Field trial of effects of TerraBioGen liquid and granular organic fertilizer on performance of established Kentucky bluegrass home lawn turf on a soil rootzone with standard and reduced fertilizer regime

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Sponsor: TerraBioGen

The objective of this research project was to compare the effects of the sponsor's organic fertilizer products on performance, root and shoot growth of established Kentucky bluegrass home lawn turf on a soil rootzone under a standard and reduced fertilizer program.

Data collected included: 1. turf performance (color , quality, density, uniformity) estimated visually and by canopy reflectance (normalized-difference vegetation index) 2. total root system growth.

MATERIALS/METHODS

The experimental design was eight management treatments (sponsor's products at single rates, combined with an industry standard urea fertilizer at nominal 1/2x and 1x rates (2.5 and 5 g actual N m^{-2}), and untreated controls at the two urea rates – see Table 1). Each treatment was replicated four times in 1 x 3 m plots on a mixed Kentucky bluegrass home lawn type turf at the Guelph Turfgrass Institute (Figure 1). Treatments were arranged in a randomized complete block design.

Figure 1. Plot area in Kentucky bluegrass research range, August 15, 2012.

Treatments were applied July 23 (urea) and 24 (products), August 31, and September 24. Urea and liquid products were applied with a compressed air sprayer; the granular product SG was applied with a hand shaker. The nominal 1/2x and 1x urea rates as applied were 2.2 and 4.4 g N m^{-2} (July 23), 1.9 and 3.9 g N m^{-2} (August 31, and 1.7 and 3.3 g N m^{-2} (September 24).

Canopy reflectance was measured with the Greenseeker NDVI meter. Other performance features (colour, quality, uniformity, density) were assessed visually. Assessments of other

Table 1. Treatment list.

Treatment		Rate ai L ha^{-1}	Volume L ha^{-1}	Frequency	Fertilizer kg N 100 m^{-2}	Frequency
1	Control 1x	—	—	—	0.5	28 D
2	Control 1/2x	—	—	—	0.25	28 D
3	LC	2.5	300	28 D	0.5	28 D
4	LC	2.5	300	28 D	0.25	28 D
5	F4	0.1	100	28 D	0.5	28 D
6	F4	0.1	100	28 D	0.25	28 D
7	FX	0.1	100	28 D	0.5	28 D
8	FX	0.1	100	28 D	0.25	28 D
9	SG	100 kg ha^{-1}		28 D	0.5	28 D
10	SG	100 kg ha^{-1}		28 D	0.25	28 D

stresses as may occur naturally (insect, disease) were made as they occurred.

Plots were maintained on a normal home lawn program, with mowing at 60 mm and irrigation to prevent stress, except for drought stress test periods. No pesticides or other management other than mowing and irrigation were applied.

Root systems were sampled prior to the beginning of the experiment and again at the end of the season. Core samples were collected, root systems were washed free of soil, length (depth) and density was measured, and root systems were dried (60°C for 48 hours) and weighed for dry matter accumulation.

An anecdotal photographic record of the experiment was kept.

Winter survival and spring greenup will be assessed in spring of 2013.

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

RESULTS

Environmental data

Daily air and soil temperatures for May - October 2012 are presented in Figures 2 and 3. Because of failures in weather station equipment at the GTI, we do not have on-site precipitation information, but Figure 4 shows the precipitation records at the Region of Waterloo International Airport (YKF), which is about 20 km from the GTI.

Turf quality

There were no treatment effects on turf colour, quality, density, or uniformity.

Canopy reflectance

The canopy reflectance (NDVI) data from the plots indicated no differences among treatments until the last observation date, October 19 (Table 2). There was an increase

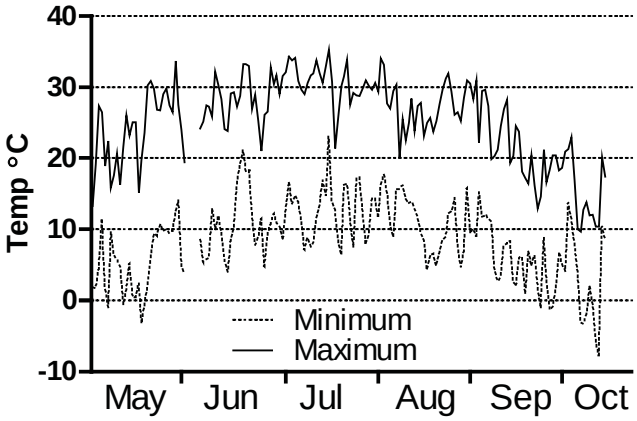

Figure 2. Daily air temperatures at GTI, summer 2012.

