

Nitrogen Losses: A Meta-analysis of 4R Nutrient Management in U.S. Corn-Based Systems

Synthesize currently available research to examine N losses from U.S. Corn-Based Systems

Dr. Alison Eagle, Nicholas Institute for Environmental Policy Solutions, Duke University

Project dates: January 2014-December 2015

Project Number: 4RM-10

Collaborators: Advisors: Lydia Olander, Jim Heffernan, Emily Bernhardt. Research associates: Katie Locklier, Tibor Vegh. Numerous Master's students helped collect and manage the large volume of data.



PROJECT GOALS

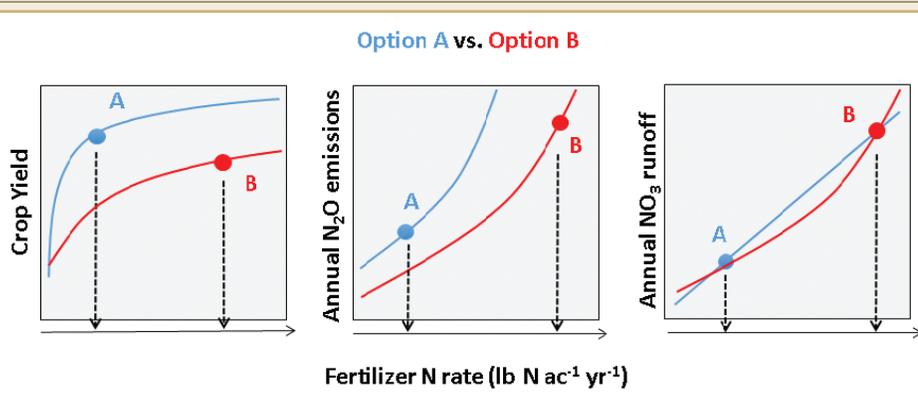
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| SOURCE | Crop yield, nitrate leaching, and N air emissions response to N sources |
| RATE | Crop yield, nitrate leaching, and N air emissions response to N rates |
| TIME | Crop yield, nitrate leaching, and N air emissions response to N timing |
| PLACE | Crop yield, nitrate leaching, and N air emissions response to N placement |
| 4R | How do climate and soil factors influence these responses? |

PROJECT RESULTS

Along with soil and weather, management of fertilizer rate, source, and timing all affect the amount of nitrogen lost to air and water from corn cropping systems. In-season fertilizer application and nitrification inhibitors are two options for reducing nitrogen losses.

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| SOURCE | Nitrous oxide (N ₂ O) losses are highest with Anhydrous Ammonia > Urea = Polymer Coated Urea = Urea Ammonium Nitrate (UAN) = UAN + AGROTAIN PLUS® > SuperU®. However there is potential for the placement of the fertilizer to confound these results. |
| RATE | On average, lower N fertilizer rates will reduce nitrate (NO ₃) and N ₂ O losses when scaled to the crop yield. |
| TIME | Side dress fertilizer, reserving a significant amount of N for application while crop was growing, reduced N ₂ O loss. |
| PLACE | While individual experiments have seen reduced losses with different fertilizer placement, these results were not observed when data from across North America was combined. |
| 4R | Environmental – N ₂ O emissions are higher with warmer temperatures, and nitrate leaching losses increase with precipitation. |

MORE PROJECT RESULTS ▼



@alison eagle2
Alison.eagle@duke.edu

MEET ALISON

"My career goal is to leave farmland and its surroundings in better shape than it was when I started. 4R research helps us to develop and refine management that maintains productive agriculture while conserving the supporting environment.

"I still have strong connections to the farming community in Alberta, Canada, where I was raised. Even though my work is now at a computer most of the day, my first job experiences were feeding pigs, working beef cattle, cleaning stalls, and driving tractors around (and around and around) the fields. In my spare time I like to grow vegetables, hike, run, knit, read, and enjoy life with my husband and children."

WHAT DO WE DO NEXT?

- Further investigation of relationship of loss as NO₃⁻ and N₂O from the same place and practice. Only one of the 49 field studies measured both at the same time. What practice reduce losses of both N forms? And what other factors could have opposite effects?
- Standardization of results reporting so all research data can be used in synthesis and meta-analysis.

Figure 1. Yield, NO₃, and N₂O loss response to N fertilizer rate. Yield responds with diminishing returns for each additional pound of N fertilizer applied. NO₃ and N₂O loss continually increases with each pound of fertilizer N applied (Option A). Environmental and management conditions can change these responses (Option B). The goal is to apply N at rates and in conditions that maximize crop response and minimize NO₃ and N₂O losses.