Nitrous Oxide Emissions As Affected By Drainage Design and Management in Corn Based-Cropping Systems.

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Introduction

- Subsurface drainage removes excess water from agricultural land and is required to optimize crop production in the Midwest U.S.A.
- The effect of subsurface drainage on nitrate load to surface water is well documented. However, there is little information about the effect of subsurface drainage on nitrous oxide (N_2O) emissions.

Objectives

- The objectives of this study were to evaluate the effect of subsurface drainage spacing on N_2O emissions.

Experimental Procedure

Field Measurements

The field research was conducted in Southeast Iowa. Nitrous oxide fluxes were measured over two growing seasons (April-Sept. 2013 and April-Oct. 2014) in continuous corn at following treatments.

- Conventional drainage (18m drainage spacing, 1.2m depth)
- Controlled drainage (18m drainage spacing, 1.2m depth, controlled drain)
- Shallow/Intensive drainage (12.2m drainage spacing, 0.75m depth)
- No-drainage plots (No drainage)

Laboratory Measurements

Two treatments with drainage extremes (i.e. No drainage vs Shallow drainage) were selected for following laboratory analyses.

- Potential denitrification through Denitrification Enzyme Assay (DEA).
- Soil organic carbon (SOC)
- Dissolved organic carbon (DOC)
- Soil mineralizable carbon

Results and Discussion

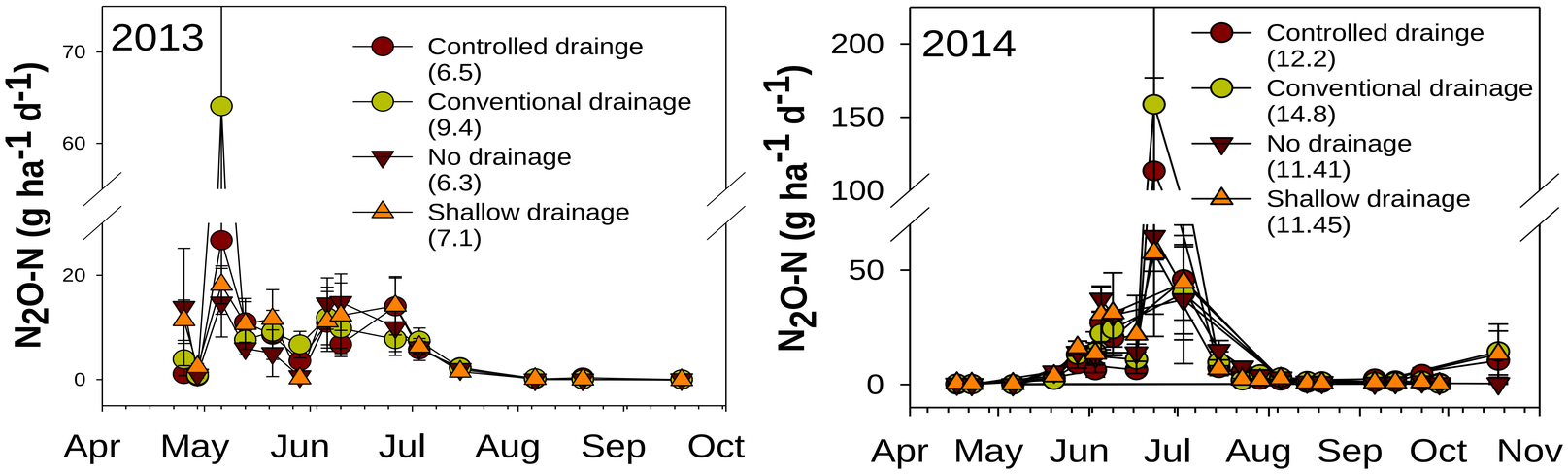

Fig. 1. In situ soil N_2O-N fluxes as determined during the growing season of 2013 and 2014 at Southeast Iowa. Seasonal mean of N_2O-N of each treatment is shown in the legend.

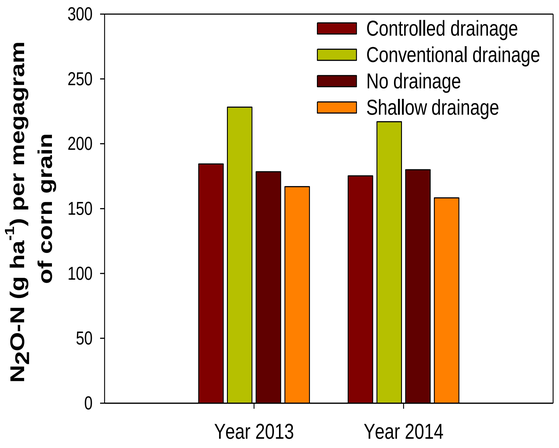

Fig. 2. Cumulative seasonal soil N_2O-N fluxes per mega-gram of corn grain yield across the treatments as determined during the growing seasons of 2013 and 2014.

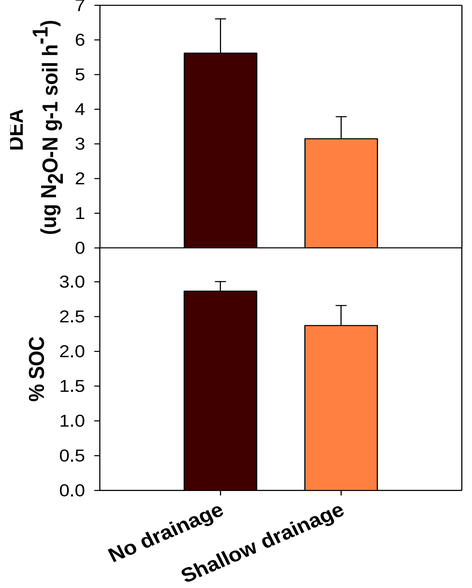

Fig. 3. Denitrification enzyme activity (DEA) and soil organic carbon (SOC) as determined from selected treatments.

- In situ N_2O fluxes did not show a clear pattern across drainage treatments in both years.
- In situ N_2O fluxes per unit of corn grain yield were higher in conventional drainage compared to no drainage treatment in both years.
- In the laboratory, potential denitrification measured as DEA was significantly higher in no-drained compared to shallow drained plots.
- The pattern of DEA was positively associated with soil organic carbon across no-drained and shallow drained treatments.

Conclusions

- In the laboratory, denitrification enzyme activity positively correlated with soil organic carbon which suggests possible differences in N_2 and N_2O as denitrification product.
- The laboratory results suggest drainage may have an effect on N_2O emissions, but our field data indicate that understanding this effect will be difficult.
- Higher denitrification enzyme activity coupled with higher soil organic carbon in no-drained plots could lead to higher N_2 and lower N_2O.

Recommendations

Due to significant differences of DEA and SOC between no-drained and shallow drained treatments, further laboratory denitrification measurements are required to detect any differences in N_2 vs. N_2O between these treatments.

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