Evaluating N source and placement strategies to manage N_2O emissions in no-till corn

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Introduction

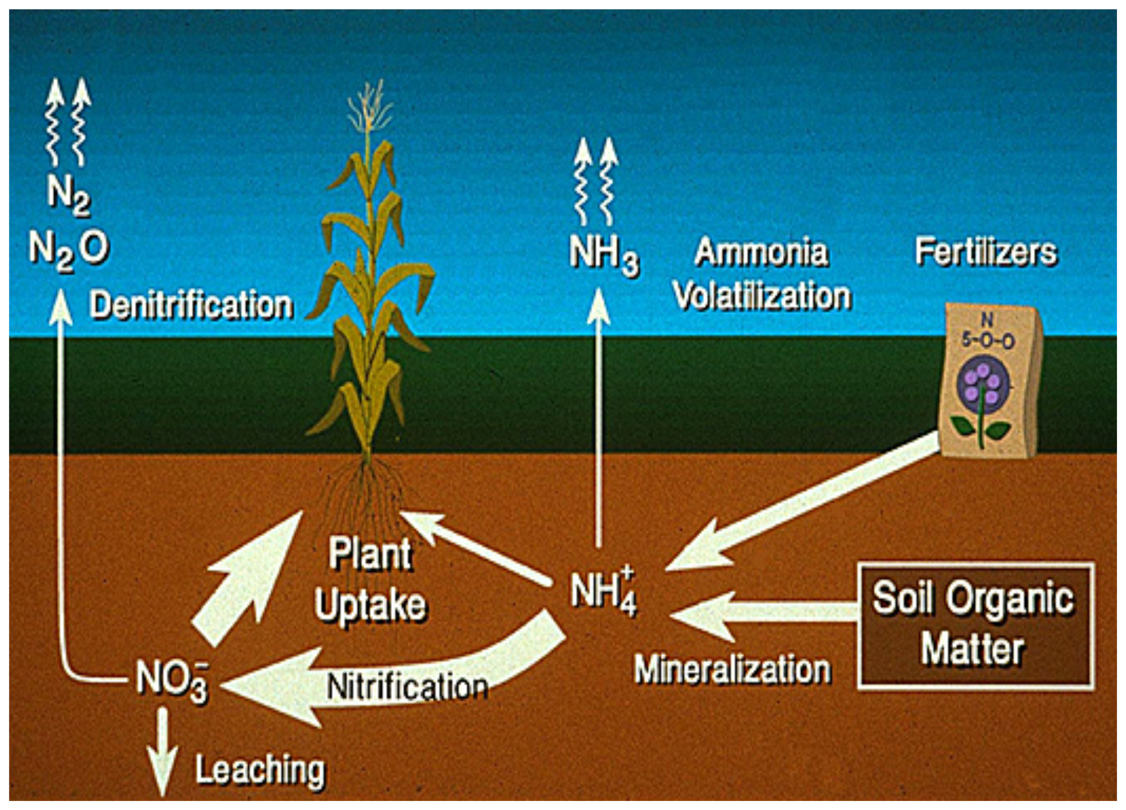

Fig 1. Nitrogen (N) cycle. Source: Doerge, 2002.

N_2O emission

- Economical loss (~ 1-5% of applied N)
- 298x higher GWP than CO_2
- Negative environmental impact (global warming, ozone layer depletion)

Objective

Evaluate N fertilizer strategies in order to mitigate N_2O emissions.

Material and Methods

- Corn planted on May 16, 2013.
- 168 kg N ha^{-1} were applied after planting.

