Greenhouse Gas Emissions Following Urea Application in an Incubation Experiment

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BACKGROUND

Greenhouse gas (GHG) emissions from soils are highly dependent on environmental variables such as soil water content and temperature as well as nutrient availability. This research was part of a larger study focused on quantifying GHG emissions and developing nitrogen (N) fertilizer best management practices for the Lower Fraser River Valley (LFRV) in British Columbia, Canada. This region is characterized by a humid climate and fine textured soils with poor natural drainage.

OBJECTIVE

To evaluate the short-term responses of GHG emissions (CO_2, N_2O, and CH_4) and plant available N (NH_4-N and NO_3-N) to

- urea application rates (0, 90, and 120 kg N ha^{-1}),
- soil water content (20% and 40% vol.), and
- soil temperature (4°C and 20°C).

METHODS

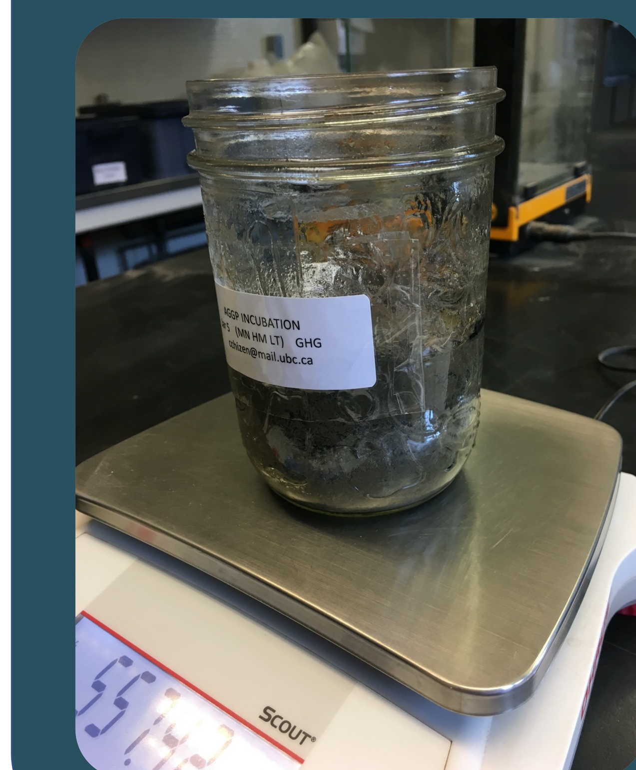
Measured CO_2, N_2O, and CH_4 fluxes using the Picarro G2508 as well as NH_4-N and NO_3-N using colorimetry every 3 to 4 days for an 18-day period following urea application. The soil was collected from a crop field and sieved to 4 mm for this incubation experiment.

RESULTS

Fertilizer rate, soil temperature, and water content had a combined effect on N_2O emissions (Fig. 1). There were no differences in CO_2 or CH_4 emissions between the treatments. The nitrification process was inhibited at 4°C as limited NH_4^+ was converted to NO_3^- (Fig. 2).

SIGNIFICANCE

In the LFRV, heavy precipitation in the spring and fall can stimulate N_2O emissions following N fertilization or due to high residual plant available N after harvest. Conditions of 20°C and 40% vol. soil water content are common in the spring. This research shows that delaying the timing of N fertilizer application until the soil water content has decreased can lower N_2O emissions associated with N fertilizer use.



