Nitrous oxide emissions in response to adopting best management practices for nitrogen fertilization in corn production

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Introduction

- Nitrous oxide (N_2O) emissions are a global concern because N_2O is a potent greenhouse gas. Agriculture is an important sector contributing to global N_2O emissions. The 4R practices proposed by Nutrient Stewardship programs (1) have been suggested to mitigate N_2O emissions from agriculture but need to be tested in field conditions.
- Applying N fertilizer at the right time and using N sources treated with nitrification and urease inhibitors (NUI)(right source), potentialy synchronize N fertilization with plant N demands and as a consequence may mitigate N_2O emissions.

Objectives

- To assess the effect of N timing by comparing N_2O emissions from a corn field receiving urea fertilizer at planting (conventional practice) vs UAN fertilizer applied at side-dress stage;
- To assess the effect of N source by comparing N_2O emissions from a corn field receiving urea fertilizer (conventional practice) vs urea + NUI at planting, and, receiving UAN vs UAN + NUI at the side-dress stage;
- Understand the interaction effect of timing vs. source of N fertilization on N_2O emissions. For that, the conventional fertilized field will be compared to the UAN + NUI fertilized at side-dress stage field (timing + inhibitors effect).

Material and Methods

- Four 4 ha plots were used with a year-round micromet method in a 3-yr study started in May 2015 at Elora, ON, Canada. Data presented here are for planting to siling in 2015 and 2016.
- Experimental treatments:

1 - urea at planting;
2 - urea + NUI at planting;
3 - UAN at side-dress stage;
4 - UAN + NUI at side-dres stage.

N applied at planting

N applied at side-dress stage

- Rate of fertilizer: 150 kg N.ha^{-1} for all treatments (30 kg urea-N.ha^{-1} as starter + 120 kg N.ha^{-1} treatment). Dicyandiamide (DCD) and N-(n-Butyl) thiophosphoric triamide (NBPT) were used as nitrification and urease inhibitors respectively;

Flux gradient method for N_2O measurement

Sensors for soil volumetric water content measurement at 5 and 25 cm

Soil samples for inorganic N analysis at 0-15/15-30 cm depth

Results

Figure 1 - Precipitation (solid blue bars); and, soil water filled pore space - WFPS at 5 cm (solid line) and 25 cm (dashed line). The black and gray areas indicate anaerobic conditions at 5 and 25 cm, respectively.