Treatments

- Control
- Urea broadcasted (BC-U)
- Coated urea broadcasted (BC-CU)
- UAN surface-banded (SB-UAN)
- UAN subsurface-banded (SSB-UAN)
- UAN subsurface-banded + nitrification inhibitor (SSB-UAN+I)
- UAN broadcasted (BC-UAN)

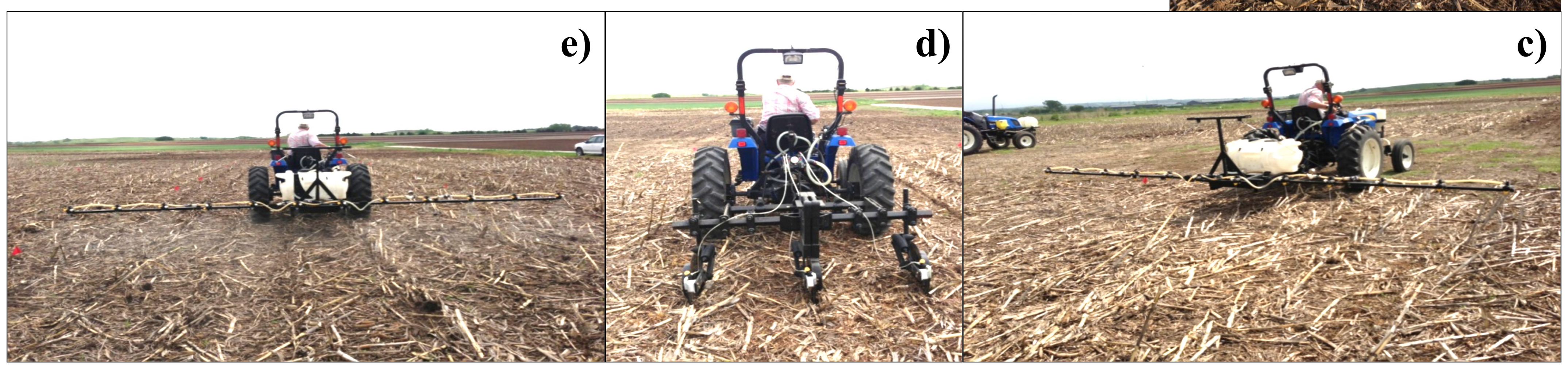

Fig 2. Corn planting (a) and N fertilizer application: broadcasted urea and coated urea (b), surface-banded UAN (c), subsurface-banded UAN with and without nitrification inhibitor (d) and broadcasted UAN (e).

Gas sampling and analysis

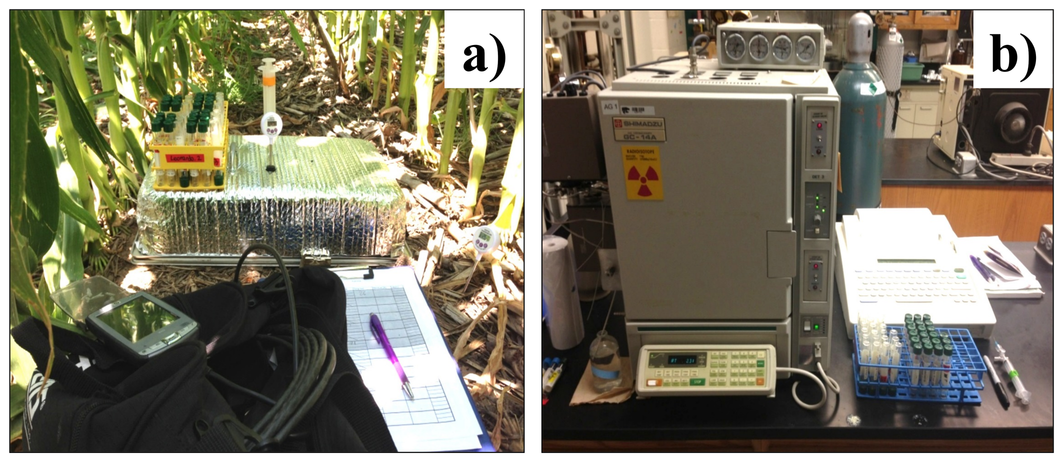

Fig 3. Chamber setup for gas sampling (a) and gas chromatograph (b).

Soil sampling

Fig 4. Soil sampling scheme with locations (a) and depths (b). Samples were analyzed for inorganic N (NH_4^+ and NO_3^-), data not shown.

