



The interaction between key soil nutrients; carbon, nitrogen and phosphorus on N-cycling, productivity and N₂O emissions.

O'Neill, R. M., Gebremichael, A. W., Lanigan, G J, Renou-Wilson, F., Müller, C., and Richards, K. G.

Rosie.oneill@Teagasc.ie

- **BACKGROUND:** Long-term (1968) grazed grassland of varying P concentrations.
- **OBJECTIVE:** Investigate effects long-term P on N₂O emissions.
- **HYPOTHESIS:** Low P will increase N₂O emissions.



WHY?

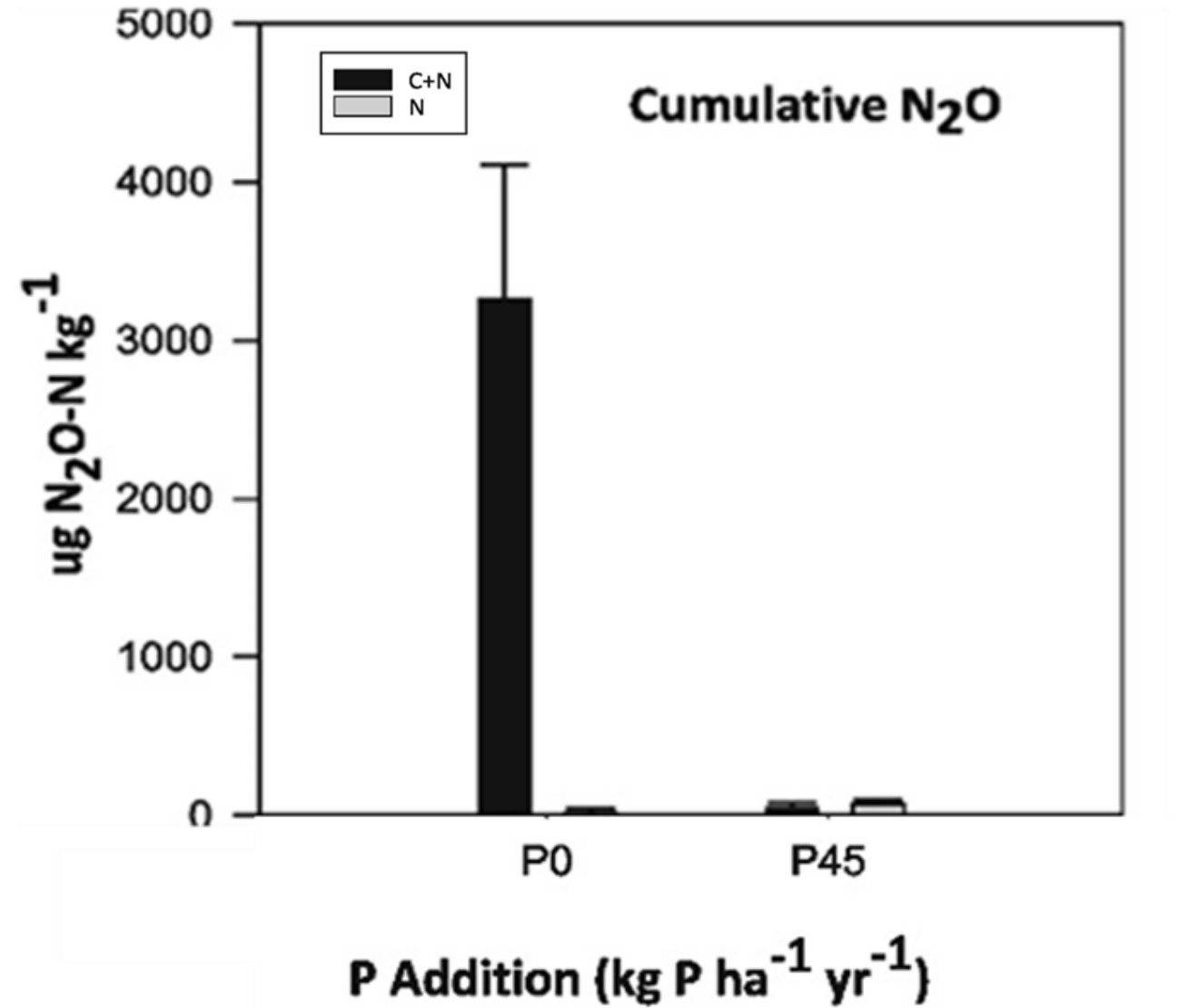
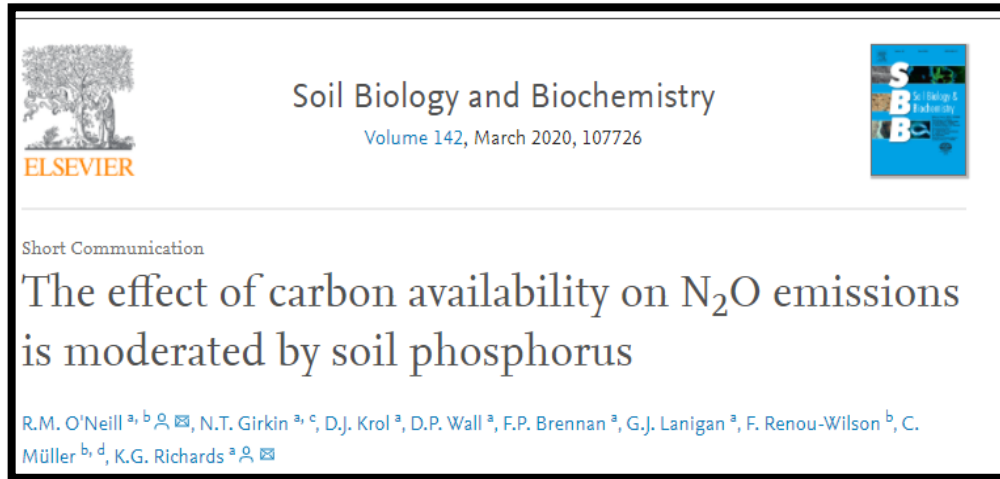
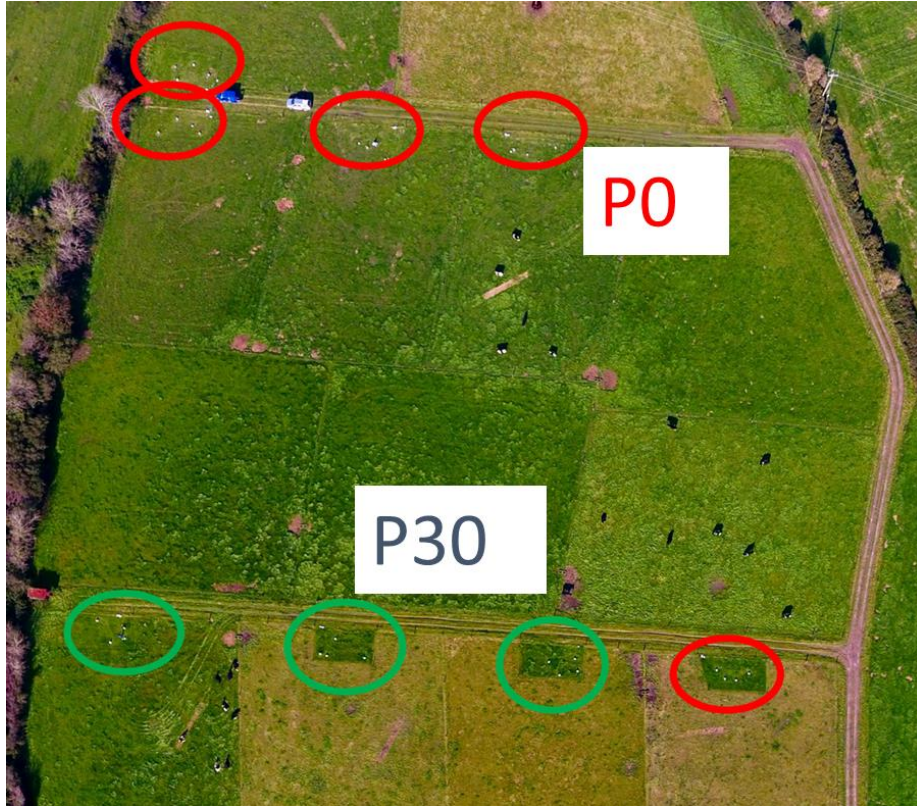