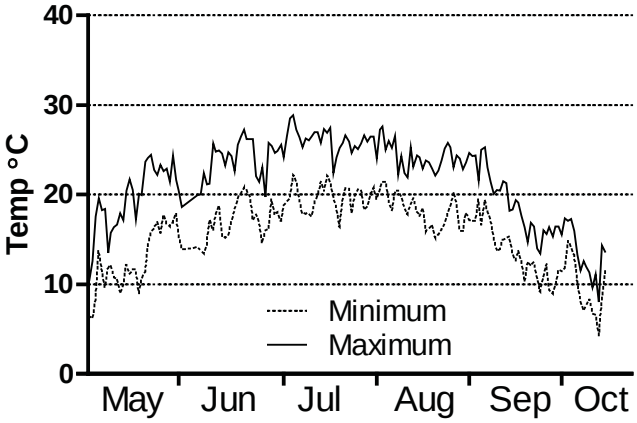

Figure 3 Daily soil temperatures at GTI, summer 2012.

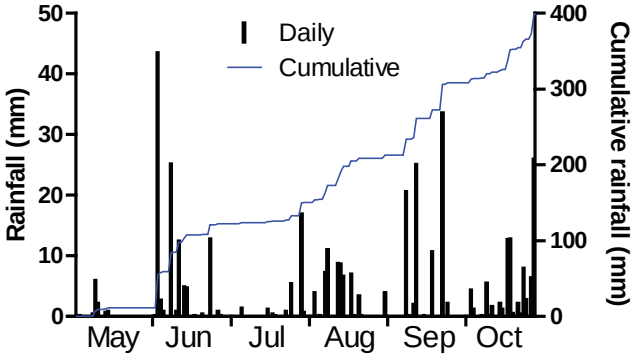

Figure 4. Daily rainfall at Region of Waterloo International Airport (YKF), summer 2012.

Table 2. Canopy reflectance in treated plots.

Treatment	07/23	07/25	07/27	07/30	07/31	08/02	08/03	08/07	08/09
Control 1/2x	0.467	0.457	0.496	0.529	0.537	0.559	0.557	0.586	0.619
Control 1x	0.447	0.471	0.510	0.553	0.558	0.592	0.592	0.613	0.643
F4 1/2x	0.522	0.513	0.551	0.577	0.579	0.595	0.600	0.622	0.649
F4 1x	0.469	0.473	0.519	0.552	0.568	0.593	0.590	0.618	0.640
FX 1/2x	0.443	0.454	0.492	0.523	0.528	0.555	0.554	0.588	0.616
FX 1x	0.425	0.457	0.500	0.536	0.543	0.575	0.575	0.599	0.632
LC 1/2x	0.490	0.472	0.510	0.539	0.534	0.562	0.568	0.593	0.627
LC 1x	0.463	0.476	0.515	0.555	0.564	0.587	0.575	0.605	0.634
SG 1/2x	0.453	0.451	0.487	0.518	0.531	0.559	0.561	0.584	0.618
SG 1x	0.468	0.455	0.499	0.538	0.553	0.581	0.583	0.621	0.645
	08/13	08/15	08/16	08/20	08/24	08/28	08/31	09/05	09/07
Control 1/2x	0.627	0.624	0.624	0.606	0.632	0.639	0.646	0.641	0.675
Control 1x	0.651	0.632	0.635	0.628	0.642	0.625	0.647	0.641	0.682
F4 1/2x	0.649	0.628	0.647	0.623	0.642	0.643	0.646	0.636	0.662
F4 1x	0.644	0.641	0.637	0.616	0.638	0.631	0.650	0.634	0.685
FX 1/2x	0.628	0.623	0.626	0.607	0.639	0.639	0.648	0.640	0.669
FX 1x	0.633	0.627	0.624	0.614	0.634	0.631	0.645	0.627	0.675
LC 1/2x	0.630	0.618	0.620	0.612	0.617	0.626	0.637	0.640	0.672
LC 1x	0.637	0.635	0.633	0.612	0.625	0.630	0.641	0.631	0.654
SG 1/2x	0.624	0.610	0.613	0.608	0.632	0.638	0.650	0.638	0.676
SG 1x	0.649	0.628	0.642	0.624	0.644	0.645	0.654	0.645	0.679
	09/10	09/17	09/24	09/28	10/02	10/10	10/19		
Control 1/2x	0.644	0.683	0.688	0.636	0.654	0.652	0.648 cd		
Control 1x	0.647	0.702	0.712	0.642	0.655	0.650	0.670 abc		
F4 1/2x	0.642	0.689	0.695	0.638	0.660	0.640	0.643 d		
F4 1x	0.647	0.698	0.709	0.639	0.659	0.658	0.675 a		
FX 1/2x	0.644	0.699	0.700	0.643	0.659	0.649	0.649 cd		
FX 1x	0.646	0.691	0.701	0.632	0.658	0.653	0.668 abc		
LC 1/2x	0.646	0.701	0.700	0.636	0.656	0.639	0.651 bcd		
LC 1x	0.643	0.680	0.698	0.629	0.655	0.654	0.672 ab		
SG 1/2x	0.642	0.685	0.697	0.642	0.659	0.645	0.649 cd		
SG 1x	0.656	0.706	0.709	0.640	0.657	0.655	0.664 a-d		

