# Smart Agriculture Research

## *2023 Summary: Impact of Fertilizer Rate on Nitrous Oxide Emissions*

Olds College Centre for Innovation (OCCI) used an automated emissions monitoring system during the 2023 growing season to research how fertilizer rate impacts nitrous oxide ($N_2O$) emissions. OCCI completed this applied research project in partnership with TELUS Agriculture.

## INTRODUCTION

4R Nutrient Stewardship is an encouraged practice for producers to utilize fertilizer effectively. The 'Right Rate' focuses on the rate of fertilizer applied and tailoring rates to specific fields. One technique is Variable Rate Technology (VRT) where fertilizer application rates are varied across different management zones within a field to ensure fertilizer is applied at a rate most effectively used by the crop.

An automated greenhouse gas emissions monitoring system from LI-COR Biosciences was used on a small plot trial on the Smart Farm. This trial evaluated how the 'Right Rate' of fertilizer impacts $N_2O$ emissions.

The LI-COR gas emissions monitoring system was used to collect high temporal resolution data on three different treatment zones. This setup included eight gas measurement chambers placed in the seed rows of a barley field. The equipment collected a single measurement from each of the eight chambers every 30 minutes throughout the growing season. In comparison to manual sampling, which is commonly used for collecting $N_2O$ emission data, this setup allowed for a higher volume of data to be collected.

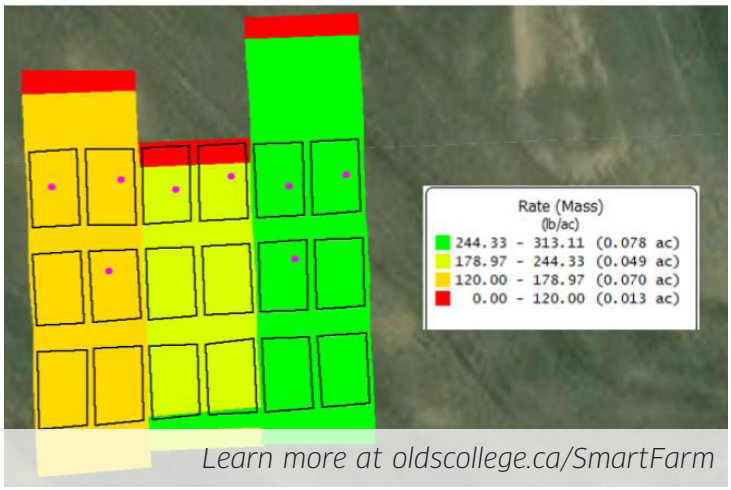
## OBJECTIVES

- Evaluate how utilizing the 'Right Rate' of the 4R Nutrient Stewardship impacts $N_2O$ emissions.
- Evaluate the relationships between fertilizer rates, yield and $N_2O$ emissions.
- Calculate the NBalance and estimated emissions based on the guide by the Environmental Defense Fund for comparison to the results measured from the LI-COR system.

## STUDY DETAILS

Small plot trial on Smart Farm Field 2W with Sirish barley.

- 3 treatment rates, 6 replicates (6 small plots per treatment), 18 plots total
  - Medium/prescribed rate (based on agronomist recommendations) *(yellow)*
  - Low rate (prescribed - 30%) *(orange)*
  - High rate (prescribed + 30%) *(green)*
- 8 automated chambers (3 high, 3 low, 2 medium treatment) *(pink circles)*
- Soil samples were collected to monitor soil nitrate throughout the season.
- Yield and nitrogen measurements for both grain and straw were collected.

