

# Optimising soil pH and phosphorus can reduce N<sub>2</sub>O 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 farmers 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<sub>2</sub>O) 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<sub>2</sub>O) emissions from grassland soils.

## 3. METHODS

- Experiments used long term pH and P grassland trials in Johnstown Castle
- N<sub>2</sub>O - 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<sup>-1</sup> as Calcium ammonium nitrate (CAN) in 8 splits.

### Soil P experiment:

- 3 soil P levels (0, 15 and 45 kg P ha<sup>-1</sup> yr<sup>-1</sup>), plots received 80 kg N ha<sup>-1</sup> in 2 splits.
- Cumulative N<sub>2</sub>O emissions were analysed 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<sub>2</sub>O emissions decreased with increasing pH.
- CAN emission factor decreased from 2% pH 5 to 1.2% pH 6.9.

### Soil Phosphorus (Fig. 2)

- N<sub>2</sub>O emissions very low in absence of glucose
- N<sub>2</sub>O emissions decreased with increasing soil P

## 5. SUMMARY:

- Improving soil fertility to agronomic optimums (pH & P) can significantly reduce N<sub>2</sub>O emissions in denitrifying temperate grassland soils.
- Effect of soil fertility on N<sub>2</sub>O & CO<sub>2</sub> needs to be investigated further across a wider range of soils and cropping systems to optimise soil C, N and P cycles

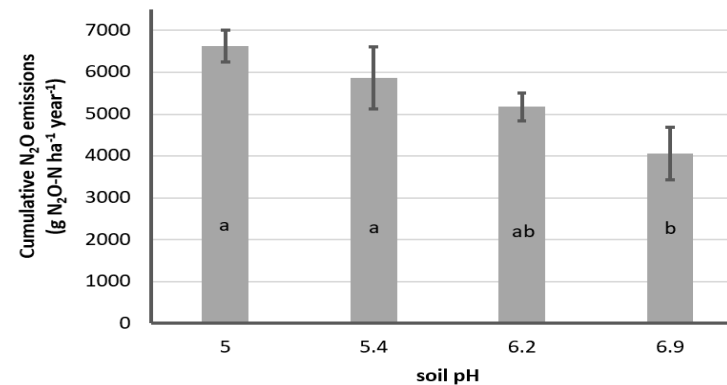


Fig 1– The effect of soil pH on cumulative N<sub>2</sub>O emissions from cut grassland receiving 300 kg N ha<sup>-1</sup> as CAN (Žurovec et al. 2021).

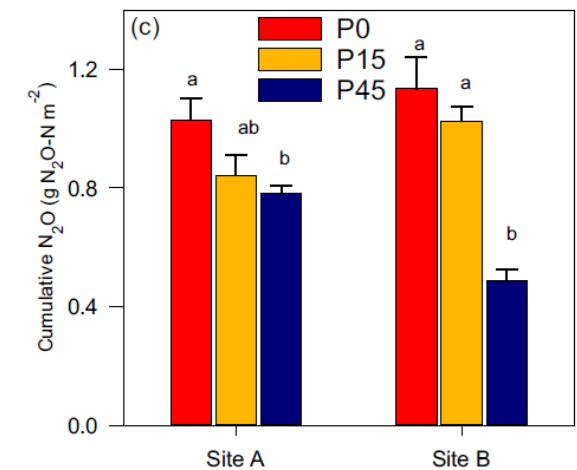


Fig 2 – Effect of long term soil phosphorus fertilisation on cumulative N<sub>2</sub>O emissions (Gebremichael et al. 2022).

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