Figure. O'Neill et al., 2020. cumulative N₂O from 0 kg P ha⁻¹ yr⁻¹ & 45 kg P ha⁻¹ yr⁻¹ treated soils following C + N or N addition. Means ± 1 SE. (n = 3). <https://doi.org/10.1016/j.soilbio.2020.107726>

Map of site

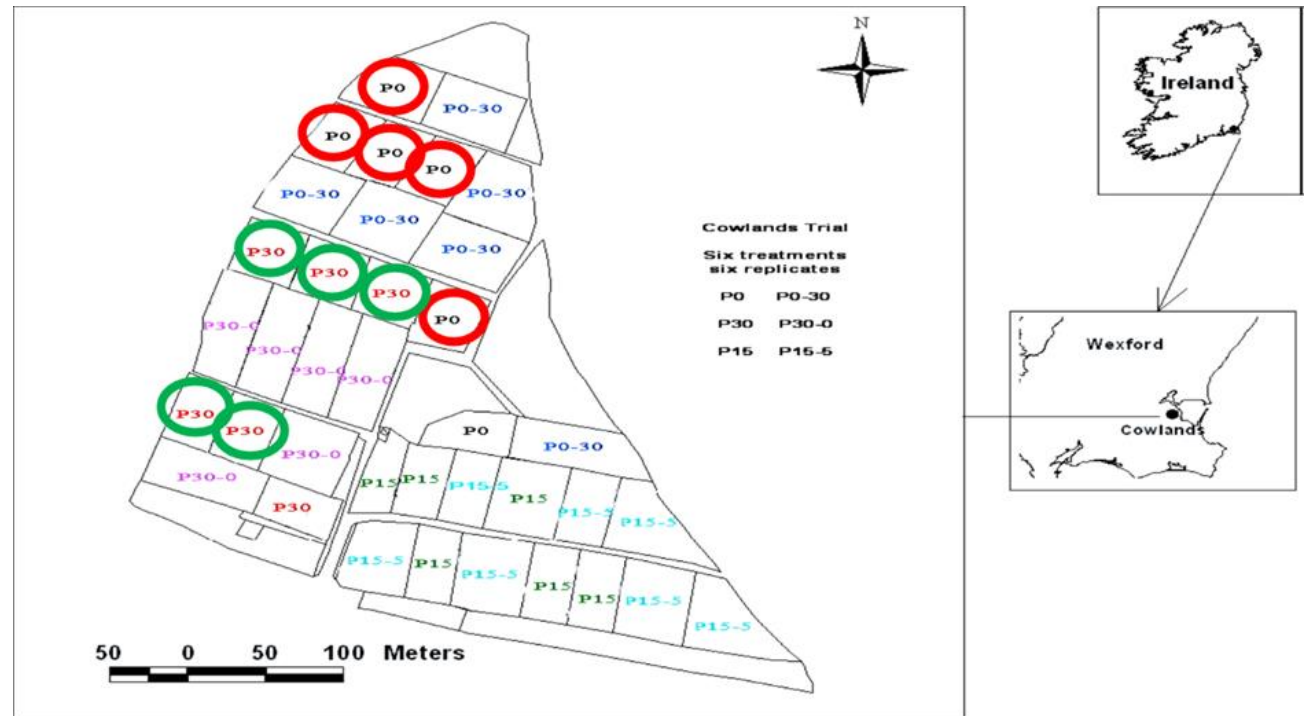


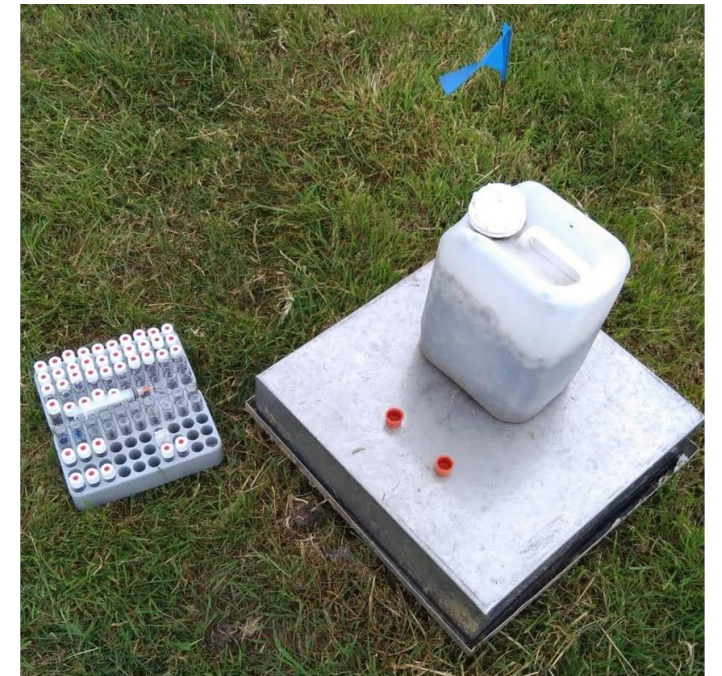
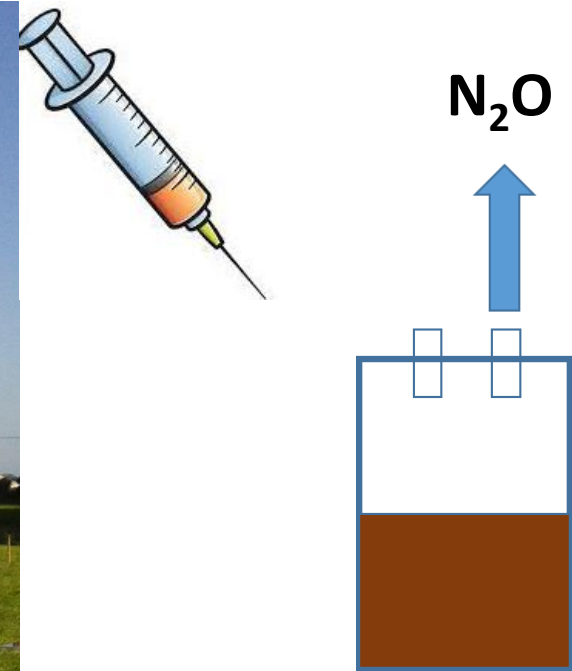
Treatments

