Nitrogen Losses from Warm-season Turfgrasses During Establishment

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As potable water supplies shrink and communities grow, treated effluent is one of the few water supplies that continues to grow (Devitt et al., 2007). Watering turfgrass with treated effluent decreases the use of potable water for irrigation, and has become increasingly common particularly in the southwestern United States. However, treated effluent is often used on fully established grasses, but is currently not recommended for establishing grasses.

The research conducted this summer compared the use of tailored effluent water with the use of potable water and granular fertilizer on the establishment of warm-season turfgrasses. We defined tailored water as treated effluent with a nitrate concentration of 15 mg l^{-1}. The three warm season turfgrasses included in the study were: bermudagrass [*Cynodon dactylon* (L.)] cv. 'Princess 77', buffalograss [*Buchloe dactyloides* (Natt.) Eng.] cv. 'SWI 2000', and [*Distichlis spicata* (L.) Greene] inland saltgrass (unknown variety). All grasses are warm-season with a high drought tolerance. Inland saltgrass was added to the study this year because it is the most salt-tolerant warm-season grass, and can even be irrigated with seawater.

This study builds on past ReNUWIt projects and was designed to further understand the nitrogen cycle in turfgrass systems. Past experiments have accounted for 60–70 percent of the nitrogen inputs from either granular fertilizer or tailored water. We hypothesized that some of the nitrate applied to the system is converted to nitrous oxide gas by microbial activity in the soil. Nitrous oxide is a harmful greenhouse gas that remains in the atmosphere for 114 years and is 298 times more harmful than the equivalent amount of carbon dioxide (United States Environmental Protection Agency, 2015). Therefore, if a significant amount of nitrous oxide is emitted, turfgrass management practices must be altered to avoid such a release.

This study was conducted in a greenhouse to create a controlled environment where the amount and type of irrigation were monitored. The grasses were grown in 5-gallon containers using Bluepoint loamy sand, which was collected locally. The containers were arranged in a completely randomized design. Each type of grass and water treatment were replicated three times. Each bucket contained a suction cup lysimeter at a soil depth of 10 cm and holes at the bottom allowed for free drainage (50 cm depth).

Leachate samples were collected weekly from the suction cup lysimeters. Samples were also taken from the trays that were placed below each container and that collected the free draining water. Leachate samples were subsequently analyzed for nitrate and electrical conductivity.

Chambers were constructed from PVC cylindrical cores, which were covered with foam and foil pipe wrap insulation tape. The cylindrical core was fitted to a Gamma Seal Lid in order to create an airtight seal on the bucket. The chamber included a rubber stopper through which a 1 mL syringe was inserted to collect gas samples. Gas samples were collected bi-weekly during weeks that granular fertilizer was added to the container irrigated with potable water. During all other weeks, gas samples were collected once weekly. Gas samples were analyzed for nitrous oxide using a Varian Saturn 2000 Gas Chromatograph.

Clippings were collected and weighed weekly to determine biomass production. Pictures were taken following the collection of clippings and were analyzed for percent green coverage using SigmaScan, a program to scan for green pixels on each photograph.

Results:

Only preliminary results can be presented at this point, as the experiment will be continued until all grasses are fully established (most likely through August 2015). Our results are similar to the past two ReNUWIt experiments and indicate that bermudagrass establishment rates differed significantly based on the irrigation treatment. On July 24, 2015 (45 days after seeding), bermudagrass irrigated with tailored water had reached 83% coverage compared to 72% for bermudagrass irrigated with potable water. Contrary to bermudagrass, buffalograss and inland saltgrass establishment did not differ between irrigation treatments. Generally, inland saltgrass establishment for both tailored and potable water treatments were lower than for buffalograss and bermudagrass (Figure 1).

