Performance of organic fertilizers on low- to medium-maintenance Kentucky bluegrass-perennial ryegrass-fine fescue home lawn type turf on poor rootzones - 2012

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The objective of this research project was to determine the performance of the sponsor's fertilizer product at various rates on low maintenance home lawn type turf on a poor quality rootzone.

Data collected included the duration and strength of the color response following applications of the tested products.

MATERIALS/METHODS

The 9 treatments consisted of single applications of the sponsor's product at 5 rates, as well as a standard slow release synthetic fertilizer product (ProTurf Turf N (Polyon) 44-0-0 SGN 250), a slow release compost fertilizer (Aim compost homogenous product 20-1-5) and fast release fertilizer (urea 46-0-0) at 5 g actual N m^{-2} (Table 1). An unfertilized check treatment was also included. Treatments were applied to 1 x 1 m plots of mixed species turf maintained as a low maintenance turf on a poor soil (limited topsoil, low fertility) area at the Guelph Turfgrass Institute (Figure 1). Treatments were replicated four times in a randomized complete block design. Treatments were applied September 20, 2011.

Table 1. Treatments

Treatment		N (g m^{-2})
1	C-0	0
2	C-5	5
3	C-10	10
4	C-15	15
5	C-20	20
6	C-30	30
7	Urea (46-0-0)	5
8	Slow release ProTurf Turf N (Polyon) 44-0-0 SGN 250	5
9	AIM compost Homogenous Product (20-1-5)	5

Figure 1. Plot area in low maintenance turf: September 22, 2011 (2 DAT).

Color response of the turf to treatments was assessed using canopy reflectance (Greenseeker normalized-difference vegetation index [NDVI] meter). Other stresses were be measured as they occurred (disease, weed, drought). Spring greenup will be assessed in April 2012. An anecdotal photographic record of the experiment was kept.

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

RESULTS

Canopy reflectance. The patterns of treatment effects on NDVI and by inference chlorophyll content and nitrogen fertility status were statistically significant (Table 2). The differences appeared by six days after application of the

Table 2. Canopy reflectance (NDVI) and change (ΔNDVI) in treated plots

Treatment	0	1	2	3	6	7	8	9
NDVI					DAT			
AIM compost	0.282[1]	0.300	0.277	0.337	0.329 abc	0.355 abc	0.401 bc	0.321 abc
C-0	0.278	0.295	0.268	0.324	0.294 bc	0.316 c	0.344 c	0.268 c
C-10	0.264	0.286	0.262	0.322	0.318 abc	0.360 abc	0.408 abc	0.343 ab
C-15	0.291	0.301	0.274	0.347	0.337 abc	0.369 abc	0.422 abc	0.370 ab
C-20	0.294	0.313	0.299	0.363	0.380 a	0.429 a	0.481 a	0.384 a
C-30	0.291	0.306	0.284	0.356	0.330 abc	0.385 abc	0.444 ab	0.338 abc
C-5	0.288	0.307	0.290	0.353	0.348 abc	0.382 abc	0.422 abc	0.331 abc
Slow release (Polyon)	0.272	0.294	0.263	0.337	0.291 c	0.325 bc	0.358 c	0.305 bc
Urea	0.316	0.332	0.311	0.376	0.369 ab	0.397 ab	0.443 ab	0.358 ab
ΔNDVI								
AIM compost	0.007[2]	0.011	0.012	0.016	0.039 abc	0.044 abc	0.063 bc	0.056 abc
C-10	-0.011	-0.003	-0.003	0.001	0.028 abc	0.049 abc	0.071 abc	0.078 ab
C-15	0.016	0.012	0.009	0.026	0.048 abc	0.057 abc	0.085 abc	0.105 ab
C-20	0.018	0.024	0.034	0.041	0.091 a	0.117 a	0.144 a	0.120 a
C-30	0.015	0.017	0.018	0.035	0.041 abc	0.073 abc	0.106 ab	0.073 abc
C-5	0.013	0.018	0.024	0.031	0.059 abc	0.070 abc	0.084 abc	0.066 abc
Slow release (Polyon)	-0.003	0.005	-0.003	0.016	0.002 c	0.013 bc	0.021 c	0.041 bc
Urea	0.041	0.043	0.045	0.055	0.080 ab	0.085 ab	0.105 ab	0.094 ab
msd p=0.05	NS	NS	NS	NS	0.076	0.075	0.079	0.071