Other measurements

- Soil temperature at gas sampling
- Soil moisture at gas sampling

- N use efficiency: $\dfrac{\Delta \text{ kg N/ha uptake}}{\text{kg N/ha applied}}$
- Grain Yield

Results and Discussion

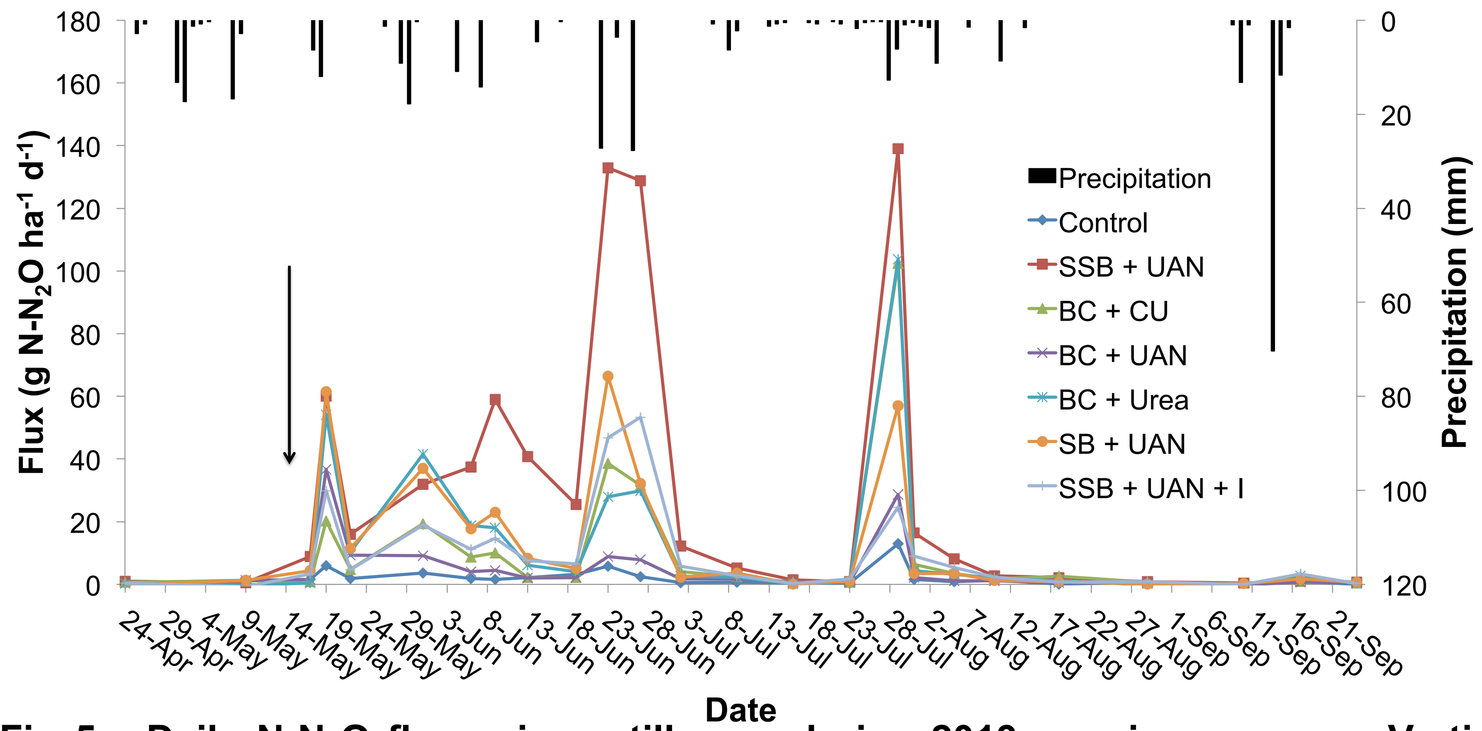

Fig 5. Daily N-N_2O fluxes in no-till corn during 2013 growing season. Vertical columns on the top represent precipitation. Black arrow represents corn planting and fertilizer application event.

