N_2O emissions from timothy grassland under different fertilization regimes in boreal climate

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Background and methods

Cultivated grasslands can be significant sources of nitrous oxide (N_2O), due to application of fertilizers. Using cattle slurry as fertilizer is a common grassland management practice, however, it has been shown to increase N_2O emissions.

The aim of this study was to quantify N_2O emissions and yields using different rates of cattle slurry and mineral nitrogen (N) fertilization in boreal grassland.

We measured N_2O fluxes from May 2024 to April 2025 from timothy (*Phleum pratense*) grassland on mineral soil in Maaninka, Eastern Finland.

Treatment	Fertilizer type	Total N applied (kg ha^{-1})	Total soluble N applied (kg ha^{-1})	Yield (kg ha^{-1})	Annual N_2O emission (kg N_2O-N ha^{-1} y^{-1})	Yield-scaled N_2O emissions (kg N Mg^{-1})
M0	-	0	0	2520	0.50	0.22
M250	Mineral	250	250	9250	0.85	0.09
M350	Mineral	350	350	9710	1.18	0.12
S0	Slurry	203	107	5760	1.65	0.30
S250	Slurry + mineral	333	237	9040	2.44	0.27
S350	Slurry + mineral	433	337	8150	2.29	0.28

Table 1. The total N application amounts, obtained yield, annual N_2O emissions and yield-scaled N_2O emissions during the one-year experiment.

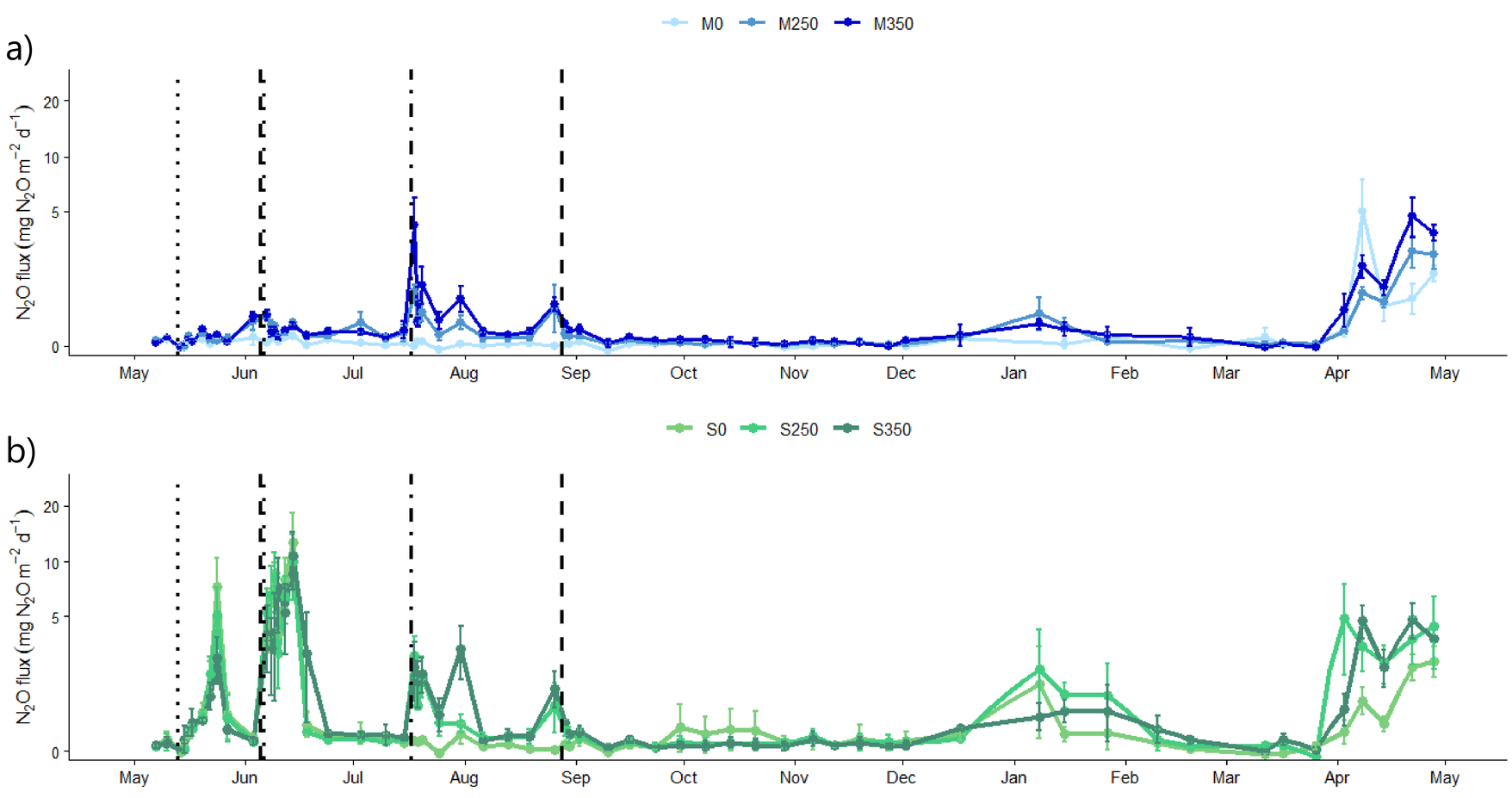

Figure 1. Measured N_2O fluxes (mg N_2O m^{-2} d^{-1}) during the experiment year from a) mineral fertilizer plots and b) slurry supplemented with mineral fertilizer. Different colors represent different N application rates and vertical lines indicate timing of fertilization (dotted) and harvest (dashed). Values are mean (n=4) and SE.

Figure 2. N_2O fluxes were measured with closed chamber method with portable analyzer (LI-7820) in snow-free periods and with the snow gradient method during snow-cover.

Preliminary results

- Slurry application increased N_2O flux rates after each fertilization; mineral fertilizer only after the third
- Freeze-thaw events in the non-growing season triggered considerable N_2O emissions
- Yield-scaled emissions were lowest from mineral fertilizer application rates of 250 and 350 kg N ha^{-1} y^{-1}
- Early part of the growing season was dry and precipitation free, indicating soil moisture to regulate the effect of different fertilizer types and rates on N_2O emissions

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