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PROGRAM AND ABSTRACTS

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Introduction:

Mitigation measures to reduce diffuse nitrogen (N) losses from agricultural soils are increasingly being sought. Nitrification inhibitors, which inhibit the conversion of ammonium to nitrate, are one such measure being considered. Nitrate is easily lost to water and can be reduced by microbial communities to gaseous forms, including the greenhouse gas nitrous oxide (N_2O). This study aimed to determine the impact of the nitrification inhibitor dicyandiamide (DCD) on microbial community structure and functional microbial communities involved in N cycling in grassland soils.

Methods:

Microcosms containing three contrasting grassland soils were incubated at 15°C for a 20 day period. Soils were amended with cattle slurry either with or without DCD treatment and ^{15}N isotopic labelling was employed to determine gross transformation rates. The community structure of the soil microbial community was determined by phospholipid fatty acid (PLFA) analysis while the abundance of ammonia oxidisers and denitrifiers were determined by qPCR.

Results:

DCD treatment significantly inhibited gross autotrophic nitrification by 79–90% across the soils. This was associated with significantly lower ammonia-oxidizing bacterial (AOB) populations. No effect was observed on ammonia oxidizing archaea (AOA). PLFA profiles indicated that community structure varied temporally but was not affected by DCD. Nitrite reductase populations NirK decreased with DCD while NirS, and nitrous oxide reductase (NosZ) populations were unaffected. N_2 fluxes and fluxes of N_2O from the nitrifying pool were both reduced by DCD treatment, which indicated effects of DCD on both nitrifier denitrification and coupled nitrification-denitrification. DCD significantly increased total gross mineralisation and immobilisation.

Discussion:

DCD proved to be an effective inhibitor of nitrification, with a resulting decrease in N_2O emissions from soil. It acted on AOB populations but not AOA. Community phenotype and denitrifiers were mostly unaffected by DCD. However, NirK populations were decreased and there were non-target effects on mineralisation and immobilisation.

Keywords: Ammonia oxidisers, Denitrifiers, Nitrogen, Community structure