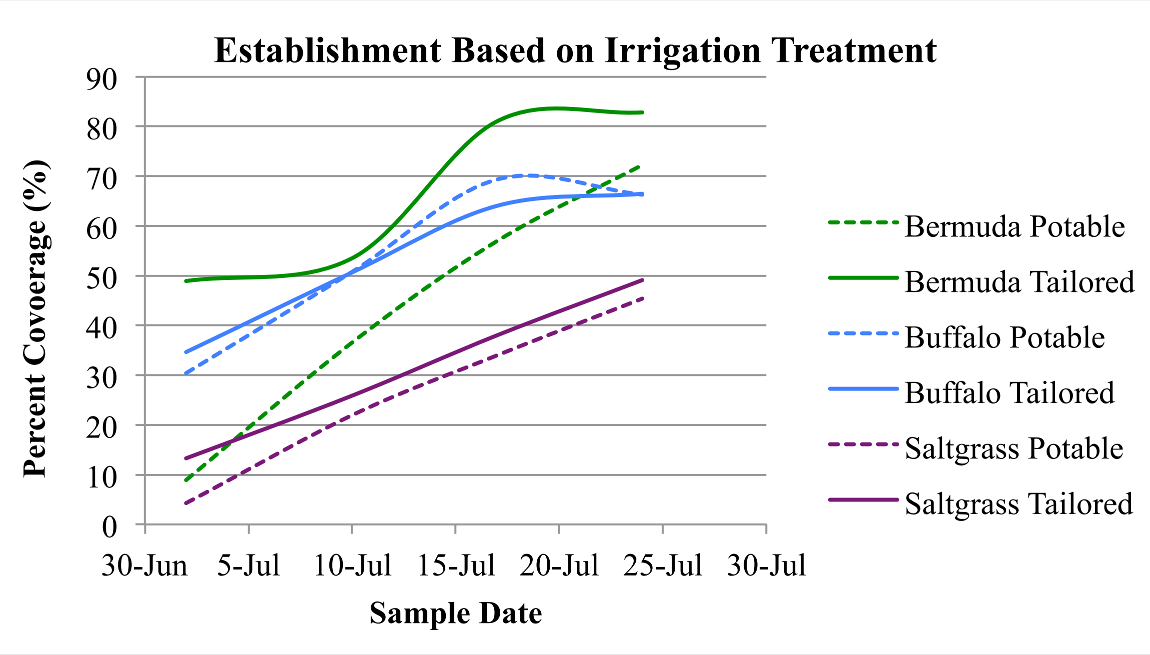

Figure 1. Establishment Based on Irrigation Treatment.

All gas samples collected were below the detectable limit for nitrous oxide (0.01% or 100 ppm). Additional tests were run with standards to determine that nitrous oxide gas could be detected by the GC and the concentration could be calculated and that nitrous oxide gas injected into in the chambers was also detectable. Both tests were successful.

Nitrate concentrations in the leachate initially exceeded the EPA standard of 10 ppm at both 10 cm and in the free draining water. However, as the grasses continued to establish, nitrate concentrations decreased in both the 10 and 50 cm depths. The addition of fertilizer to the potable irrigation water caused an increase of the nitrate concentrations at the 10 cm depth, as shown in Figures 2 and 3.

