Fertiliser type controls N_2O emissions on wet grassland soils

Karl Richards[1], Mary Harty, Patrick Forrestal, Dominika Krol, Rachael Carolan, Catherine Watson, Gary Lanigan

[1] Teagasc, Wexford, Ireland, e-mail: karl.richards@teagasc.ie

Fertiliser nitrogen (N) is a cornerstone input in many intensive agricultural systems including those prevalent in Irish temperate grassland. However, N fertiliser is associated with environmental loss of the potent greenhouse gas nitrous oxide (N_2O). Agriculture faces the challenging target of reducing greenhouse gas emissions while also remaining economically competitive. Nitrogen fertiliser form and the use of N stabilisers have potential to improve fertiliser efficiency and reduce N_2O emissions while maintaining production. Five N fertiliser formulations; 1. calcium ammonium nitrate (CAN), 2. urea 3. urea+NBPT 4. urea+DCD and 5. urea+NBPT+DCD were evaluated for agronomic and environmental performance on three Irish grassland soils. The study followed a randomised block design with 6 replicates per treatment. The static chamber technique was used to measure N_2O and NH_3 was measured using wind tunnels. Emissions of the greenhouse gas N_2O were highest and most variable for CAN which had an emission factor (EF) of 1.49 %. Emissions for the urea treatments were lower at all site-years, mean emission factors were 0.25, 0.4, 0.11 and 0.11 % for urea, urea+NBPT, urea+NBPT+DCD and urea+DCD, respectively. N_2O emissions from urea fertilisers were less variable than CAN with CVs ranging for urea based treatments 14–38 % compared to 61 % for CAN. Thus urea based fertilisers reduced N_2O emissions by 58–87 %. All fertiliser options gave similar grass dry matter annual yields across the sites and years, with the exception of urea+DCD which had significantly lower yield than the other treatments at three site-years. Urea and urea+DCD had significantly lower apparent fertiliser N recovery efficiency than CAN and urea+NBPT which were consistently equal. The urea+NBPT treatment had significantly lower NH_3 emissions compared with urea; on average 78.5 % lower. Switching fertiliser type from CAN to urea stabilised with NBPT and DCD is a tool that reduces N_2O emissions by 58–87 %. The use of NBPT with urea does not substantially increase NH_3 emissions. Urea with NBPT matches the grass yield and N fertiliser recovery of CAN on Irish grassland soils while reducing N_2O emissions and not increasing NH_3 emissions. Fertiliser formulation including the use of nitrogen stabilisers is a useful tool for meeting agronomic and environmental goals without reducing the N rates that underpin production.

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