NDVI	12	13	14	16	17	21	22	27
AIM compost	0.343 bc	0.375 bc	0.364 bc	0.377 cd	0.406 bc	0.434 c	0.441 c	0.472 c
C-0	0.280 d	0.304 d	0.286 d	0.294 e	0.312 d	0.346 d	0.335 d	0.339 d
C-10	0.371 abc	0.413 abc	0.401 abc	0.414 bcd	0.442 bc	0.469 bc	0.491 bc	0.522 abc
C-15	0.395 ab	0.435 ab	0.428 ab	0.453 ab	0.469 ab	0.512 ab	0.527 ab	0.564 ab
C-20	0.427 a	0.477 a	0.463 a	0.496 a	0.508 a	0.542 a	0.571 a	0.601 a
C-30	0.375 abc	0.411 abc	0.404 abc	0.435 abc	0.462 ab	0.501 ab	0.533 ab	0.577 ab
C-5	0.350 bc	0.394 bc	0.372 bc	0.390 bcd	0.405 bc	0.438 c	0.441 c	0.463 c
Slow release (Polyon)	0.319 cd	0.358 cd	0.341 cd	0.349 de	0.377 cd	0.406 cd	0.417 c	0.444 c
Urea	0.380 abc	0.412 abc	0.407 abc	0.413 bcd	0.431 bc	0.468 bc	0.472 bc	0.503 bc
ΔNDVI								
AIM compost	0.065 bc	0.074 bc	0.082 bc	0.086 cd	0.096 bc	0.091 c	0.110 c	0.133 c
C-10	0.093 abc	0.113 abc	0.119 abc	0.124 bcd	0.131 bc	0.125 bc	0.160 bc	0.183 abc
C-15	0.117 ab	0.134 ab	0.145 ab	0.162 ab	0.158 ab	0.169 ab	0.196 ab	0.225 ab
C-20	0.149 a	0.177 a	0.181 a	0.206 a	0.197 a	0.199 a	0.240 a	0.261 a
C-30	0.097 abc	0.110 abc	0.122 abc	0.145 abc	0.152 ab	0.158 ab	0.202 ab	0.238 ab
C-5	0.072 bc	0.093 bc	0.090 bc	0.100 bcd	0.094 bc	0.095 c	0.110 c	0.124 c
Slow release (Polyon)	0.041 cd	0.057 cd	0.059 cd	0.059 de	0.066 cd	0.063 cd	0.086 c	0.105 c
Urea	0.102 abc	0.112 abc	0.124 abc	0.122 bcd	0.120 bc	0.124 bc	0.141 bc	0.164 bc
msd p=0.05	0.063	0.070	0.071	0.066	0.066	0.063	0.075	0.079

NDVI	28	30	31	34	35	38	41
AIM compost	0.494 cd	0.550 c	0.516 d	0.491 de	0.490 d	0.535 d	0.550 b
C-0	0.365 e	0.417 d	0.413 e	0.370 f	0.364 e	0.407 e	0.440 c
C-10	0.556 bc	0.606 bc	0.563 bcd	0.542 bcd	0.545 bcd	0.602 bcd	0.609 ab
C-15	0.599 ab	0.634 ab	0.592 abc	0.570 abc	0.590 abc	0.627 abc	0.660 a
C-20	0.659 a	0.697 a	0.656 a	0.616 a	0.627 a	0.703 a	0.683 a
C-30	0.616 ab	0.650 ab	0.606 ab	0.601 ab	0.619 ab	0.671 ab	0.670 a
C-5	0.487 cd	0.535 c	0.527 cd	0.484 de	0.482 d	0.537 cd	0.551 b
Slow release (Polyon)	0.477 d	0.530 c	0.498 d	0.465 e	0.472 d	0.535 d	0.552 b
Urea	0.540 bcd	0.578 bc	0.561 bcd	0.527 cde	0.529 cd	0.588 bcd	0.605 ab
ΔNDVI							
AIM compost	0.132 cd	0.134 c	0.106 d	0.124 de	0.125 d	0.131 d	0.113 b
C-10	0.194 bc	0.190 bc	0.153 bcd	0.175 bcd	0.180 bcd	0.198 bcd	0.171 ab
C-15	0.236 ab	0.219 ab	0.183 abc	0.203 abc	0.224 abc	0.223 abc	0.222 a
C-20	0.297 a	0.281 a	0.247 a	0.249 a	0.262 a	0.299 a	0.246 a
C-30	0.254 ab	0.234 ab	0.196 ab	0.234 ab	0.254 ab	0.267 ab	0.233 a
C-5	0.125 cd	0.119 c	0.117 cd	0.117 de	0.117 d	0.133 cd	0.114 b
Slow release (Polyon)	0.115 d	0.114 c	0.088 d	0.099 e	0.106 d	0.131 d	0.115 b
Urea	0.177 bcd	0.162 bc	0.151 bcd	0.160 cde	0.164 cd	0.184 bcd	0.167 ab
msd p=0.05	0.079	0.077	0.075	0.072	0.078	0.090	0.087

[1]Normalized-difference vegetation index: mean of 4 replicates.

