Assessment of Enhanced Efficiency Fertilizers and Timing Interactions on Nitrate Leaching in Corn (*Zea Mays L.*)

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Introduction

- Nitrogen (N) fertilizers contribute to contamination of ground and surface water through nitrate (NO_3^-) leaching.
- Supplying N fertilizer at the right time has been suggested to reduce NO_3^--N leaching by synchronizing N with plant demand.
- Enhanced efficiency fertilizers (EEFs) (right source) contain nitrification and urease inhibitors (NUI) that could also reduce NO_3^--N leaching.
- The benefit of these 4R N fertilizer practices needs to be evaluated at the field scale.

Objectives

The objectives of this work were to evaluate NO_3^--N leaching under the following practices:

1. Product,
   I. Urea vs. urea+NUI (at planting)
   II. UAN vs. UAN+NUI (at sidedress)
2. And a combination of these practices
   I. Urea+NUI at planting vs. UAN at sidedress stage

Methods

- Experimental site in Elora, Ontario, Canada
- Study was started in May 2015, measurements from Nov. 2015 to July 2016
- Continuous corn system
- 30 kg N/ha applied as urea at planting
- 120 kg N/ha applied at planting (urea and urea+NUI) or at sidedress (UAN and UAN+NUI*)
  * dicyandiamide and N-(n-butyl) thiophsphoric thaimide
- Four 4 ha plots within a 30 ha micromet area (Fig. 1A.) (N_2O flux study, poster 161-902)
- NO_3^--N calculated using the following (Fig. 2A,B):

$$[NO_3^-N]_{Leached} = D * [NO_3^-N]_{80cm\ depth}$$

- Drainage calculated using a soil water budget approach[1]:

$$D = P - ET \pm \Delta S$$

- Variables were measured over 30 min, then aggregated to weekly values.
- Where:
  D = Drainage (Average of four plots)
  P = Precipitation (Tipping bucket rain gauge)
  ET = Evapotranspiration (Fig 2C. Eddy Covariance Method)
  ΔS = Change in soil water storage (Fig 1B.,2D. Calculated using WCR for soil profile.)

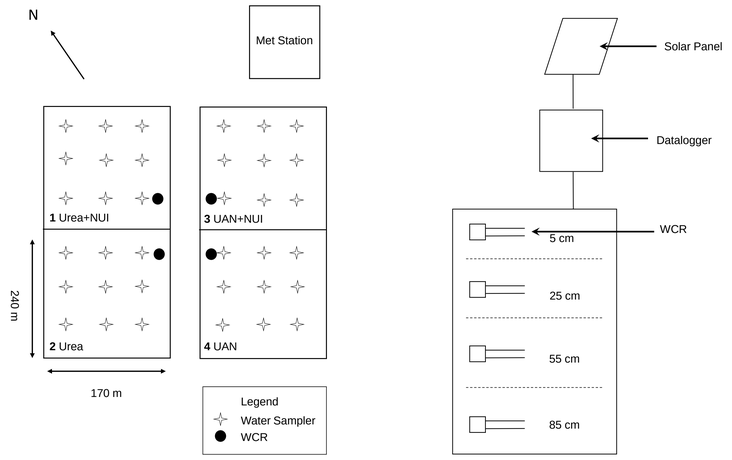

Figure 1A. Site map showing locations of soil solution samplers and fertilizer treatments. B. Cross-section diagram of the soil profile showing installation of four water content reflectometers (WCR).

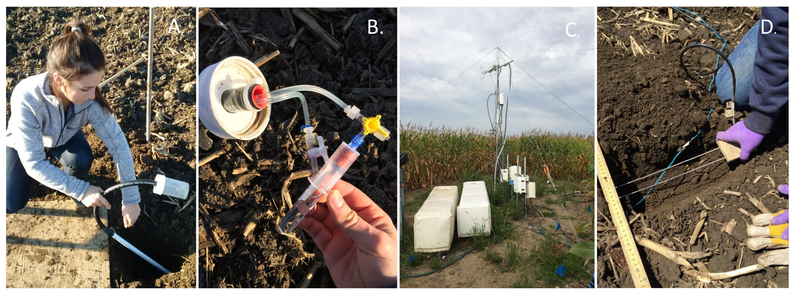

Figure 2A.,B. Porous ceramic cup lysimeters used to sample soil water.
C. EC tower with a CSAT3 sonic anemometer and LI-7500 open path system.
D. WCR used to measure soil water content (Campbell Scientific CS616).