KNO_3 40Kg N ha⁻¹

$\text{NH}_4\text{2SO}_4$ 40 Kg N ha⁻¹

Synthetic Urine 750 Kg N ha⁻¹





Static Chamber technique

Results

750 Kg N ha⁻¹ High Phosphorus



750 Kg N ha⁻¹ Low Phosphorus

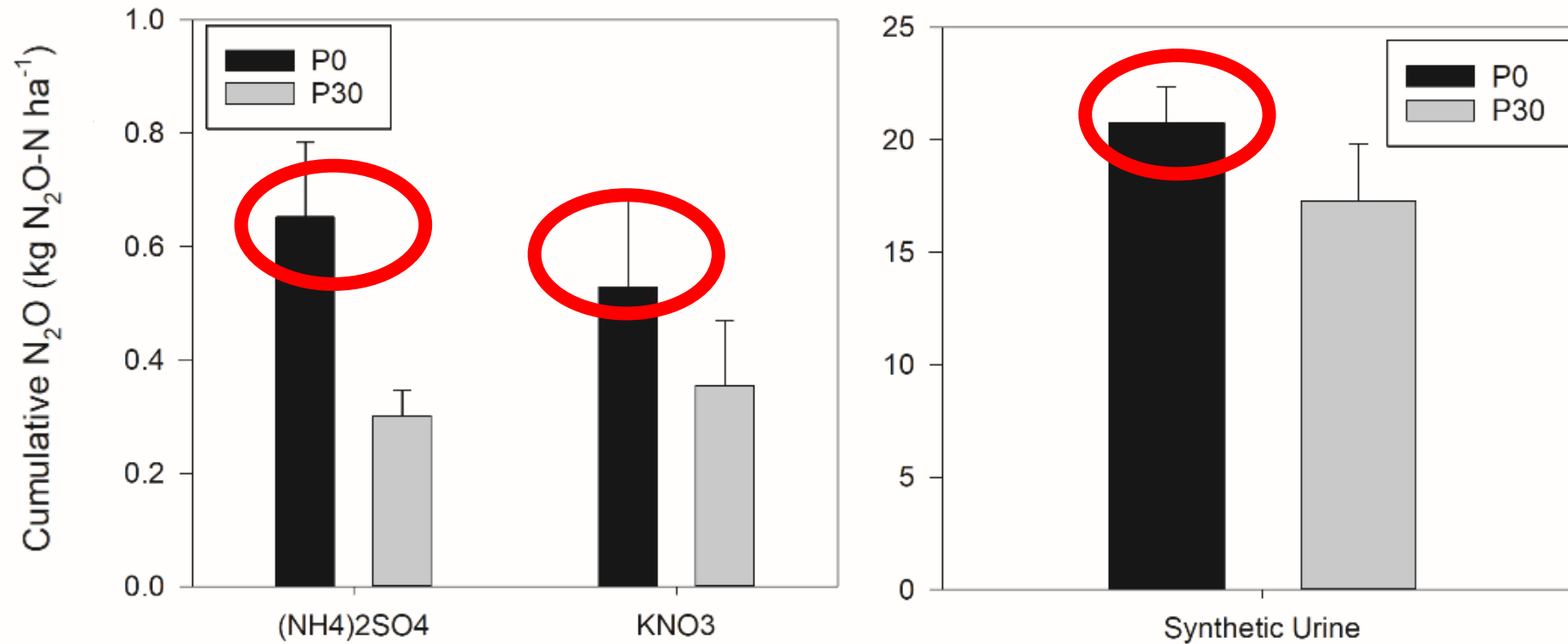


Figure. Cumulative N₂O (Kg N ha⁻¹) under KNO₃, and NH₄SO₄ addition; and under synthetic urine addition (n = 5, means = +/- std dev).

