Using nitrification inhibitors to reduce nitrogen losses

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The steady increase in the cost of N fertiliser on farms has resulted in a renewed interest in methods to improve the utilisation efficiency of N sources such as fertiliser, manure and faeces/urine from grazing animals. Improving N efficiency reduces farm input costs and N losses to the environment. The main N losses with negative impacts on the environment are nitrate (NO3) leaching to surface and groundwater and gaseous losses of ammonia (NH3) and nitrous oxide (N2O). Losses of N through NO3 leaching and denitrification occur when NO3 is present in the soil. Nitrate is produced in the soil through nitrification, which is the enzymatic conversion of ammonium (NH4) to NO3 by soil microorganisms. The rate of NO3 formation in soil can be reduced by using a nitrification inhibitor to reduce the activity of specific soil microorganisms. There are a number of commercial sources of nitrification inhibitors, with dicyandiamide (DCD) being commonly used on grassland in New Zealand. Nitrification inhibitors are effective when applied directly to the soil or in combination with organic or ammoniacal N sources. Experiments examining the use of DCD with urine, fertiliser and manure N sources have been conducted at Johnstown Castle in collaboration with Lincoln University New Zealand, AFBI Northern Ireland and Teagasc Moorepark over the past 5 years. Recently our research has shown that DCD significantly reduces NO3 leaching from urine patches by approximately 40%. Current legislation for acceptable NO3 levels in waters is based on concentrations and thus the finding that DCD significantly reduces peak NO3 concentrations is important. Our research has shown that the use of the nitrification inhibitor DCD can reduce environmental emissions of NO3 and N2O. These N savings would be expected to result in increased herbage DM production, due to the higher N availability in the DCD treatments. Here our results have been conflicting. Although DCD consistently increased herbage N content, there was no consistent effect on herbage DM production. Lysimeter studies have shown that DCD increased herbage DM by up to 35% on a free draining soil under low fertiliser N inputs, but there was little response at high fertiliser N rates. Incorporation of DCD with band spread slurry significantly increased herbage DM production by 5.5% in one of the two year studies. At Moorepark, low herbage DM response to DCD has been reported. Variable responses to DCD on herbage DM production have been reported in New Zealand, from 1 to 21%. The effect of DCD on herbage production appears to be more pronounced at low N fertiliser inputs, due to lower soil N availability and thus a greater impact of N saved from loss. Nevertheless, it is under high N input situations that DCD can reduce the environmental impact of Irish agriculture. Inhibitors are a useful technology to reduce environmental N losses occurring within Irish agricultural systems. Reductions of NO3 leaching and N2O emissions of up to 70% are sizable but currently in Ireland there is no financial benefit associated with the reduction in environmental emissions. The agronomic benefits are less clear, but there appears to be increased agronomic responses at low N fertiliser rates.