

Field trial of effects of various rates of TerraBioGen liquid organic fertilizer on performance of established creeping bentgrass/annual bluegrass fairway turf on a sand rootzone with standard and reduced fertilizer regime

E. Lyons, K. Jordan, and K. Carey

Department of Plant Agriculture and the Guelph Turfgrass Institute,
University of Guelph, Ontario.

Sponsor: TerraBioGen

The objective of this research project was to compare the effects of various rates of the sponsor's organic fertilizer products on performance, root and shoot growth of established creeping bentgrass/annual bluegrass fairway turf on a sand rootzone under a reduced fertilizer program.

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

MATERIALS/METHODS

The experimental design included management treatments (sponsor's product at various rates in a single application, urea liquid fertilizer (53.3 g/L) at 1.8 g actual N m⁻², and an untreated control – see Table 1). Each treatment was replicated four times in 1 x 2 m plots on a mixed creeping bentgrass/annual bluegrass fairway turf on the California style sand green at the Guelph



Figure 1. Plot area on California green, August 13, 2012

Turfgrass Institute (Figure 1). Treatments were arranged in a randomized complete block design. Treatments were applied August 28, 2012 (fertilizer) and August 29 (other treatments).

Colour was assessed visually. Canopy reflectance was measured with the Greenseeker NDVI meter. Other performance features (quality, uniformity, density) were assessed visually. Assessments of other stresses as may occur naturally (insect, disease) were made as

Table 1. Treatment list.

| Treatment | Formulation Type | Rate L ha ⁻¹ ai | Application Volume L ha ⁻¹ |
|-----------|-------------------|----------------------------|---------------------------------------|
| 1 | Untreated control | | |
| 2 | TBG LC200 | LC | 500-600 |
| 3 | TBG F4 | LC | 100 |
| 4 | TBG F4 | LC | 100 |
| 5 | TBG F4 | LC | 100 |
| 6 | TBG F4 | LC | 100 |
| 7 | TBG F4 | LC | 100 |
| 8 | TBG FX | LC | 100 |
| 9 | TBG FX | LC | 100 |
| 10 | TBG FX | LC | 100 |
| 11 | TBG FX | LC | 100 |
| 12 | TBG FX | LC | 100 |



they occurred (dollarspot disease).

Plots were maintained on a normal greens program, with mowing at 4 mm and irrigation to prevent stress. No pesticide or cultural treatments 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. Pre-treatment root systems were dried (60°C for 48 hours) and weighed for dry matter accumulation. Post-treatment root systems were analysed with the WinRhizo root analysis software (total root length, average root diameter, total root volume, etc.) and then dried and weighed.

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

Apart from the effects of slight dollarspot infection in late September, there were no treatment effects on turf colour, quality, density, or uniformity (Table 2).

Canopy reflectance

The canopy reflectance (NDVI) data from the plots indicated no differences among treat-

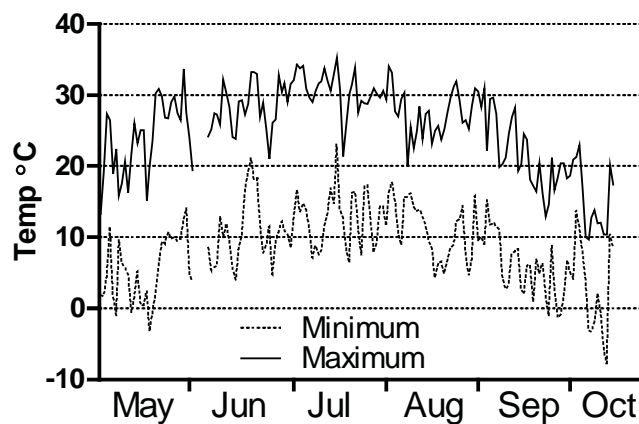


Figure 2. Daily air temperatures at GTI, summer 2012.

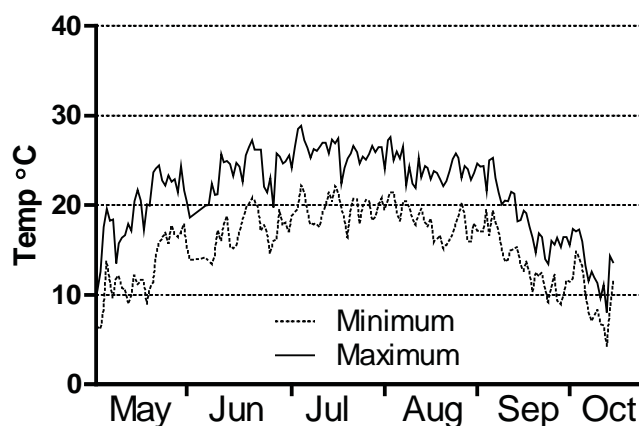


Figure 3 Daily soil temperatures at GTI, summer 2012.