Results

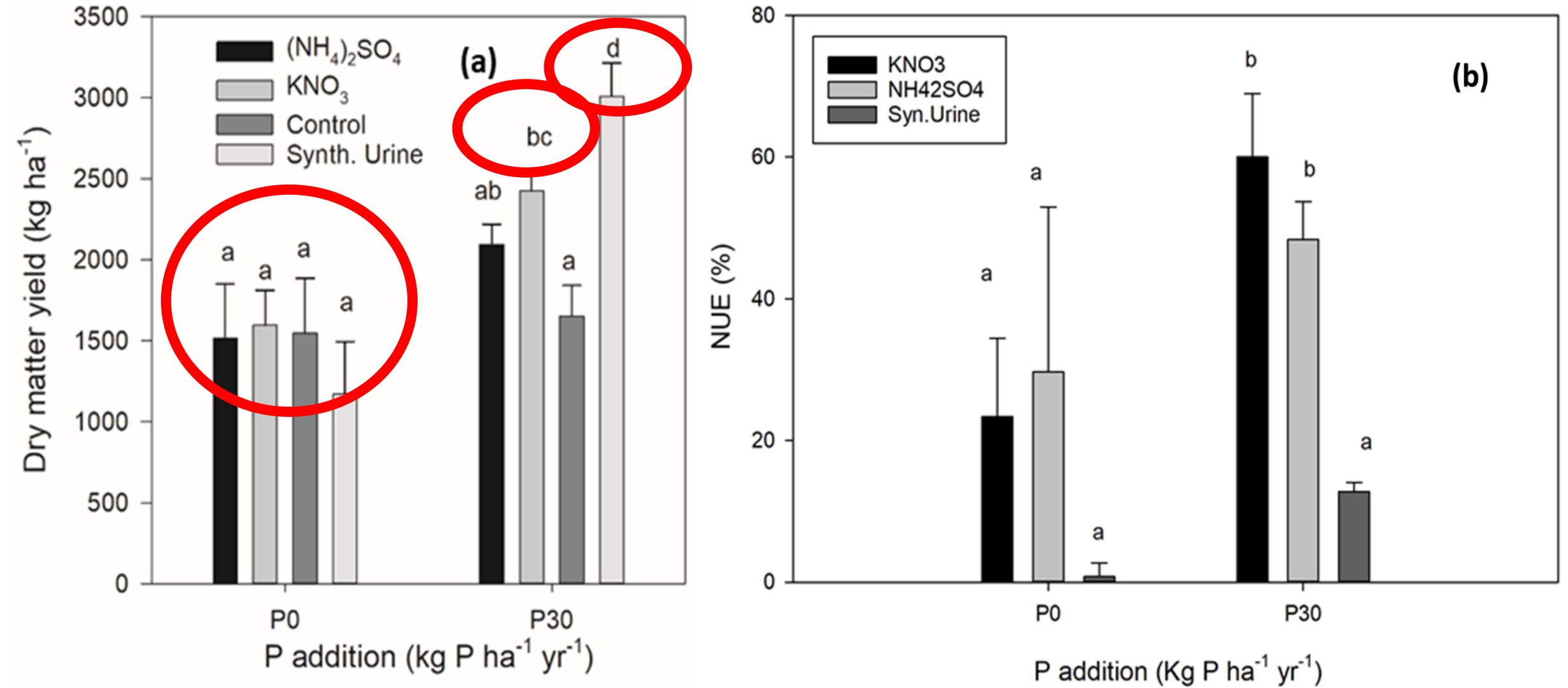
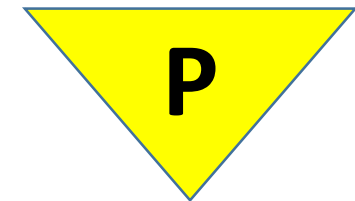