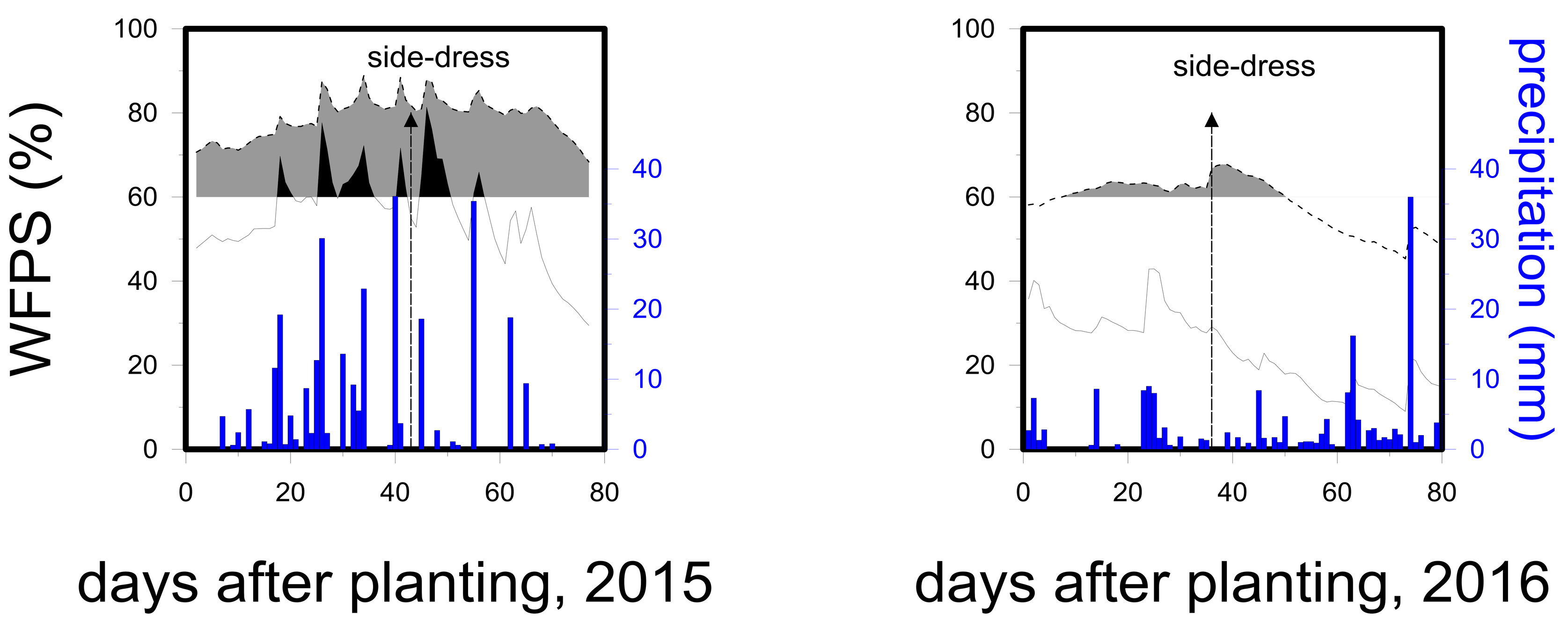


Figure 2 - N_2O flux (solid gray line with solid circles); soil nitrate at 0-15 cm (dash dot line and dark circles); and, soil nitrate at 15-30 cm (dashed line and open triangles).

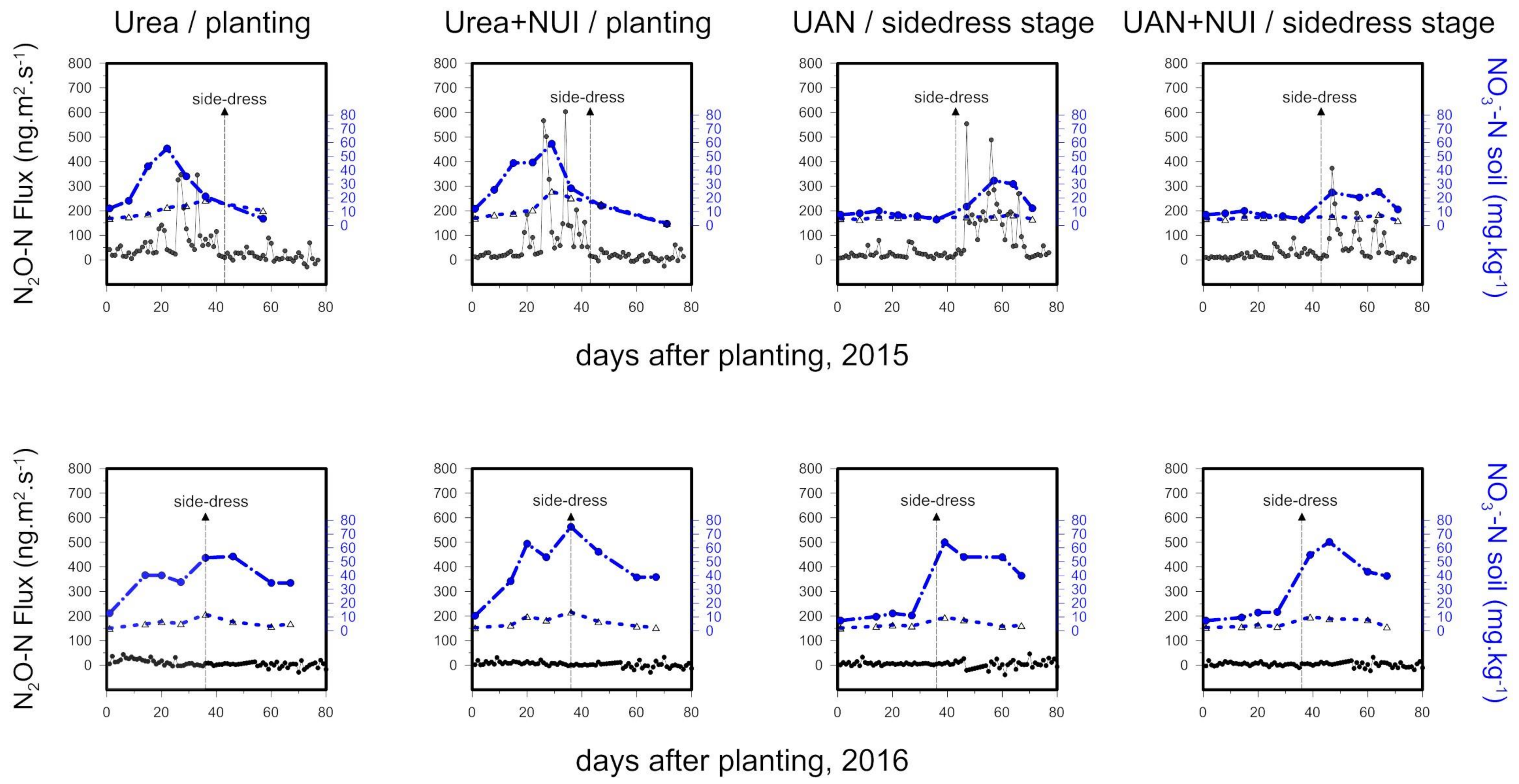
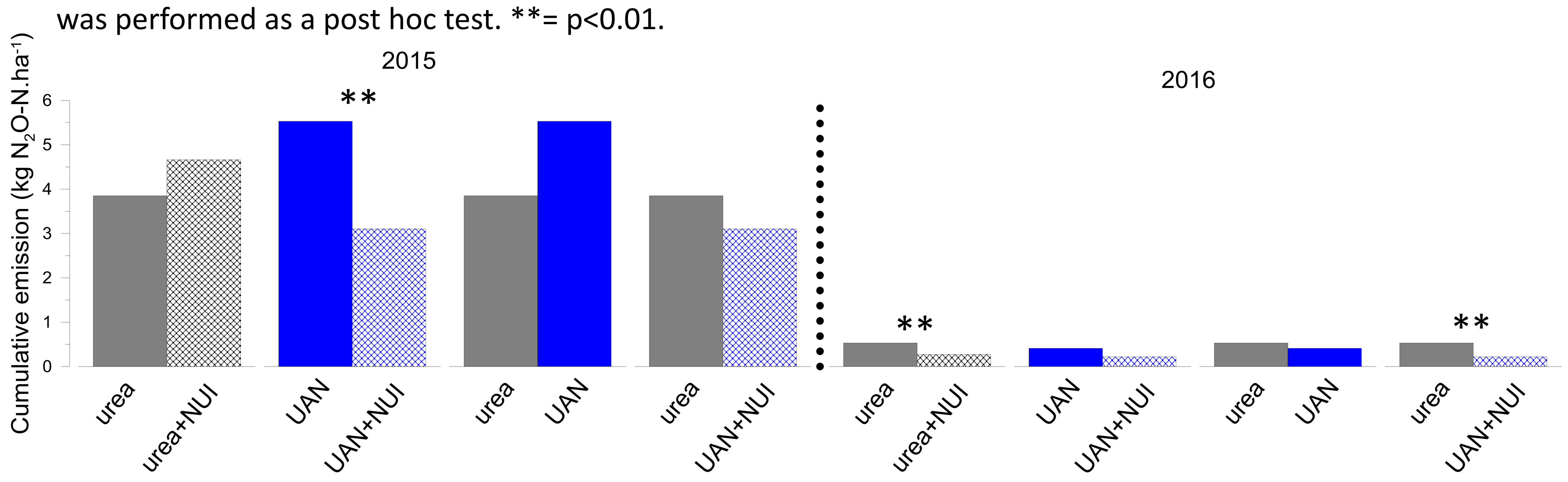