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

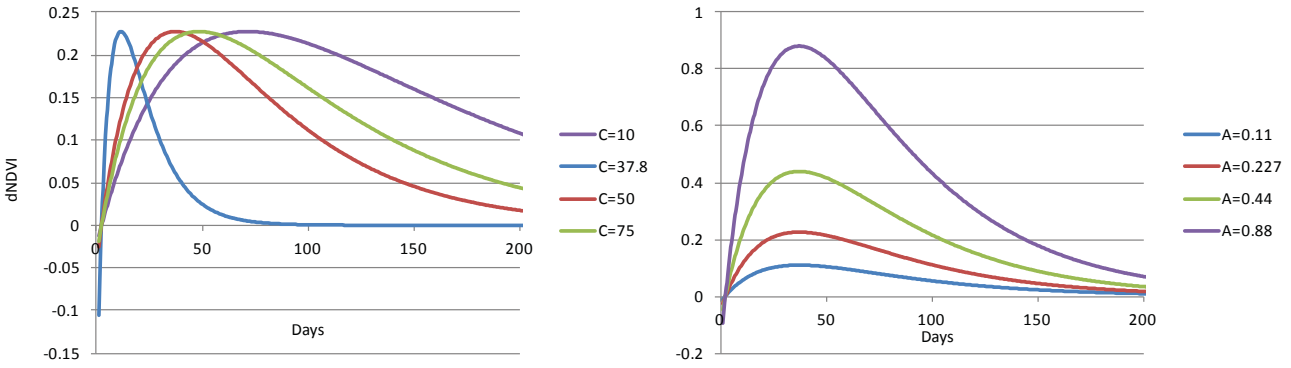

Figure 2. Families of curves of the function $\Delta NDVI = 4 \star A \star e^{(-DAT/C)} \star (1 - e^{(-DAT/C)})$ illustrating the effects of varying the parameters A and C.

fertilizer, and persisted until the end of the season. There was a clear rate effect in the experimental material, with increasing canopy reflectance up to 20 g N m^{-2}, but no additional increase from 20 to 30 g N m^{-2}.

The ΔNDVI values, when plotted over time, allowed some differentiation among the fertilizer treatments in terms of release characteristics as detected by canopy reflectance. Replicate mean values of ΔNDVI were tested against various curves to determine which functions had potential to adequately describe the responses. The online curve fitting and surface fitting web site at www.zunzun.com was used to investigate families of curves. One of the best functions to fit the data was a compound exponential function $\Delta NDVI = 4 \star A \star e^{(-DAT/C)} \star (1-e^{(-DAT/C)})$, in which there are two fitted parameters: A, which varies with maximum ΔNDVI, and C, which varies with days to maximum ΔNDVI (Figure 2). The suitability was judged based on the combination of goodness of fit, minimum number of parameters, and interpretability of the parameters.

The release curves fitted to the ΔNDVI data are shown in Figure 3 (all 5 g N m^{-2} treatments) and Figure 4 (all experimental compost treatments).

Because the application of the fertilizers was late in the season and the fertilizer material is (apart from urea) slow release, the release curves are in the early part of the curve and estimates of

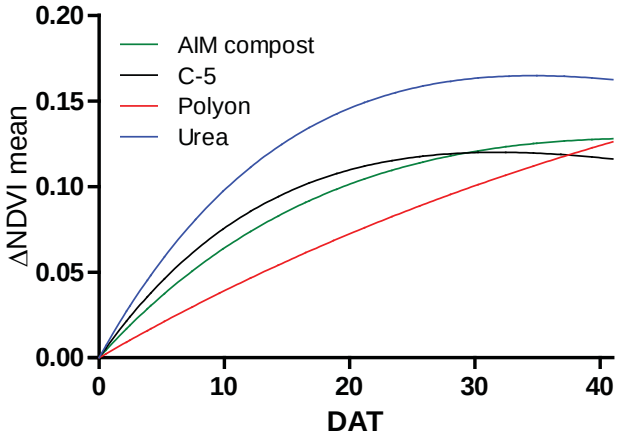

Figure 3. Curves fitted to fertilizer response as estimated by ΔNDVI. See Table 3 for estimates of A (max ΔNDVI) and C (days to max ΔNDVI). Curves are fitted to means of 4 replicates.

