Mitigation of Nitrous Oxide Emissions from Turfgrass using Controlled Release Fertilizers

Jason D. Lewis and Dale J. Bremer

Horticulture, Forestry & Recreation Resources, Kansas State University, Manhattan, KS 66502

Introduction

Anthropogenic activities have contributed to increases in concentrations of atmospheric nitrous oxide (N_2O), a major greenhouse gas with >300 times the warming power of CO_2; 80% of all N_2O emissions are attributed to agriculture. In general, N_2O emissions are higher from croplands fertilized with nitrogen (N). Urbanization in the U.S. and elsewhere is replacing significant tracts of land once occupied by natural or agricultural ecosystems with turfgrass. In the USA in 2005, up to 20 million ha of urbanized land were covered by turfgrass (e.g., golf courses, sports fields, parks, home lawns, etc.), which represents an area three times larger than any irrigated crop.

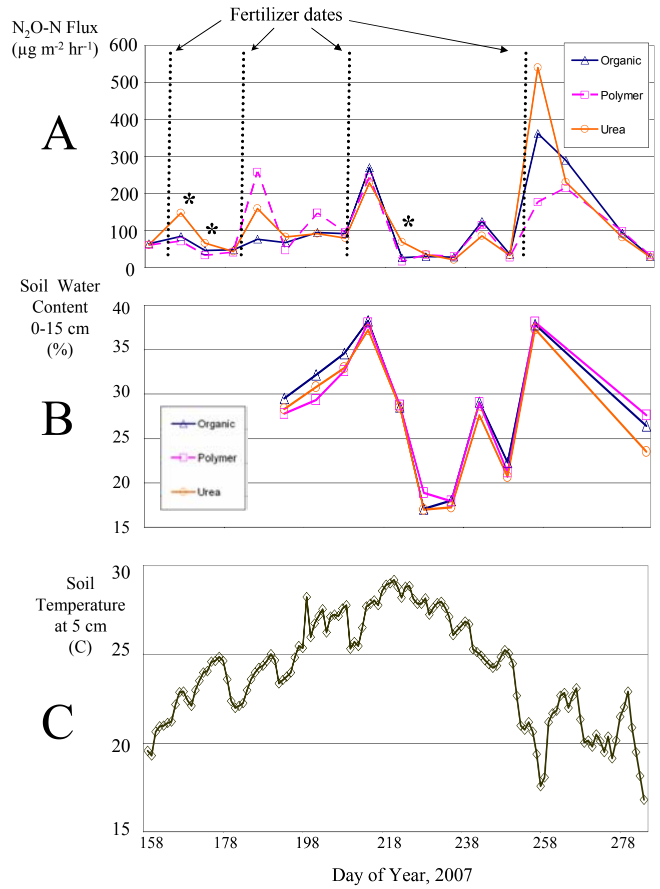
Because turfgrass is often fertilized with N, turfgrass may represent an underappreciated but significant contributor to atmospheric N_2O concentrations. Controlled-release N fertilizers may represent a best management practice (BMP) for mitigating N_2O emissions from turfgrasses because controlled-release N may slow the soil processes of denitrification and nitrification, which are major sources for atmospheric N_2O. In this study we investigated emissions of N_2O from turfgrass fertilized with two controlled-release N fertilizers and urea.