- The highest fluxes occurred following rainfall events until tasseling stage.
- After that, even with favorable soil moisture conditions, the fluxes were low due to corn uptake of N.

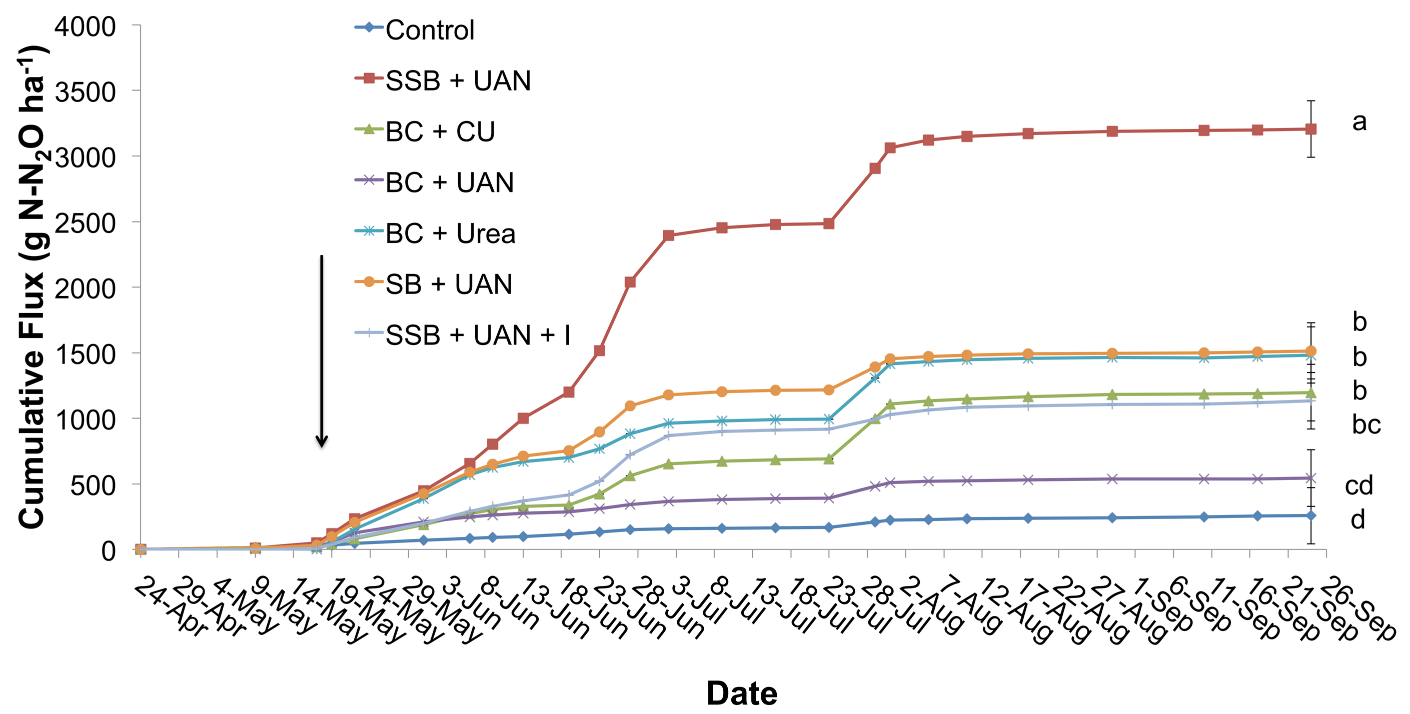

Fig 6. Cumulative N-N_2O flux in no-till corn during 2013 growing season. Bars represent standard error. Treatments followed by a different letter were statistically significantly different ($p < 0.05$).

- SSB + UAN emitted the most N_2O.
- Control, BC + UAN, BC + CU and SSB + UAN + I emitted the least N_2O.
- The use of nitrification inhibitor decreased N loss as N_2O by 66%.

