4-52 N_2O emissions from timothy grassland on mineral soil under different fertilization regimes in boreal climate

Sanni Semberg[1], Hem Raj Bhattarai[1], Maija Marushchak[2], Maarit Termonen[1], Perttu Virkajärvi[1]

[1]Luonnonvarakeskus (Luke)
[2]Itä-Suomen yliopisto

ABSTRACT

Cultivated grasslands can be significant sources of nitrous oxide (N_2O), due to application of fertilizers. Using cattle slurry as a fertilizer is a common grassland management practice, and it can also improve soil organic carbon stock and fertility. Slurry application has been found to cause higher N_2O emissions compared to mineral fertilizer, although current knowledge on the effect of different fertilizer types and rates on N_2O emissions is still incomplete.

In N-Teho and N-Fiksu -projects we measured N_2O emissions from a mineral soil cultivated with timothy (Phleum pratense L.) in Central Finland from May 2024 to April 2025. The experimental field was fertilized and harvested three times in the growing season. The experiment consisted of six treatments, combining two slurry regimes (“no slurry” and “30 tons of slurry for the first harvest and 30 tons for second harvest”) with three mineral N application rates (0, 250 and 350 kg soluble N ha^{-1} $year^{-1}$). Soluble N was divided for three harvests using ratios 0.44:0.36:0.20, respectively. The closed chamber method with a portable analyzer was used in snow-free period and the snow gradient method was used during snow-cover.

Our preliminary findings suggest that N_2O emissions from timothy grassland on mineral boreal soil is considerably affected by slurry application. Slurry application increased N_2O emissions by 3.5 folds compared to only mineral fertilization, and the trend was observed in both first and second fertilization events. In the third fertilization, when only mineral fertilizer was used to all treatments except 0N, the emission rates were similar across treatments. Interestingly, slurry treated plots showed occasionally higher emissions compared to mineral fertilizer plots during the non-growing season also. In addition to lower emissions, mineral fertilized plots tented to produce higher yields compared to slurry plots, resulting in lower yield-scaled N_2O emissions. Although N_2O emissions from the non-fertilized treatment (0N) were the lowest from all treatments, it produced remarkably lower yields compared to other treatments, making the yield-scaled emissions relatively high. Therefore, assessments of climatic impact of agricultural management strategies should incorporate also economic viability and agronomic performance. Emission reductions that compromise productivity may not be beneficial for farmers in the long term. An appropriate conclusion from this study will be derived by including and analyzing data from second measurement year.

KEYWORDS: nitrous oxide, cattle slurry, chamber measurements, boreal grassland