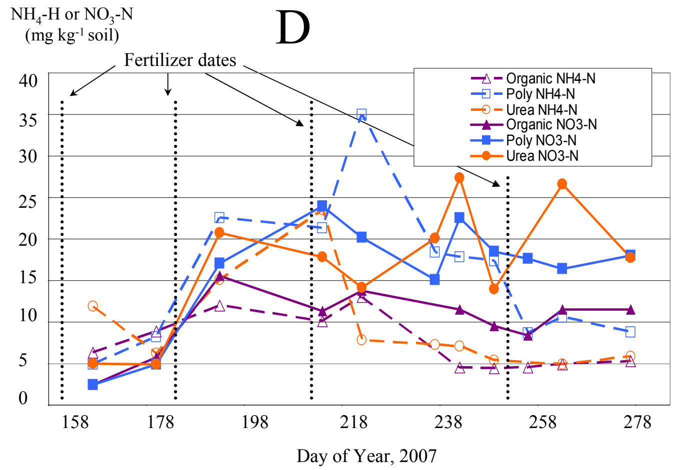
Objectives

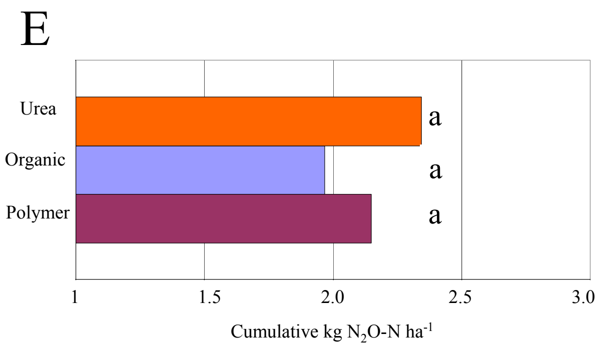
- Identify best management practices that mitigate N_2O emissions in turfgrass
- Determine if controlled-release N fertilizers reduce N_2O emissions in turfgrass

Materials and Methods

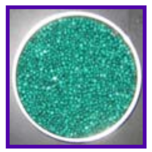
- Total nitrogen application was 200 kg N ha^{-1}
  - Polymer coated was applied once on June 15, day of year (DOY) 165
  - Organic and urea N were applied June 15, July 4, Aug 1, and Sept 12 (50 kg ha^{-1} application^{-1}; DOY 165, 185, 213, 255)
  - All plots were irrigated after fertilization (35 mm)
- Soil-surface fluxes of N_2O were measured using static surface chambers and gas chromatography
- Soil water content was measured 0-15 cm by TDR
- Soil temperature measured at 5 cm with thermocouples
- Soil NH_4-N and NO_3-N was measured from 0-15 cm
- Plots measured 2 by 2 m and were arranged in a repeated Latin Square Design
- Established bermudagrass (*Cynodon dactylon* (L.)Pers. X (*C. transvaalensis* Burtt-Davy)







Organic	Polymer Coated	Urea
Sustane, Cannon Falls, MN	Agrium, Calgary, Alberta, CA	
Controlled Release	Controlled Release	Quick Release
8-2-4	41-0-0	46-0-0



Results

A • N_2O-N fluxes (μg m^{-2} hr^{-1}) through the summer of 2007. Fluxes increased after fertilization. The * indicates when the urea fertilizer treatment had a higher flux then the organic and poly-coated fertilizer (DOY 167, 173 and 222)

B • Volumetric soil water (0-15 cm) during the summer of 2007. N_2O-N fluxes generally increased with soil water content.

C • Soil temperature (C) (5 cm); relationship between N_2O-N fluxes and soil temperature appeared weaker than with soil moisture.

D • Soil NH_4-N and NO_3-N (mg kg^{-1} of soil; 0-5 cm) from 0-15 cm soil samples.

E • Cumulative amounts of N_2O-N (kg ha^{-1}) from the summer of 2007

Conclusions

- Cumulative N_2O fluxes were statistically similar among N fertilizer sources
- N_2O fluxes generally increased with increased soil water content
- There were no significant correlations between N_2O-N fluxes and soil NH_4-N and NO_3-N measurements.
- Fluxes returned to pre N-fertilization levels after 7 to 10 days.
- Initial results suggest fertilizer type, including controlled release N, does not affect overall N_2O emissions in turfgrass
- This study will be repeated during summer of 2008

Acknowledgements

We appreciate financial support from the International Plant Nutrition Institute and the Kansas Turfgrass Foundation, and the contribution of N fertilizer from Agrium and Sustane.

Static Surface Chambers

Plot layout with collars