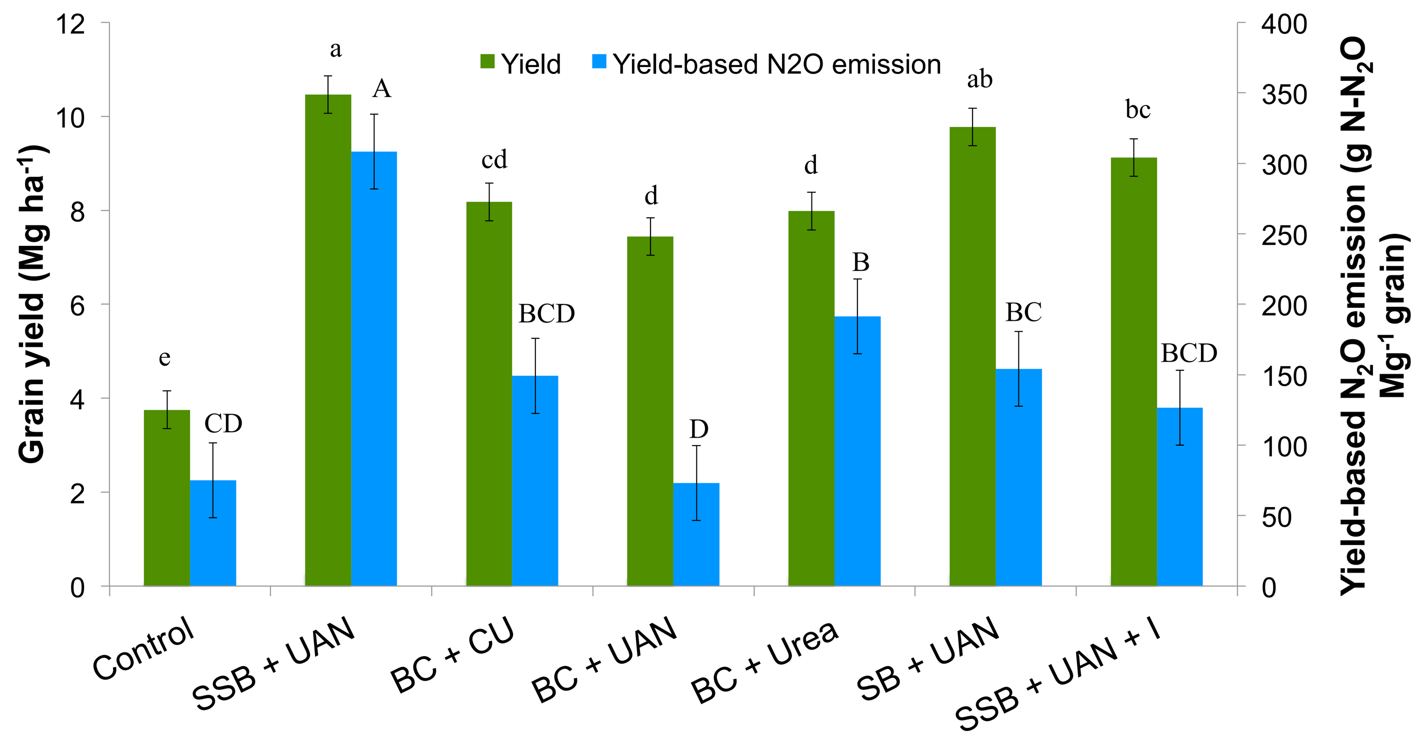

Fig 7. Grain yield (green) and yield-based N_2O emissions (blue) for each treatment. Bars represent standard error. Treatments followed by a different letter were statistically significantly different ($p < 0.05$). Lowercase letters were used to show differences in yield and uppercase letters in yield-based N_2O emissions.

- SSB + UAN and SB + UAN were the highest yielding treatments.
- BC + UAN was the lowest yield-based N_2O emission.

Conclusion

- The gaseous losses through N_2O vary depending on fertilizer source and placement.
- The use of nitrification inhibitor reduces gas losses when compared to the fertilizer alone, but its effect wasn't expressed in grain yield.
- SB + UAN had the best combination of productivity and reduced N_2O emissions.

Acknowledgements

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