Figure 3 – Cumulative emissions and statistical analysis. Wilcoxon signed-rank test with a Bonferroni correction was performed as a post hoc test. **= p<0.01.



Summary

- Anaerobic events at 5 cm occurred after both planting and side-dress fertilization in 2015. In 2016 the soil was drier and no anaerobic condition at 5cm was seen between planting and silking stage (Figure 1);
- High emission events occurred when nitrate concentration in soil was high and after precipitation events leading to WFPS values higher than 60% (Figures 2);
- For the weather conditions experienced in the 2015 corn growing season, significantly less emission happened for the field receiving UAN + NUI compared to the field fertilized with UAN at side-dress stage. No N source effect was seen between the fields fertilized at planting. Also non signifficant was the timing effect and the interaction timing x source (Figure 3);
- Due to the drier soil conditions, significantly less emissions happened in 2016 than in 2015 (Figures 3). For 2016, applying urea + NUI at planting resulted in less N_2O emissions than just urea applied at planting; and, applying UAN + NUI at sidedress stage resulted in less emission than urea applied at planting (Figure 3);
- Corn yield and year round N_2O measurements will be considered to make recomendations. Nitrate leaching from these treatments is being considered in a separate study (see poster 125-511).

Reference

1) Snyder, C. S., Bruulsema, T. W., Jensen, T. L., & Fixen, P. E. (2009). Review of greenhouse gas emissions from crop production systems and fertilizer management effects. *Agriculture, Ecosystems & Environment*, *133*(3), 247-266.

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