Optimising soil pH and phosphorus can reduce N_2O emissions from grassland soils

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1. INTRODUCTION:

The effect of soil pH and soil test phosphorus (STP) on crop yields is well understood and famers around the world receive agronomic advice on how to improve the soil fertility on their farms for optimal crop growth. The effect of soil fertility on emissions of greenhouse gases such as nitrous oxide (N_2O) from fertilisation is less well understood (O'Neill et al. 2020).

2. OBJECTIVES:

To quantify the effect of soil pH and soil phosphorus on fertilizer derived nitrous oxide (N_2O) emissions from grassland soils.

3. METHODS

- Experiments used long term pH and P grassland trials in Johnstown Castle
- **N_2O** - static chambers - Measurements were made frequently after fertilizer application over 12 months (pH) and 3 months (P).

Soil pH experiment:

- 4 pH levels, cut grassland, 300 kg N ha^{-1} as Calcium ammonium nitrate (CAN) in 8 splits.

Soil P experiment:

- 3 soil P levels (0, 15 and 45 kg P ha-1 yr-1), plots received 80 kg N ha-1 in 2 splits.
- Cumulative N_2O emissions were analysis using ANOVA in R.
- Both experiments have been published (Žurovec et al. 2021 and Gebremichael et al. 2022)

4. RESULTS

Soil pH (Fig. 1)

- Significant effect of soil pH, cumulative N_2O emissions decreased with increasing pH .
- CAN emission factor decreased from 2% pH 5 to 1.2% pH 6.9.

Soil Phosphorus (Fig. 2)

- N_2O emissions very low in absence of glucose
- N_2O emissions decreased with increasing soil P

5. SUMMARY:

- Improving soil fertility to agronomic optimums (pH & P) can significantly reduce N_2O emissions in denitrifying temperate grassland soils.
- Effect of soil fertility on N_2O & CO_2 needs to be investigated further across a wider range of soils and cropping systems to optimise soil C, N and P cycles

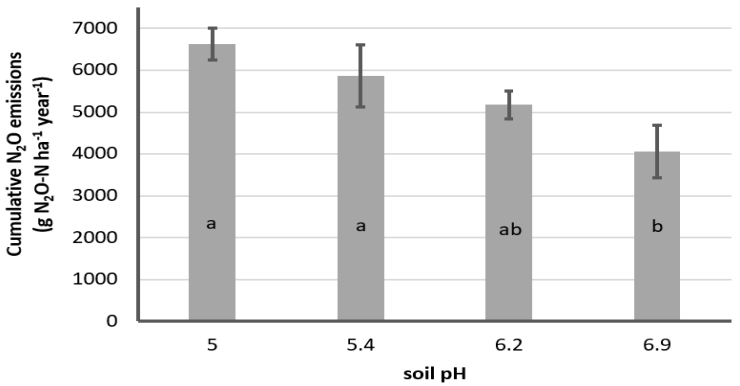

Fig 1– The effect of soil pH on cumulative N_2O emissions from cut grassland receiving 300 kg N ha^{-1} as CAN (Žurovec et al. 2021).

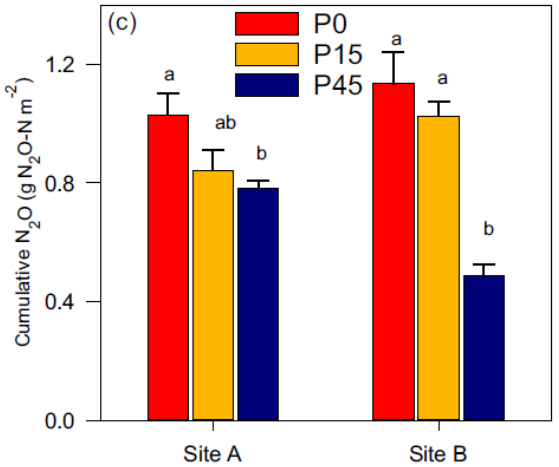

Fig 2 – Effect of long term soil phosphorus fertilisation on cumulative N_2O emissions (Gebremichael et al. 2022).

Acknowledgements

This research was financially supported under the National Development Plan, Research Stimulus Fund, Department of Agriculture, Food and the Marine (Grant number RSF15S655), and under the ERA-GAS 2016. FACCE ERA-GAS has received funding from the European Union's Horizon 2020 research & innovation programme (Grant agreement No 696356)

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