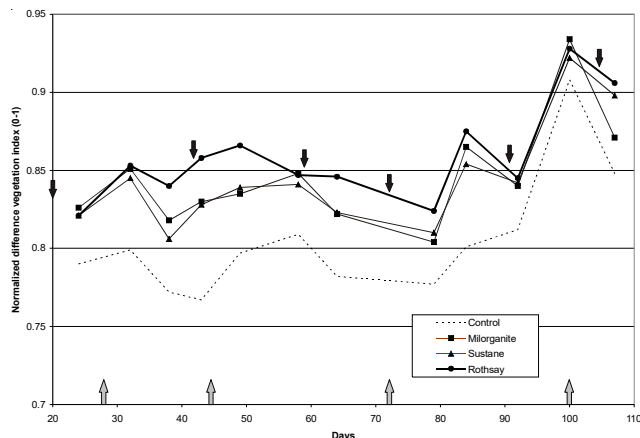


Figure 3. Normalized difference vegetation index readings in treated plots. Grey arrows indicate treatment application dates. Black arrows are clipping collection dates.

Table 4. Chlorophyll index in treated plots.

Treatment	05/23	06/12	06/19	06/26	07/04	07/10	07/17	07/24
Control	232.1 b <sup>1</sup>	238.0	227.2 c	219.3 d	246.3 d	263.6 c	217.0 c	208.5 d
Milorganite	231.8 b	244.0	261.5 a	267.4 b	309.1 b	288.6 b	245.0 a	238.8 b
Sustane	239.4 a	237.2	255.2 b	256.9 c	288.5 c	291.8 b	232.8 b	230.0 c
Rothsay	237.4 a	239.1	265.8 a	283.9 a	335.5 a	339.5 a	250.9 a	247.5 a
lsd p=0.05	5.0	NS	5.8	8.4	11.5	8.1	6.8	7.3
Treatment	07/31	08/14	08/21	08/28	09/05	09/22	10/03	
Control	227.7 c	247.6 d	249.9 c	269.5 d	253.2 d	252.9 d	226.9 d	
Milorganite	263.0 b	291.8 b	276.1 b	315.9 b	273.0 c	328.2 b	294.4 b	
Sustane	257.6 b	278.7 c	272.0 b	306.9 c	283.2 b	305.6 c	272.5 c	
Rothsay	284.3 a	328.4 a	293.4 a	348.3 a	330.0 a	346.0 a	314.6 a	
lsd p=0.05	7.3	7.9	6.5	7.3	7.2	8.8	7.3	

<sup>1</sup>Chlorophyll index (0-1000), measured with Spectrum CM1000 chlorophyll meter; higher value indicates more absorbance of light at 740 nm and by inference a higher chlorophyll concentration. Means of 10 readings x 5 replicates. Means within columns followed by the same letter are not significantly different (Fisher's protected LSD, p=0.05).

Table 5. Normalized difference vegetation index in treated plots.

Treatment	06/15	06/23	06/29	07/04	07/10	07/19
Control	0.790 c	0.799 b	0.772 d	0.767 c	0.797 c	0.809 b
Milorganite	0.826 a	0.851 a	0.818 b	0.830 b	0.835 b	0.848 a
Sustane	0.821 b	0.845 a	0.806 c	0.828 b	0.839 b	0.841 a
Rothsay	0.821 b	0.853 a	0.840 a	0.858 a	0.866 a	0.847 a
lsd p=0.05	0.0048	0.0126	0.0088	0.0052	0.0097	0.0099
Treatment	07/25	08/09	08/14	08/22	08/30	09/06
Control	0.782 c	0.777 c	0.801 d	0.812 b	0.908 c	0.848 c
Milorganite	0.822 b	0.804 b	0.865 b	0.840 a	0.934 a	0.871 b
Sustane	0.823 b	0.810 b	0.854 c	0.842 a	0.922 b	0.898 a
Rothsay	0.846 a	0.824 a	0.875 a	0.845 a	0.928 ab	0.906 a
lsd p=0.05	0.0107	0.0109	0.0066	0.0094	0.0103	0.0125

<sup>1</sup>NDVI (0-1), measured with Greenseeker meter; higher value indicates more absorbance of light and by inference a higher chlorophyll concentration. Means of 10-20 readings x 5 replicates. Means within columns followed by the same letter are not significantly different (Fisher's protected LSD, p=0.05).

date to date, but the Milorganite usually produced the least growth of the three, and the highest growth rate was either the Rothsay treatment (3 dates) or the Sustane treatment (3 dates).

## CONCLUSIONS

All fertilized treatments provided significant improvement in nitrogen status over the unfertilized control throughout the season (16 weeks plus). Differences among the fertilized treatments in visual ratings of performance (color, quality, uniformity, and density) were relatively small, but the Rothsay and Milorganite plots generally had higher ratings than the Sustane. The instrumental color, chlorophyll index, and shoot tissue accumulation data all indicated that there was significant turfgrass response to all three fertilizer treatments, particularly after the second application. There was a clear superiority of the Rothsay treatments in the chlorophyll index, while the difference was less marked in the NDVI readings. Growth rate data did not indicate the same clear cut ranking among the fertilizer treatments. Generally, the Rothsay fertilizer performed as well as or better than either of the industry standards.