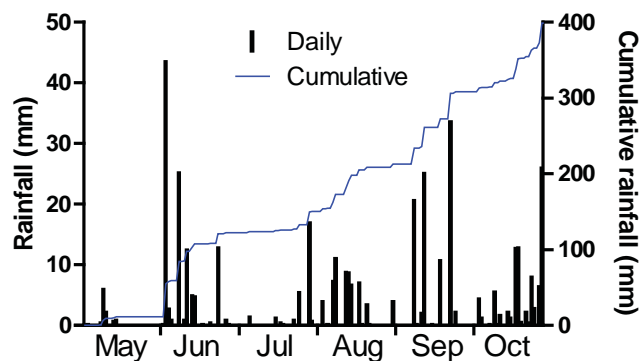


Figure 4. Rainfall at Region of Waterloo International Airport (YKF), summer 2012.

ments (Table 3). Canopy reflectance values were high, in accord with the assessed high visual quality of the turf. There was a slight decline in late October as temperatures cooled topgrowth slowed on the plots.

Root growth

Pre-treatment root samples, collected August 17, 2012, showed large amounts of variation among individual cores, but no significant pattern of variation across the plots (Table 4). Post-treatment cores were collected October 22, 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 4). 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

Table 2. Visual ratings of plots, Sept. 17 (20 DAT).

| Treatment | Dollar spot lesion count | Quality |
|-----------------|--------------------------|------------------|
| Control | 17.5 ¹ | 8.0 ² |
| TBG F4 - 0.005 | 22.0 | 7.8 |
| TBG F4 - 0.01 | 37.3 | 8.3 |
| TBG F4 - 0.05 | 9.0 | 7.5 |
| TBG F4 - 0.1 | 25.8 | 8.0 |
| TBG F4 - 0.2 | 15.3 | 8.0 |
| TBG FX - 0.005 | 23.3 | 7.8 |
| TBG FX - 0.01 | 36.8 | 8.0 |
| TBG FX - 0.05 | 17.0 | 7.8 |
| TBG FX - 0.1 | 31.5 | 7.8 |
| TBG FX - 0.2 | 12.5 | 7.8 |
| TBG LC200 - 2.5 | 11.3 | 8.0 |

¹ Mean number of lesions per 2 m² plot; means of four replicates.

² Visual quality rating, 1 – 9, 9 = best, 6 = acceptable quality

Table 3. Canopy reflectance in treated plots.

| Treatment | 07/27 | 08/28 | 08/30 | 08/31 | 09/05 | 09/07 | 09/10 | 09/17 | 09/24 | 09/28 | 10/02 | 10/10 | 10/19 |
|-----------------|--------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Control | 0.640 ¹ | 0.668 | 0.655 | 0.644 | 0.665 | 0.666 | 0.656 | 0.662 | 0.641 | 0.621 | 0.625 | 0.581 | 0.558 |
| TBG F4 - 0.005 | 0.633 | 0.668 | 0.651 | 0.649 | 0.663 | 0.661 | 0.650 | 0.657 | 0.637 | 0.616 | 0.624 | 0.581 | 0.569 |
| TBG F4 - 0.01 | 0.641 | 0.668 | 0.655 | 0.644 | 0.675 | 0.654 | 0.647 | 0.655 | 0.630 | 0.610 | 0.627 | 0.572 | 0.549 |
| TBG F4 - 0.05 | 0.633 | 0.671 | 0.655 | 0.648 | 0.663 | 0.673 | 0.659 | 0.673 | 0.648 | 0.625 | 0.631 | 0.589 | 0.576 |
| TBG F4 - 0.1 | 0.629 | 0.656 | 0.649 | 0.642 | 0.658 | 0.658 | 0.647 | 0.659 | 0.628 | 0.604 | 0.608 | 0.563 | 0.541 |
| TBG F4 - 0.2 | 0.631 | 0.665 | 0.657 | 0.644 | 0.667 | 0.671 | 0.659 | 0.674 | 0.640 | 0.616 | 0.620 | 0.577 | 0.557 |
| TBG FX - 0.005 | 0.632 | 0.665 | 0.651 | 0.640 | 0.669 | 0.657 | 0.649 | 0.654 | 0.633 | 0.609 | 0.624 | 0.571 | 0.549 |
| TBG FX - 0.01 | 0.635 | 0.663 | 0.647 | 0.640 | 0.665 | 0.648 | 0.639 | 0.649 | 0.628 | 0.605 | 0.617 | 0.579 | 0.555 |
| TBG FX - 0.05 | 0.642 | 0.655 | 0.649 | 0.638 | 0.655 | 0.659 | 0.646 | 0.656 | 0.632 | 0.606 | 0.616 | 0.567 | 0.546 |
| TBG FX - 0.1 | 0.631 | 0.657 | 0.640 | 0.631 | 0.658 | 0.647 | 0.637 | 0.648 | 0.620 | 0.599 | 0.609 | 0.566 | 0.549 |
| TBG FX - 0.2 | 0.644 | 0.668 | 0.656 | 0.651 | 0.661 | 0.673 | 0.661 | 0.673 | 0.652 | 0.624 | 0.633 | 0.592 | 0.570 |
| TBG LC200 - 2.5 | 0.630 | 0.665 | 0.654 | 0.648 | 0.660 | 0.666 | 0.657 | 0.669 | 0.642 | 0.615 | 0.623 | 0.580 | 0.560 |