Soil N transformations were highly dependent on soil temperature and water content

Nitrous oxide emissions increased with urea application rates and were negative when no urea was applied

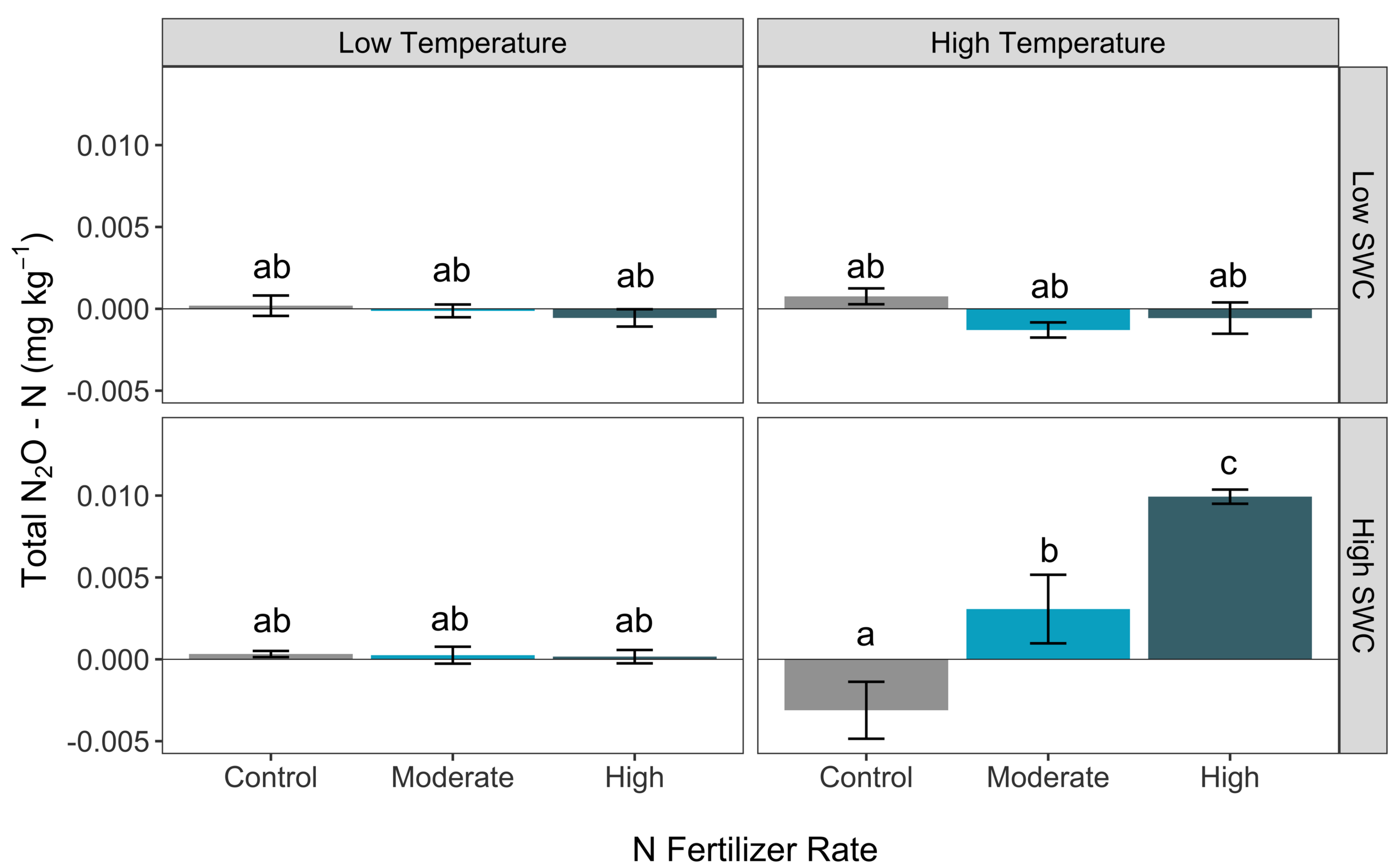


Fig. 1. Total N_2O emissions after the 18-day incubation period. Different letters indicate a significant difference (α = 0.05) between treatments.

