# The impact of manure injection and urease inhibitor application on greenhouse gas emissions in a hayfield at Borderview Research Farm

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## Background

Manure injection and urease inhibitor application are two best management practices that aim to support crop growth and provide environmental benefits by increasing nitrogen retention. Manure injection is an alternative to manure surface application (i.e., manure broadcast) that places manure within slots in the soil to minimize manure runoff and the loss of nitrogen as ammonia gas. Urease inhibitors are added to fertilizers, whether manure or synthetic, and decrease ammonia production by temporarily blocking the conversion of urea to ammonia. These practices can both alter soil-borne greenhouse gas emissions and therefore impact agriculture's contribution to or mitigation of climate change.

*Manure injection*

*Synthetic urea with urease inhibitor*

Previous studies have found that, compared to manure broadcast, manure injection increases production of nitrous oxide, a greenhouse gas 265 times more powerful than carbon dioxide. In addition, a former trial in corn silage at Borderview Research Farm found that manure injection not only enhances nitrous oxide emissions but can also increase carbon dioxide emissions. In contrast, the effect of urease inhibitor application on nitrous oxide emissions is more mixed. To better understand the environmental and agronomic impacts of these best management practices, we measured greenhouse gas emissions and forage yields from different nitrogen sources (manure and synthetic urea), application methods (manure injection and manure broadcast), and with or without a urease inhibitor during a two-year field trial from 2020-2021 in a hayfield at Borderview Research Farm.

## Key Findings

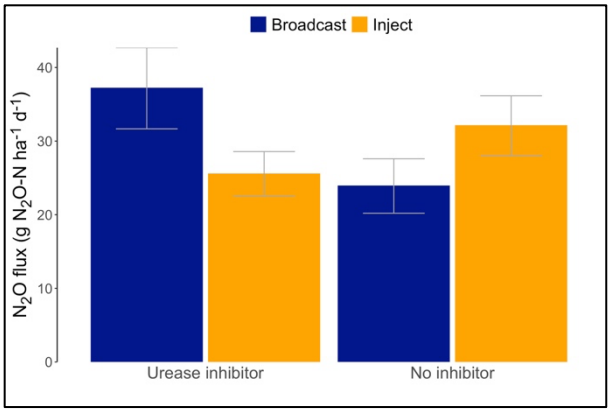
### *Manure injection did not increase nitrous oxide or carbon dioxide fluxes compared to manure broadcast*

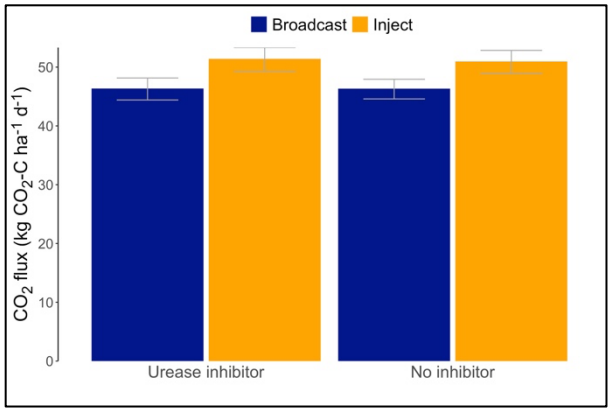
In contrast with previous studies, including a trial in corn silage at Borderview Research Farm, average daily greenhouse gas fluxes were similar for the manure injection and manure broadcast treatments during both years of the trial. This may have been a product of low precipitation and soil moisture levels generally reducing greenhouse gas production, as our field site fluctuated between being abnormally dry and in a moderate drought from 2020-2021.

### *Urease inhibitor application did not impact nitrous oxide or carbon dioxide fluxes, regardless of manure application method or nitrogen source*

Greenhouse gas fluxes were comparable between treatments applied with and without the urease inhibitor. In our analysis, urease inhibitor application was the least important variable

impacting greenhouse gas emissions. In fact, environmental conditions (i.e., soil moisture and soil temperature), mineral nitrogen availability, and days since treatment all impacted fluxes more than urease inhibitor application.



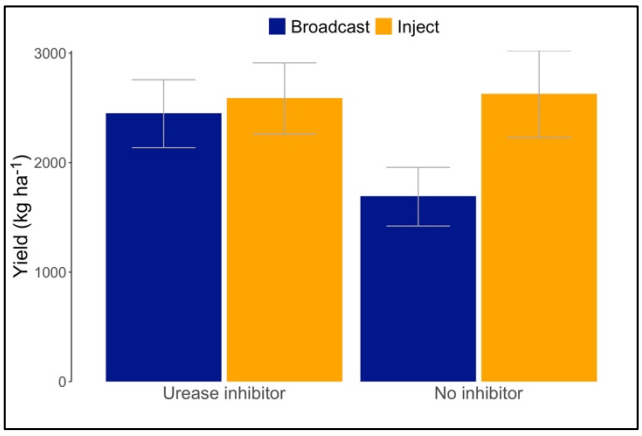




***Nitrous oxide and carbon dioxide emissions increased with soil moisture***

Although the dry conditions during our trial contributed to low greenhouse gas emissions production, both nitrous oxide and carbon dioxide increased when soil moisture increased. Furthermore, relatively large rainfall events the day before greenhouse gas sampling contributed to pulses of elevated nitrous oxide emissions.

***Forage yields were higher for manure broadcast with urease inhibitor than for manure broadcast without urease inhibitor, but were otherwise comparable among treatments***

There is evidence that the urease inhibitor increased nitrogen retention in the manure broadcast with urease inhibitor treatment, therefore leading to higher yields, since mean daily nitrate availability was higher for manure broadcast with inhibitor than without inhibitor. However, nitrate availability was highly variable, and more research is needed to understand the impact of urease inhibitors on forage yields.




## Next Steps and Opportunities

We are continuing to measure greenhouse gas emissions in a hayfield at Borderview Research Farm this summer, and we aim to better understand the role of changing precipitation levels on the production of greenhouse gas emissions and forage yields.

To learn more about the results of this field trial, contact Sarah Brickman at sarah.brickman@uvm.edu, and to learn more about our ongoing greenhouse gas monitoring efforts, contact Lindsey Ruhl at lindsey.ruhl@uvm.edu.

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