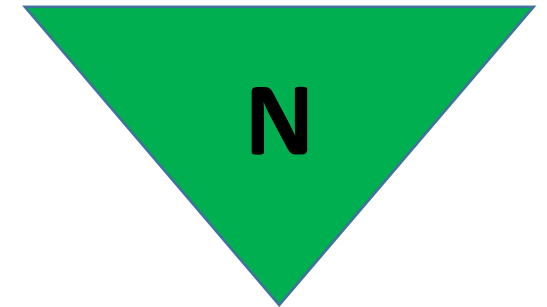
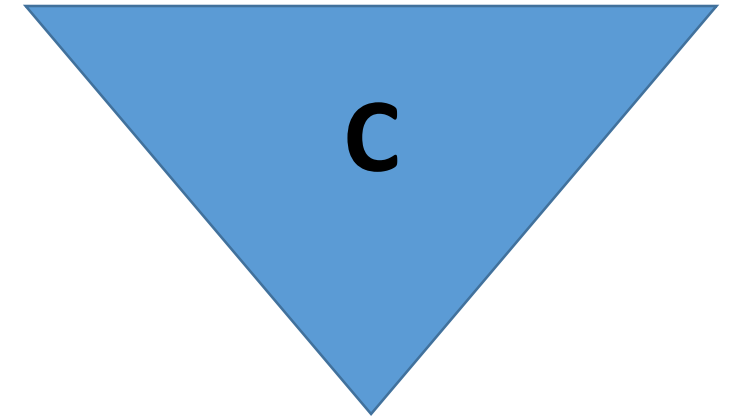
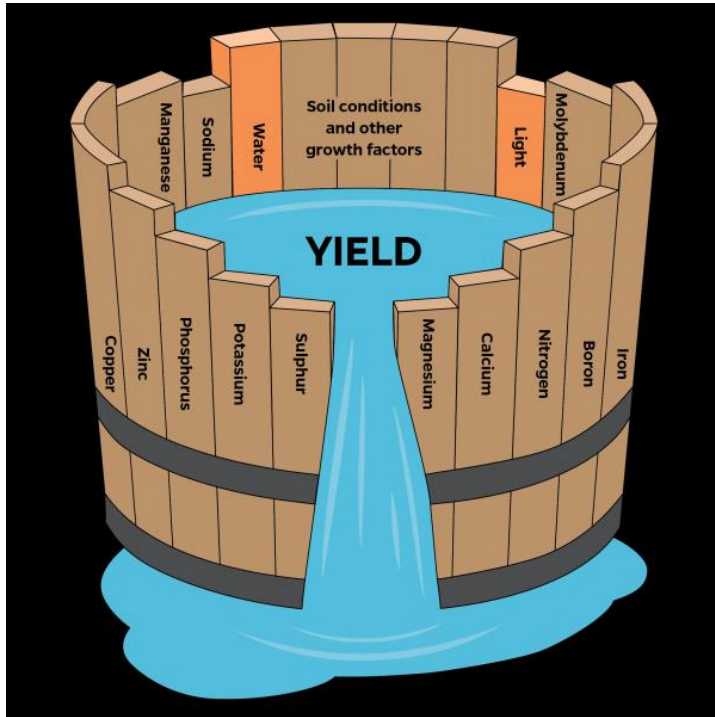