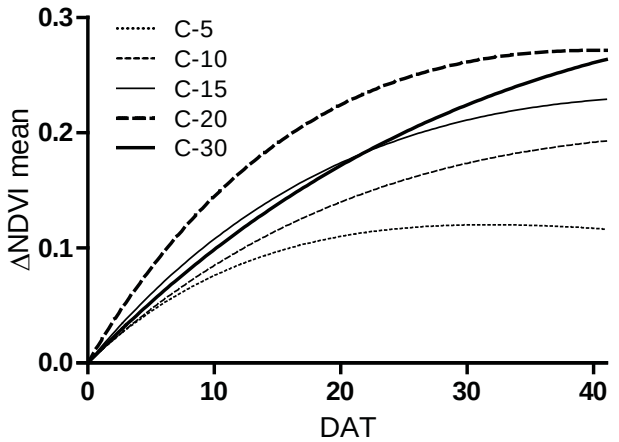

Figure 4. Curves fitted to fertilizer response as estimated by ΔNDVI. See Table 3 for estimates of A (max ΔNDVI) and C (days to max ΔNDVI). Curves are fitted to means of 4 replicates.

Table 3. Multiple comparisons of estimated parameters for fitted curves of ΔNDVI.

Treatment	A	C
AIM compost	0.13[1]	63.2
C-5	0.12	45.9
Polyon	0.20	192.5
Urea	0.16	50.0
	NS	NS
	A	C
C-5	0.12 a	45.9 a
C-10	0.20 ab	78.0 ab
C-15	0.23 bc	69.5 ab
C-20	0.27 bc	58.2 ab
C-30	0.30 c	108.0 b

[1] Parameters followed by the same letter are not significantly different (Tukey's Multiple Comparison Test, p=0.05)

Table 4. Canopy reflectance (NDVI) and change (ΔNDVI) in treated plots – spring 2012

Treatment	Apr 04	May 08	May 27	May 31	Jun 4	Jun 11	Jun 25
NDVI							
AIM compost	0.348 b	0.480 cd	0.275	0.286	0.300	0.254	0.206
C-0	0.333 b	0.438 d	0.280	0.279	0.308	0.257	0.242
C-10	0.428 ab	0.540 abc	0.311	0.314	0.328	0.273	0.220
C-15	0.415 ab	0.543 abc	0.271	0.291	0.311	0.266	0.256
C-20	0.484 a	0.593 a	0.281	0.297	0.318	0.256	0.217
C-30	0.503 a	0.592 ab	0.325	0.328	0.354	0.283	0.246
C-5	0.372 b	0.492 cd	0.299	0.312	0.337	0.270	0.264
Slow release (Polyon)	0.375 b	0.508 bcd	0.278	0.283	0.295	0.249	0.196
Urea	0.370 b	0.504 cd	0.295	0.301	0.323	0.269	0.249
ΔNDVI							
AIM compost	0.016 b	0.044 b	-0.005	0.015	-0.008	-0.003	-0.039
C-10	0.095 ab	0.103 ab	0.031	0.042	0.020	0.015	-0.025
C-15	0.082 ab	0.107 ab	-0.009	0.019	0.003	0.008	0.011
C-20	0.151 a	0.157 a	0.001	0.026	0.010	-0.002	-0.028
C-30	0.170 a	0.156 a	0.044	0.056	0.046	0.026	0.002
C-5	0.039 b	0.056 b	0.019	0.040	0.029	0.012	0.019
Slow release (Polyon)	0.042 b	0.072 b	-0.003	0.011	-0.013	-0.009	-0.049
Urea	0.038 b	0.068 b	0.015	0.030	0.015	0.011	0.004
msd p=0.05	0.096	0.083	NS	NS	NS	NS	NS

[1]Normalized-difference vegetation index: mean of 4 replicates.

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

both strength and duration of response are likely to have large errors. This is particularly true of the high rate of experimental compost material. The estimates of the strength and duration of the responses are given in Table 3.

Spring 2012 data. The patterns of treatment effects on NDVI and by inference chlorophyll content and nitrogen fertility status were statistically significant in spring 2012 (Table 4). The differences were small in April, and stronger in May as growth conditions improved. The same clear rate effect was evident as in the fall 2011 data. By the end of May the treatment effects had disappeared, in large part because the trial was unirrigated, and hot, dry weather conditions had put the turf into summer dormancy.

DISCUSSION AND CONCLUSIONS

The experimental compost fertilizer had performance similar to the standards. At comparable rates (5 g N m^{-2}), the C-5 treatment had similar strength of response to the AIM compost, but a speed of response similar to the fast release. The synthetic slow release (Polyon) had a stronger but much slower response under the experimental conditions. The different rates of the experimental compost showed the expected pattern, with increased speed and strength of response up to 20 g N m^{-2}, but no further increase from 20 to 30 g N m^{-2}.