Long-term effects of cropping system on N₂O emission potential

The potential for N₂O emissions outside the main growing season may be influenced by long-term effects of cropping system. This was investigated by collecting intact soil cores (100 cm³, 0-4 cm depth) under winter wheat in three organic cropping systems and a conventional reference within a long-term crop rotation experiment. Average annual inputs of C in crop residues and manure ranged from 1.7 to 3.3 Mg ha⁻¹. A simulated freeze-thaw cycle resulted in a flush of CO₂ during the first 48 h, which could be mainly from microbial sources. Other samples were adjusted to approximately -10, -30 or -100 hPa and amended with excess ¹⁵NO₃⁻ prior to freezing and thawing. Denitrification was the main source of N₂O during a 72-h incubation at 22 °C, as judged from N₂O and total ¹⁵N evolution. Although the input of C in the conventionally managed cropping system was significantly less than in the organic cropping systems, it showed higher N₂O evolution at all three matric potentials. Estimates of relative gas diffusivity (DP/D₀) in soil from the four cropping systems indicated that C input affected soil aeration. Soil from the two cropping systems with highest C input showed N₂O evolution at DP/D₀ in excess of 0.02, which is normally considered a threshold for development of anaerobic sites in the soil, presumably because the oxygen demand was also high. The study shows that cropping system affects both soil gas diffusivity and C availability, and that both characteristics significantly influence the N₂O emission potential.

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Contributors: Petersen, S. O., Ambus, P., Elsgaard, L., Schjønning, P., Olesen, J. E.
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