Figure 5.(a) Dry Matter Yield from each treatment (Kg DM ha⁻¹). (b) NUE(%) over the first 45 days after fertilisation for the control , KNO₃, (NH₄)₂SO₄ and synthetic urine treatments at soil P0 and P30.

Law of the Minimum

Justus von Liebig (1803-1873)

“Law of the Minimum,” states that **if one of the essential plant nutrients is deficient, plant growth will be poor even when all other essential nutrients are abundant.**



Conclusions:

1. Higher P levels reduce N₂O
2. Higher P levels promote NUE
3. N-saturation – spread in excess.

Future Research:

1. Obtain C:N:P ratios for more soil/land use types.
2. Examine C:N:P ratios for seasonal changes.

Thank you

Any Questions?



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Short Communication

The effect of carbon availability on N₂O emissions is moderated by soil phosphorus

R.M. O'Neill^{a,b,*}, N.T. Girkin^{a,c}, D.J. Krol^a, D.P. Wall^a, F.P. Brennan^a, G.J. Lanigan^a, F. Renou-Wilson^b, C. Müller^{b,d}, K.G. Richards^a

Biology and Fertility of Soils
<https://doi.org/10.1007/s00374-022-01627-y>

ORIGINAL PAPER

Linking long-term soil phosphorus management to microbial communities involved in nitrogen reactions

R. M. O'Neill^{1,2} · A. M. Duff¹ · F. P. Brennan¹ · A. W. Gebremichael¹ · N. T. Girkin⁴ · G. J. Lanigan¹ · D. J. Krol¹ · D. P. Wall¹ · F. Renou-Wilson² · C. Müller^{2,3} · K. G. Richards¹ · C. Deveautour⁵



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Assessing the impact of long-term soil phosphorus on N-transformation pathways using ¹⁵N tracing

R.M. O'Neill^{a,b,*}, D.J. Krol^a, D. Wall^a, G.J. Lanigan^a, F. Renou-Wilson^b, K.G. Richards^a, A. B. Jansen-Willems^c, C. Müller^{b,c,**}

scientific reports

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Effect of contrasting phosphorus levels on nitrous oxide and carbon dioxide emissions from temperate grassland soils

Amanuel W. Gebremichael^{1,2}, David P. Wall¹, Rosie M. O'Neill^{1,2}, Dominika J. Krol¹, Fiona Brennan¹, Gary Lanigan¹ & Karl G. Richards^{1,2}

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Why farm soils cause greenhouse gas emissions - and how to fix it

Updated / Monday, 19 Jul 2021 16:03



"Soils can vary drastically from one another, even to those that are right beside each other, as the correct fertiliser application for one field might not be right for its neighbour." Photo: Getty Images

Analysis: a large proportion of agricultural greenhouse gas emissions come from the loss of soil nutrients via applied fertilisers and other chemicals

By [Dineen O'Neill](#) Teagasc



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