Comparison of soil properties and mineral composition of turfgrass shoots prior to and after 10 years of irrigation with effluent water

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Start Date: 2014
Project Duration: 2 years
Total Funding: $31,150

Turfgrass and Environmental Research Online
Volume 14, Number 2 | March—April 2015

Objectives:

1. *Determine chemical property changes of soil at 5 different depths prior to and after 10 years of irrigation with effluent water.*
2. *Dtermine turfgrass mineral composition prior to and after 10 years of irrigation with effluent water.*
3. *Determine soil exchangeable sodium percentage (ESP) changes along soil profile (to 1 m depth) on fairways with gypsum treatment when compared to no gypsum treatment as the control.*

A golf course study site that has been irrigated with effluent water for 10 years.

To ensure sustainable and affordable water supplies, more and more golf courses are using effluent water for irrigation. It is well documented that effluent water has marginal quality with relatively high levels of salts and nutrients. Long-term and continued use of effluent water may lead to changes in soil chemical and physical properties. However, to determine the impact of effluent water irrigation on landscape plants and soils, it is difficult to conduct long-term field monitoring due to budget limitations. One opportunity for this project is that in 2004, PI collected soil and plant baseline information for several landscape facilities (including 3 golf courses) prior to their use of effluent water for irrigation. All the sampling sites were marked physically and with GPS systems. The original soil samples were archived for measurement comparison. Baseline data are available.

In 2014,10 years after the start of effluent water irrigation for these sites, we re-sampled those sites. Soil samples were collected to a depth of 1 m at 20 cm increments at 3 golf courses. Soil cores were collected about one foot from the 2004 soil sampling locations. Samples are currently being analyzed for soil texture, electrical conductivity (dS/m), pH, exchangeable sodium percentage (ESP), soil organic matter, major soluble and exchangeable cations (Na, K, Ca, Mg, Zn, Fe), soil B and Cl concentrations, and soil P and N content. So far, we have completed 20% of the soil analysis. Preliminary results suggest that soil sodium content, sodium exchangeable percentage, and soil pH have increased after recycled water irrigation.

Concurrently, turfgrass (a mix of Kentucky bluegrass and perennial ryegrass) clippings were collected for mineral analysis. So far, we have completed about 50% of the turfgrass tissue analyses. Data from 2004 and 2014 are presented in Table 1.Ten years of effluent water irrigation has increased clipping sodium content by more than 5 times. Boron content increased about 130%, whereas tissue zinc content was reduced (Table 1).

Table 1. Mean ion concentrations in Kentucky bluegrass and perennial ryegrass clippings prior to and after 10 years of irrigation with effluent water.

Parameters (mg kg^{-1})	Prior to effluent water irrigation	After 10 years of effluent water irrigation
B	9.0**	21.5
Ca	3754	4888
Fe	296	387
K	19048	20129
Mg	1610	1239
Na	450***	3012
P	4915	5080
Zn	45.1**	34.7

, * Significant difference at $P \leq 0.005$, and < 0.001, respectively.

Despite the significant mineral content changes, turfgrasses generally exhibited good quality. We observed salinity stress on some localized sites with fine soil texture and poor drainage under effluent water irrigation.

In addition, soil exchangeable sodium percentage (ESP) and other parameters along the soil profile (1 m deep at 20 cm increments) on four locations that have been subjected to annual gypsum applications were sampled to compare to locations that did not received gypsum application. Samples are currently being analyzed for electrical conductivity (dS/m), pH, ESP, and major exchangeable cations (Na, K, Ca, Mg, Zn, Fe).

Summary Points

- All soil samples have been collected. Soil sample analyses are in progress. Preliminary results suggest that soil sodium content, sodium exchangeable percentage, and soil pH have increased after recycled water irrigation.
- Ten years of effluent water irrigation has increased clipping sodium content by more than 5 times. Boron content increased about 130%, whereas tissue zinc content was reduced.
- Despite the significant mineral content changes, turfgrasses generally exhibited good quality. We observed salinity stress on some localized sites with fine soil texture and poor drainage under effluent water irrigation.