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Delayed N timing for maize reduced N_2O emissions and drainage [NO_3^-] while increasing yield.

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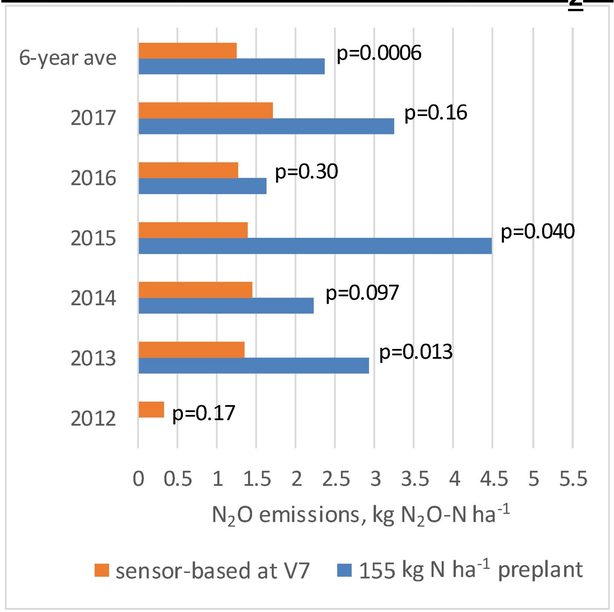
Introduction

- Nitrous oxide emissions dominate crop agriculture's carbon footprint in North America.
- These emissions are mainly from nitrogen fertilizer applied to maize.
- Most farmers in North America apply all N fertilizer before planting maize. Most N uptake happens 2 to 3 months later.
- N can be lost during these months in the form of N_2O, NO_3^-, or both, and can lead to N deficiency and yield loss.
- Equipment to apply N fertilizer to maize near the time of maximum need is increasingly available.

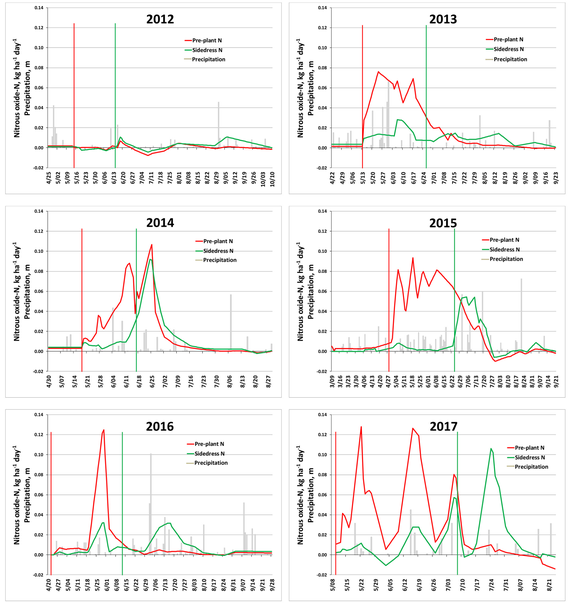
Equipment farmers use for late N

6 year impact of N timing on N_2O



- Over 6 years, later N timing cut N_2O emissions in half.
- Impact was greatest during the years with wet springs (2013, 2015, 2017).
- In 2012, the worst drought in 77 years, there were no emissions until September.
- Rate varied within plot, between plots, and by year, but overall N use for the 6 years was statistically identical for the 2 systems.

Time course of emissions



- Examining the time course of N_2O emissions reveals that the time between preplant N application (vertical red line) and late N application (vertical green line) was critical.
- During this time, 0 N fertilizer had been applied in the late N system, leading to 6x lower emissions.

N system: Impact on yield and drainage nitrate

- The late-variable N system increased maize yield by 0.8 Mg ha^{-1} from 2013-2017
  - As with N_2O, this effect occurred mainly in the wet years of 2013, 2015, 2017
  - 2012 omitted from calculation due to historic drought, yields < 2 Mg ha^{-1}
- Late-variable N also decreased drainage nitrate concentration by 20%, from 17.1 mg kg^{-1} with standard management to 13.6 mg kg^{-1}

Methods

- Central Missouri, USA
- Continuous no-till maize
- N management (injected UAN)
  - 155 kg N ha^{-1} preplant OR
  - Sensor-based variable-rate when maize height was 40-50 cm