Salinity Management in Effluent Water Irrigated Turfgrass Systems

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Objectives:

1. To determine spatial and temporal salinity accumulation patterns in soil profiles on golf course fairways with effluent water irrigation.
2. To evaluate different management practices for reducing sodium and salt accumulation in the soil.

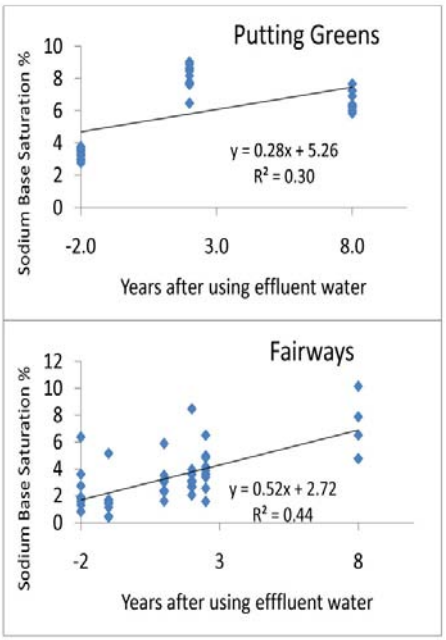
Start Date: 2008
Project Duration: three years
Total Funding: $82,459

The constituents of recycled wastewater are complex and are dependent on the source. The main constituents include total dissolved salts, nutrient elements, and small quantities of organic compounds. Golf course superintendents often have concerns about salinity accumulation when effluent water is used for irrigation. Research studying salinity accumulation patterns at field scales has been limited. Real-time soil salinity and soil water content information would provide turf professionals with insight when trying to manage turf under effluent irrigation.

Currently, we are using two types of soil sensors to monitor soil water content, soil salinity, and soil temperature changes real time and in ground. Twenty-four 5TE sensors (dielectric permittivity sensors) were installed on two fairways at the Heritage at Westmoor Golf Course in Westminster, Colorado. At each fairway, 6 plots were established. On each plot, two 5TE sensors were installed at 15 cm and 30 cm below soil surface. A total of 12 sensors were installed on each fairway. Wire leads from each sensor were buried and connected to a data logger located at the edge of the fairway.

Sensor-measured soil electrical conductivity (EC) was compared to conventional saturated paste extracted soil EC to assess data accuracy. Significant linear correlation was observed between sensor-measured soil salinity vs. saturated paste extracted soil salinity (r = 0.77). This system has been collecting salinity, moisture, and temperature data from August to November 2008 and from March to November in 2009.

Soil salinity at 15-cm depth ranged from 2 to 6 dS/m for Fairway 1 and from 1 to 4 dS/m for Fairway 10. The higher than average precipitation in 2009 reduced soil salinity from 3.0 dS/m to 1.5 dS/m measured at 30 cm below soil surface. The plots with higher soil salinity were at the edges of the fairways and likely experience increased compaction from golf cart traffic.



Changes of sodium base saturation percent with time since the initiation of using effluent water for irrigation in putting greens and fairways.

The plots with higher salinity also had greater percentages of clay content. The irrigation uniformity of study sites was 90 %. Accumulation of salts appears to relate to precipitation patterns, soil texture, the degree of compaction, and drainage effectiveness.

At Heritage Golf Course, 9 putting greens and 9 fairways were selected for regular soil testing every 2-3 years for over a 10-year period since the initial conversion to effluent water irrigation. Ten years of soil testing data show a linear correlation for the increase of particular Mehlich III extractable elements. For example, soil sodium content increases overtime with R^2 of 0.84. In addition, we have also seen increases in Mg (R^2 = 0.81), Fe (R^2 = 0.81) extractable boron (R^2 = 0.27), and phosphates (R^2 = 0.80). Increases in fairway soils ion content were observed for extractable boron (R^2 = 0.57), phosphates (R^2 = 0.57) and exchangeable Na (R^2 = 0.28).

To evaluate different management practices in reducing sodium and salts accumulations in the soil, calcium products (pelletized gypsum and liquid calcium chloride) and wetting agents (Dispatch and Primer Select) were applied to plots adjacent to the 5TE installations throughout the 2009 season. The calcium products were applied twice as a spring and fall application. Wetting agents were applied on 14-day rotation. Soil samples were taken before application and will be collected four weeks following the final fall application.

In 2009, we installed 6 Turf Guard sensors at the Common Ground Golf Course, a newly remodeled course that has transitioned to using effluent irrigation. Turf Guard sensor measurements can be accessed via a web-based interface. In lab testing, Turf Guard sensors showed strong correlation to a conventional saturated paste extracted EC measurement (r=0.73).

Summary Points

- Salinity and sodicity are among the concerns associated with effluent water irrigation.
- Fairways and putting greens irrigated with effluent water exhibited increased extractable sodium and phosphorus.
- Significant linear correlation was observed between 5TE salinity sensor-measured soil salinity, Turf Guard measured soil salinity vs. saturated paste extracted soil salinity.
- Accumulation of salts appears to relate to precipitation patterns, soil compaction level, soil texture, and drainage.