Nitrous Oxide Emissions and Carbon Sequestration in Turfgrass: Effects of Irrigation and N Fertilization

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Objectives:

1. *The main goals include evaluating the effects of irrigation on N_2O emissions and CO_2 fluxes over two years.*
2. *Cumulative N_2O emissions among treatments will be estimated over the entire study to determine how much emissions can be reduced under various irrigation levels.*
3. *The effects of irrigation on turfgrass quality and survivability will also be evaluated. Fluxes of CO_2 will be investigated with emphasis given to rates of photosynthesis (CO_2 intake) compared with respiration (CO_2 emissions) to determine the irrigation level(s) with the greatest likelihood of sequestering more carbon.*

Nitrous oxide (N_2O) and carbon dioxide (CO_2) are important greenhouse gases that have been implicated in global climate change. Furthermore, N_2O is the most important ozone–depleting substance in the atmosphere. Turfgrass systems are typically fertilized with nitrogen (N) and irrigated, which may result in significant N_2O emissions; emissions of N_2O also represent a loss of N fertilizer. Turfgrass also has the capacity to sequester or emit CO_2 from/into the atmosphere via photosynthesis and respiration. Because turfgrass covers ~50 million acres in the USA, turfgrass may have significant impacts on global atmospheric N_2O and CO_2 inventories.

Installing sod on the plot area of the rainout shelter with Meyer zoysiagrass on June 4, 2013.

The development of management practices that reduce N_2O emissions from turfgrass and enhance carbon sequestration in turf soils may help to mitigate climate change and atmospheric ozone destruction. The use of slow–release N fertilizer may mitigate N_2O emissions from turf by reducing ammonium and nitrate levels in the soil immediately after fertilization. Deficit irrigation may mitigate N_2O emissions by reducing denitrification in turfgrass soils, although deficit irrigation may also affect carbon (C) sequestration by influencing photosynthesis and respiration (i.e., CO_2 fluxes).

The primary goals of this study are to quantify the magnitude and patterns of N_2O emissions in turfgrass and to determine how irrigation and N fertilization may be managed to reduce N_2O fluxes and enhance carbon sequestration. Carbon sequestration and N_2O fluxes will be

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measured in ´Meyer´ zoysiagrass (Z. japonica) managed under deficit irrigation and fertilized with urea or slow–release N. Zoysiagrass is a warm–season turfgrass species that provides an excellent golfing surface that is commonly used for tees, fairways, and roughs in the transition zone. Fewer inputs are required in zoysiagrass, which may minimize its impacts on the environment compared to other turfgrasses.

The study is being conducted under a large rainout shelter near Manhattan, Kansas. By shielding rainfall from the turfgrass, researchers can control the amount of water applied to plots. Zoysiagrass plots were sodded on June 4, 2013 and allowed to establish during the summer of 2013. Starting in 2014, two irrigation treatments will include medium (80% evapotranspiration [ET] replacement) and medium–low (60% ET replacement). Three N–fertilization treatments will include urea and polymer–coated N, both at 2 lb/1000 ft2, and a control with no N applied.

In each treatment, N_2O emissions will be measured periodically with static chambers placed over the turfgrass surface and using gas chromatography.

Carbon sequestration in the upper soil profile (0 to 12 inches) will be measured by sampling soil C at the beginning and end of the 3–year study. Initial soil C was measured on Aug. 22, 2013. Ancillary measurements will include visual quality, percent green cover, soil moisture, temperature, and nitrate and ammonium.

Summary

- Zoysiagrass was sodded into plots in June 2013 under a large rainout shelter located in the transi–tion zone
- Carbon sequestration and emissions of N_2O will be measured from plots receiving two irrigation and three N fertilization treatments.
- Results are expected to provide golf course super–intendents with information on specific irrigation levels and N types that could reduce N_2O emis–sions and enhance carbon sequestration in zoy–siagrass fairways and roughs.

Meyer zoysiagrass in the plot area of a large rainout sheler near Manhattan, Kansas. October 21, 2013.

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