[1]Normalized-difference vegetation index: mean of 4 replicates; means within columns followed by the same letter are not significantly different (Tukey's HSD test, p=0.05).

in all plots after the first nitrogen application, but by the second and third applications the canopy reflectance had stabilized at a high level. The significant differences observed on the last date were primarily N rate differences, with the cumulative effect of three 1x N applications producing higher NDVI values in those treatments than the ½ x treatments. There was no indication of any interaction between the N fertility and the 4 product treatments.

Root system growth

Pre-treatment root samples, collected June 5, 2012, showed some variation among individual

Table 3. Root system measurements, pre- and post-treatment.

Treatment	07/05 (pre treatment)		10/10 (post treatment)			
	Dry weight (mg)	Core depth (cm)	Dry weight (mg)	Total length (m)	Average diameter (mm)	Total volume (cm^3)
Control 1/2x	0.418[1]	22.4	0.128[2]	25.0	0.186	0.70
Control 1x	0.510	22.0	0.163	30.0	0.186	0.83
F4 1/2x	0.532	21.3	0.142	26.8	0.189	0.76
F4 1x	0.349	21.3	0.120	19.7	0.194	0.57
FX 1/2x	0.455	21.4	0.155	25.4	0.196	0.81
FX 1x	0.466	20.9	0.116	23.3	0.176	0.59
LC 1/2x	0.446	21.1	0.140	26.1	0.188	0.74
LC 1x	0.419	19.6	0.125	23.9	0.182	0.62
SG 1/2x	0.473	21.6	0.147	28.5	0.184	0.77
SG 1x	0.354	22.5	0.110	18.4	0.184	0.51

[1] Mean of 2 cores x 4 replicates.
[2] Mean of 5 cores x 4 replicates.

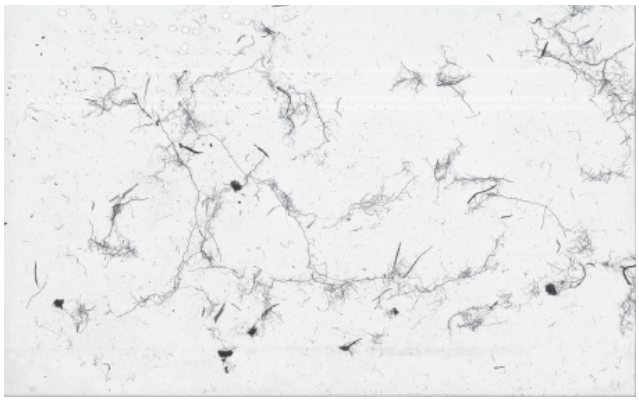

Figure 5. Typical root system scan used by the WinRhizo software to measure root system parameters.

cores, but no significant pattern of variation across the plots (Table 3). Post-treatment cores were collected October 10, 2012; the sample size was increased to 5 cores (2 cm diameter x 25 cm depth) per plot. Cores were washed and root systems analyzed on the WinRhizo root analysis equipment (Figure 5) for average root diameter, total root length and volume, and root systems were then dried to determine total dry weight (Table 3). There were no significant differences among treatments in any of the post-treatment root parameters. The increase in sample size resulted in much less plot to plot variation in root parameter estimates. The WinRhizo measurements included length and volume, as well as other parameters, in 10 root diameter classes. Only the overall values are presented here. There were no treatment effects in any of the more detailed measurements.

DISCUSSION AND CONCLUSIONS

Canopy reflectance data showed no treatment effects apart from a small rate effect of the N treatments late in the season.

The turf quality was consistently high in all plots, and no stresses were observed which reduced colour, quality, uniformity or density.

Pre-treatment root samples showed a very uniform pattern across the plot area. Post treatment root data showed no statistically significant differences among treatments for any characteristics, but there was a trend toward decreased root systems (length, diameter, volume and dry weight) in treatments with higher amounts of urea added (1x treatments), except for the control plots.