Results

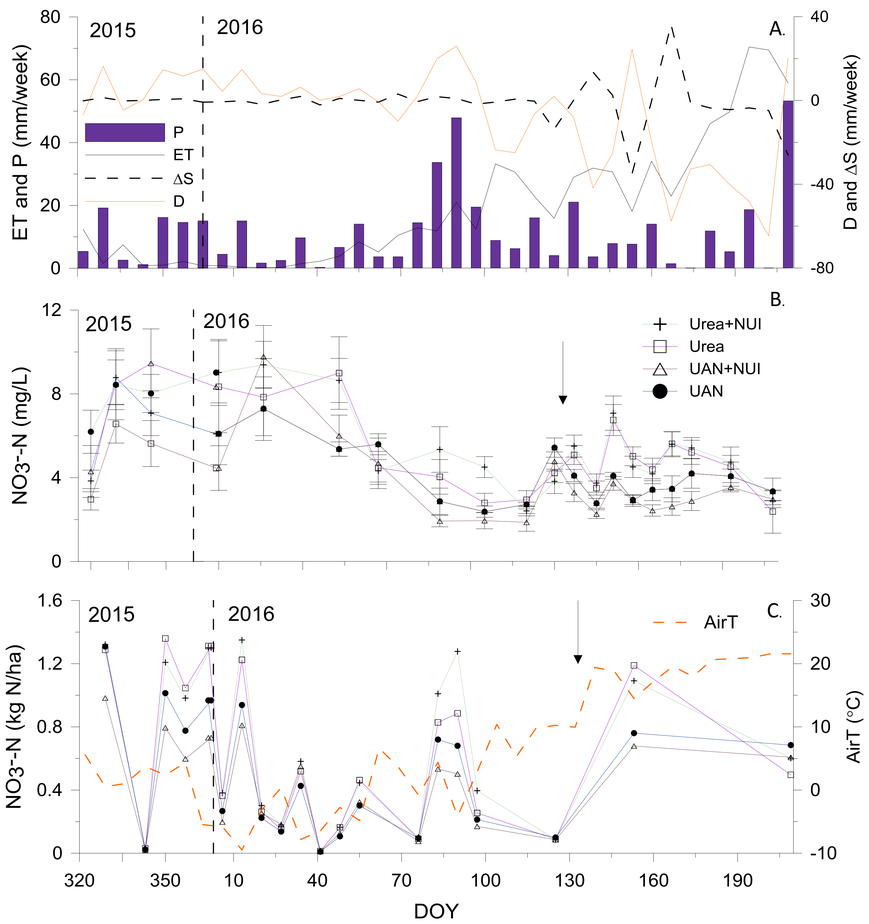

Figure 3. Weekly averages: A. water budget components. B. NO_3^--N concentration (with SEM). C. NO_3^--N leached. Arrow indicates fertilization.

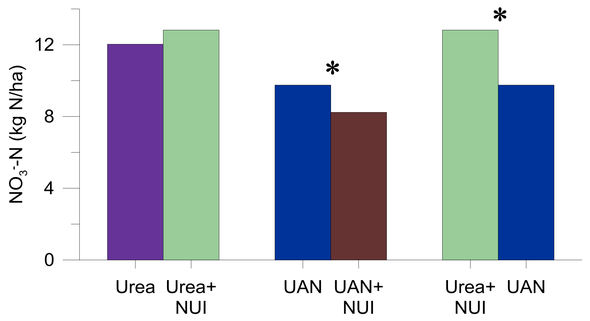

Figure 4. Comparison of NO_3^--N leached for treatments with application at planting (urea and urea+NUI) and application at sideress (UAN and UAN+NUI from Nov. 2015 to July 2016. Significant differences determined using a t-test ($P \leq 0.05$).

Summary

- Drainage events occurred during winter and early spring (Nov. to April) (Fig. 3A.)
- NO_3^--N concentration was highest during winter (Nov. to Feb.) (Fig. 3B.)
- Winter freeze-thaw cycles may have induced several NO_3^--N leaching events (Fig. 3C).
- Urea with NUI at planting did not have a significant effect on NO_3^--N leaching (Fig. 4).
- UAN with NUI at sidedress stage had a significant effect on NO_3^--N leaching, with a further reduction obtained by applying an EEF product (Fig. 4).
- This study is being continued until May 2017.

Reference

1 McCoy, R., Parkin, G., Wagner-Riddle, C., Warland, J., Lauzon, J., von Bertoldi, P., Fallow, D., & Jayasundara, S. (2006). Using automated soil water content measurements to estimate soil water budgets. *Canadian Journal of Soil Science*, 86(1), 47-56.

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