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

Table 4. Root system measurements, pre- and post-treatment.

| Treatment | 08/17 (pre treatment) | | 10/22 (post treatment) | | |
|-----------------|-----------------------|--------------------|------------------------|---------------------|---------------------------------|
| | Dry weight (mg) | Dry weight (mg) | Average diameter (mm) | Total length (cm) | Total volume (cm ³) |
| Control | 72.86 ¹ | 54.20 ² | 0.205 ² | 1563.6 ² | 0.520 ² |
| TBG F4 - 0.005 | 50.44 | 48.72 | 0.200 | 1594.8 | 0.501 |
| TBG F4 - 0.01 | 74.75 | 68.97 | 0.206 | 1793.4 | 0.604 |
| TBG F4 - 0.05 | 12.15 | 57.81 | 0.200 | 1759.1 | 0.565 |
| TBG F4 - 0.1 | 57.20 | 54.90 | 0.201 | 1797.6 | 0.578 |
| TBG F4 - 0.2 | 30.41 | 57.73 | 0.200 | 1890.6 | 0.597 |
| TBG FX - 0.005 | 66.84 | 52.36 | 0.199 | 1605.9 | 0.502 |
| TBG FX - 0.01 | 41.35 | 66.38 | 0.205 | 1756.1 | 0.582 |
| TBG FX - 0.05 | 22.24 | 58.54 | 0.202 | 1728.3 | 0.560 |
| TBG FX - 0.1 | 52.04 | 67.58 | 0.207 | 1861.6 | 0.640 |
| TBG FX - 0.2 | 16.13 | 50.35 | 0.195 | 1536.8 | 0.464 |
| TBG LC200 - 2.5 | 21.89 | 54.13 | 0.199 | 1808.3 | 0.562 |

¹ Mean of 2 cores x 4 replicates.

² Mean of 5 cores x 4 replicates.



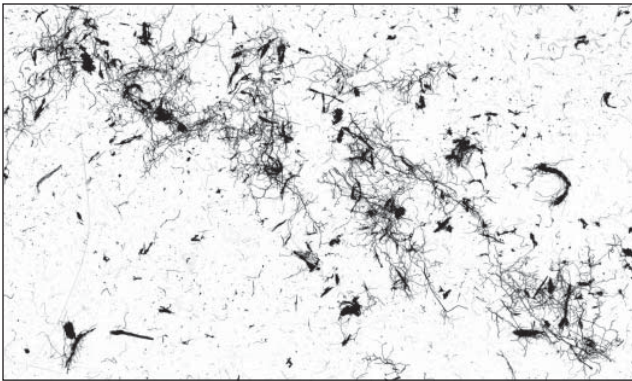


Figure 5. Typical root system scan used by the WinRhizo software to measure root system parameters.

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, which may be found in the appended data and statistical analyses.

DISCUSSION AND CONCLUSIONS

There was no evidence from either turf canopy measurements or root system measurements of any treatment effects in the plots. None of the treatments differed significantly from the untreated control in any measured characteristics.