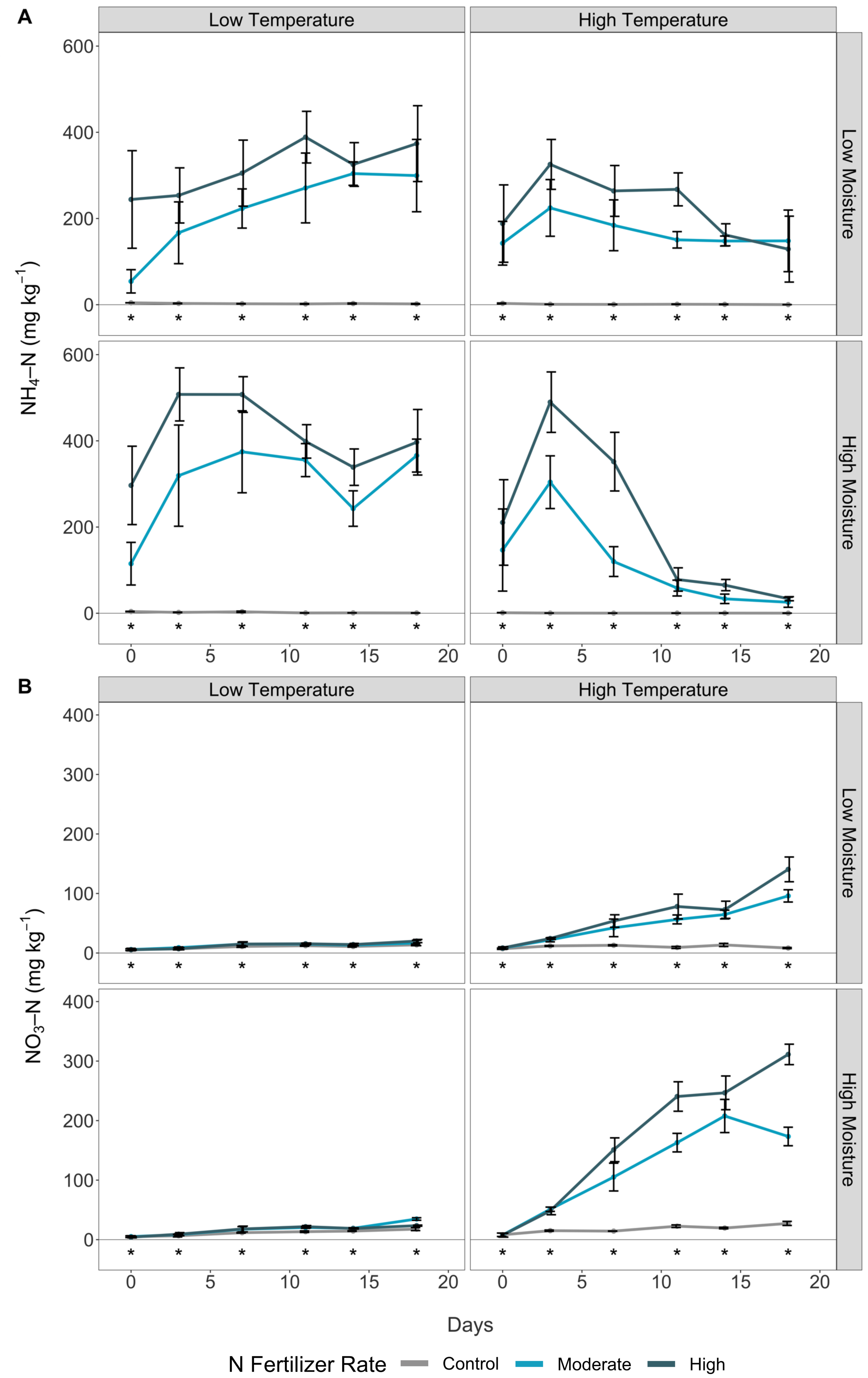


Fig. 2. Soil NH_4–N (A) and NO_3–N (B) content on a dry soil mass basis over the duration of the incubation experiment. For each day, an asterisk denotes significant difference (α = 0.05) between treatments.

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