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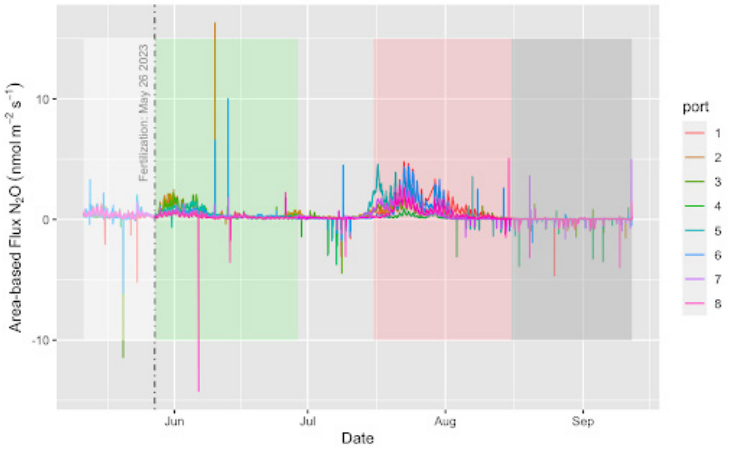
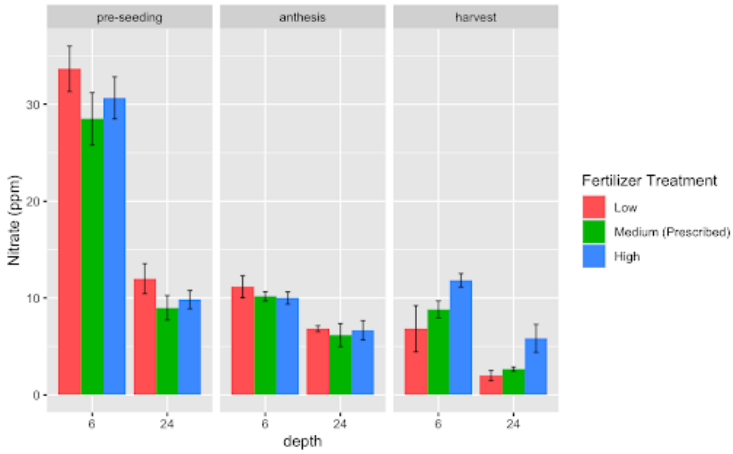
## RESULTS

- Observed daily patterns in emissions; higher emissions observed during the day and lower emissions observed at night.
- Emissions varied throughout the season; no conclusive results on the effect of fertilizer rates on emissions.
  - High treatment had highest emissions after seeding, but the lowest emissions close to harvest.
  - Low treatment had highest cumulative emissions.
  - Many factors impact emissions.
  - High emissions period around anthesis/ flowering stage of barley; may be linked to plant senescence within chambers.
- Fertilizer rate had no significant impact on NBalance or grain yield.
  - Larger variation in treatments may be necessary.
- Measured cumulative emissions over the growing season were within the Intergovernmental Panel on Climate Change (IPCC) and NBalance estimates (< 1000 g N2O-N ha-1).
- High treatment had significantly higher soil nitrate after harvest than the other two treatments.

| Fertilizer Treatment | Measured Cumulative $N_2O$-N Emissions (g $N_2O$-N $ha^{-1}$) | IPCC Estimate 1% (g $N_2O$-N $ha^{-1}$) | NBalance Estimated Emissions (g $N_2O$-N $ha^{-1}$) |
|---|---|---|---|
| High | 908 | 964 | 989 |
| Medium (prescribed) | 645 | 670 | 988 |
| Low | 978 | 522 | 910 |




## FUTURE RESEARCH

The data collected in 2023 will continue to be analyzed for detection of other patterns and compared to weather station information to identify how emissions are linked to different environmental changes. This project will be replicated in 2024 with a few proposed changes:

- Variation of just the nitrogen rate and not the overall fertilizer rate (NPK).
- Add a zero nitrogen control treatment.
- Potentially adjusting the rates (greater than 30% change between treatments).
- Changing how plants within chambers are managed either by:
  - Using chambers large enough for entire plants.
  - Placing chambers between seed rows.
  - Pulling plants once they are too large rather than clipping them.