NITRIFICATION ACTIVITY IN

NEW ZEALAND SOILS AND THE VARIABLE

EFFECTIVENESS OF DICYANDIAMIDE

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Abstract

A perfusion technique was developed by which the rate of nitrification could be monitored as it changed over time following one or more additions of a nitrification inhibitor called dicyandiamide (DCD) in two contrasting soils - namely Manawatu Silt Loam (MSL) and Manawatu Fine Sandy Loam (MFSL). The modes of action of DCD in both soils were similar but the effectiveness of DCD varied between the two soils, with greater inhibition of nitrification in the MFSL than in the MSL when expressed as a percentage of the control soil. However when expressed in actual nitrification rates (absolute terms), greater inhibition of nitrification was obtained in the MSL as compared to MFSL. The actual reductions in nitrification rates between the two soils were almost similar, but the effect of DCD on the NO_3^--N reduction in the MSL was slightly higher than in the MFSL. The nitrification rates in both soils gradually recover following the addition of DCD, but it didn't return to the initial levels in either soil. This ongoing inhibition effect was more obvious in the MFSL. The effect of DCD on the ammonia oxidising bacteria (AOB) populations in both soils followed a similar pattern to the nitrification activities, with an inhibition of nitrifier population in the presence of DCD and a recovery of the temporarily suppressed nitrifier populations when the DCD solution was removed from the system and was replaced with a fresh nitrogen source. Again, there was a residual effect of DCD on AOB numbers and this appeared to be greater in the MFSL than in the MSL.

In a separate experiment the effectiveness of DCD in the two soils was similar to that obtained in Chapter 3, in which it differed when expressed as percentage and absolute terms. DCD was more effective, with higher inhibition was obtained, in the MFSL than in the MSL when expressed as a percentage of the control. This was probably due to the differences in the rate of DCD degradation in both soils, in which DCD degraded two times slower in the MFSL than in the MSL. The effectiveness of DCD was also different between the two soils, when the same amount of DCD remained in both soils, with higher inhibition was obtained in the MSL than in the MFSL. Thus, in absolute terms DCD was more effective in the MSL.

In a further experiment it was demonstrated that soils collected from steep slopes (SS) in a hill country paddock had low nitrification rates compared to soils collected from adjacent camp sites (CS). These low nitrification rates were associated with similarly low populations of AOB in the SS soils. Of interest was the observation that the numbers of AOB and the nitrification rate in absolute terms in the SS did not increase greatly over the time, even with a plentiful supply of NH_4^+ substrate from added urea and the associated higher pH. It was not clear whether the low initial population of AOB in SS resulted from low inputs of NH_4^+ substrate over many years, or whether in addition there was an inhibitory effect that may have prevented a build-up of the nitrifiers. A subsequent investigation suggested that the low nitrifying SS soil may exert a small inhibiting effect when mixed with high nitrifying CS soils.

In conclusion DCD was found to vary in its effectiveness in soil types. The effectiveness of DCD in reducing NO_3-N production in grazed pasture systems is a function of both its half life in the soil and also the extent of inhibition of nitrification at a given concentration of DCD in the soil.

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