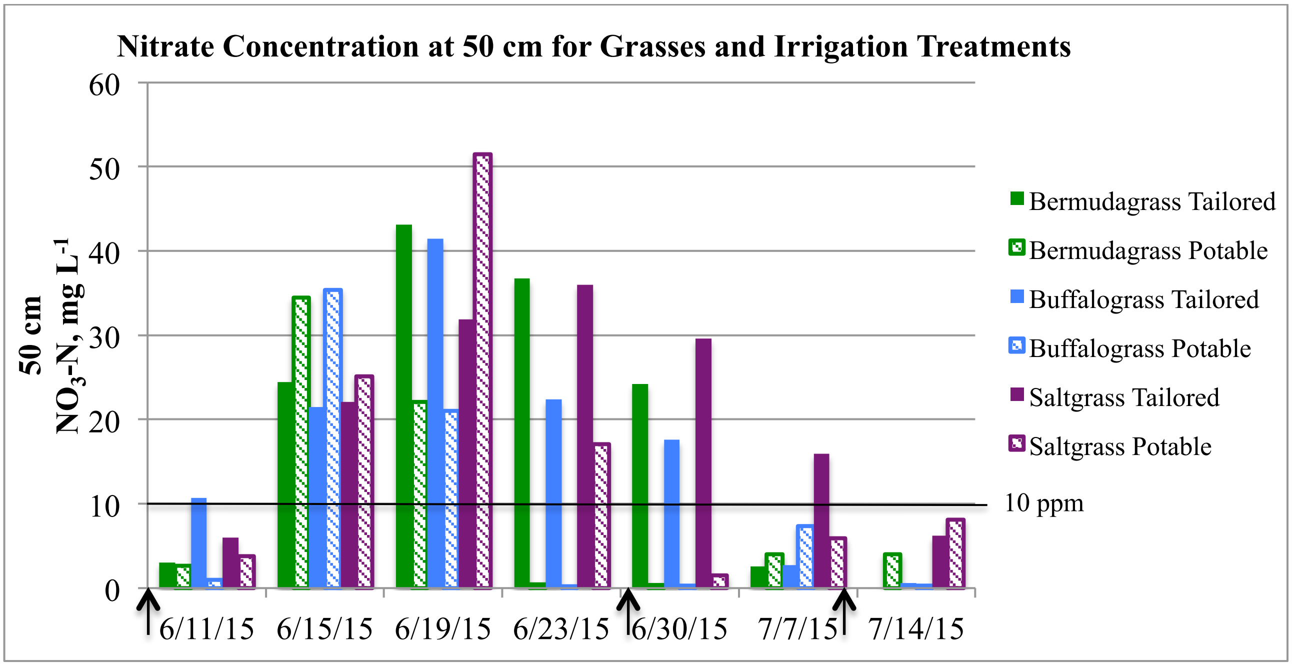

Figure 2. Nitrate Concentration at 50 cm for Grasses and Irrigation Treatments

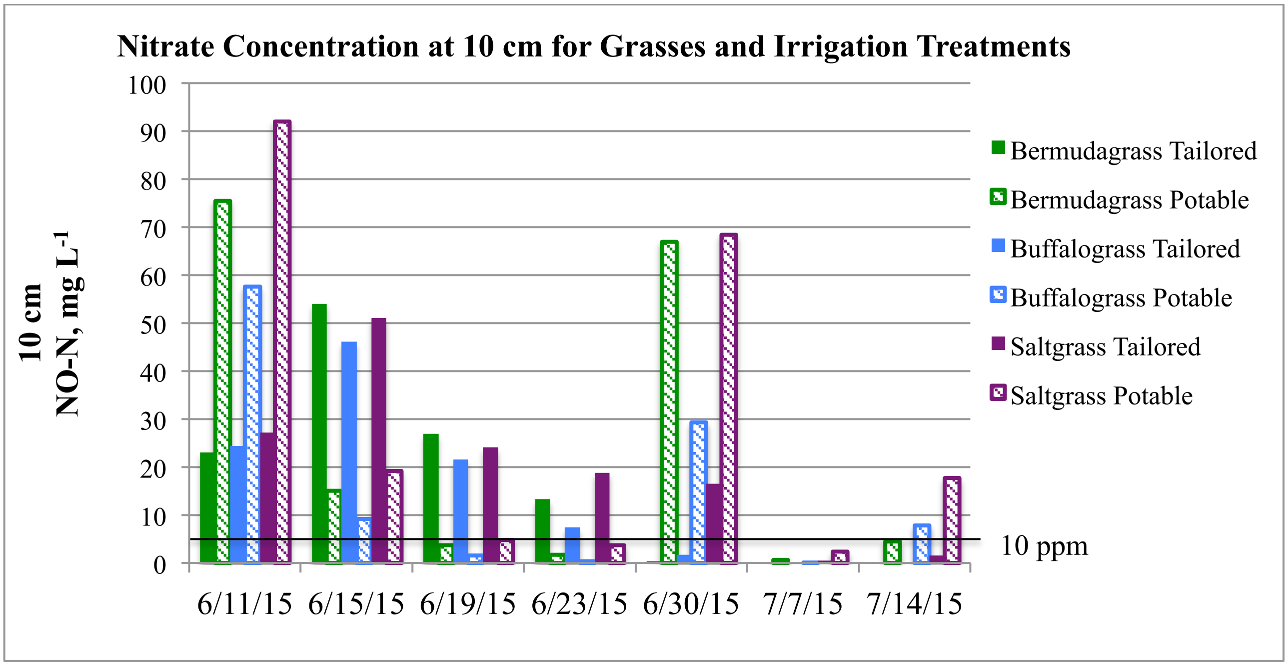

Figure 3. Nitrate Concentration at 10 cm for Grasses and Irrigation Treatments

Conclusions:

Bermudagrass established with tailored water exhibited greater coverage. The establishment of bermudagrass is much more dependent on nitrogen than the establishment of either buffalograss or inland saltgrass. Inland saltgrass establishes more slowly compared to bermudagrass and buffalograss, resulting in higher nitrate leaching. Therefore, when deciding to use potable or tailored water for the establishment of grasses, the type of grass should be considered. In our experiment, we did not find any measurable release of nitrous oxide into the atmosphere.

References

Devitt, D.A., Lockett, M., Morris, R.L., Bird, B.M. 2007. Spatial and temporal distributions of salts on fairways and greens irrigated with reuse water. Agron. J. 99: 692–700.

United States Environmental Protection Agency. 2015. Overview of greenhouse gases: nitrous oxide. http://epa.gov/climatechange/ghgemissions/gases/n2o.html (accessed July 30, 2015).