Nitrogen Losses through Denitrification from a Grazed Pasture as Affected by the Use of Anitrification Inhibitor

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Key words : Denitrification , nitrogen losses , grazed pastures , dicyandiamide (DCD)

Introduction Denitrification is an agriculturally important soil process , since it can decrease the availability of mineral N in soil for plants and can therefore cause N use inefficiency and reduce agricultural production . Additionally , nitrous oxide (N_2O) , one of the gaseous products from denitrification , contributes to global warming . Studies have shown that soil denitrification and N_2O emission rates are highly variable , with high rates being associated with animal grazing and high nitrate concentrations in grazed pastures (Luo *et al* . 2000) . Nitrification inhibitor , dicyandiamide (DCD) , has been used to inhibit the nitrification process and to reduce nitrate concentrations in soil . As a result of reduced nitrate concentrations , denitrification rates could be reduced . However , there is little information available on effects of DCD use on denitrification rates under grazed pastures . The aim of this study was to determine the effects of the use of DCD on denitrification rates under a grazed pasture .

Materials and methods The experiment was conducted at Scott dairy farm near Hamilton in New Zealand from May to September 2007 . The characteristics and details of the soil have been previously given (Luo *et al* . 2008) . The study site was under a ryegrass/white clover pasture and was rotationally grazed by cows . In the first experiment , in May 2007 , the study paddock was grazed by cows at a stocking rate of about 100 cows ha^{-1} for 24 hours . In the second experiment , in July 2007 , the grazing was repeated on an adjacent paddock at a stocking rate of about 200 cows ha^{-1} for 24 hours . Immediately after grazing , DCD was applied at a rate of 12 kg DCD ha^{-1} onto part of the grazed paddock . The rest of the paddock received no DCD and acted as a control . Measurements of denitrification rates from the DCD applied and control areas were continued for two months for each experiment . The denitrification rates were measured using the acetylene inhibition technique , by incubating minimally disturbed soil cores in a closed system under field conditions (Luo *et al* . 2000) . The concentration of N_2O in the gas samples was determined using a Shimadzu GC-17A gas chromatograph .

Results and conclusions The rate of denitrification increased after grazing in May , reaching a maximum at around 10 days , and then declined (Figure 1) . The rates were lower from the DCD treated soil than from the control soil on several sampling occasions . By the end of the 2 month measurement period , the denitrification rates in the control had declined to levels similar to those measured before grazing . However , after this time the denitrification rates from the DCD treatment were still higher than before grazing . Although the patterns of denitrification rate following the grazing in July were similar to those following the grazing in May , the magnitude of the peak rates was much higher due to the higher stocking rate and to the fact that there was more rainfall after July (data not shown) . Spatial variations in denitrification rates were large . Coefficient of variation values for the daily measured rates among the 4 replicates were up to 150% . The large variation is likely to have been caused by unevenly distributed excretal returns from grazing cows in grazed pastures . Over the measurement periods , the total denitrification N losses from the DCD treatment were lower than those from the control (Figure 2) . The lower rates from the DCD treatment were likely to be due to the lower nitrate N concentrations which resulted from the inhibition effect of DCD on nitrification in the soil .

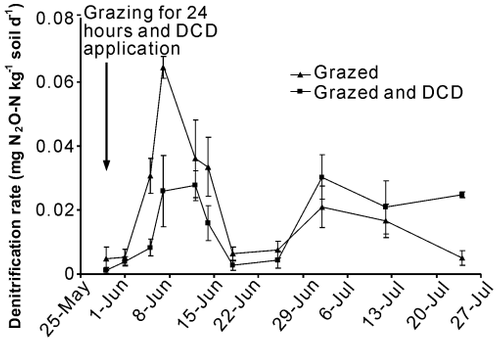

Figure 1 *Denitrification rates following a grazing event in winter 2007 .*

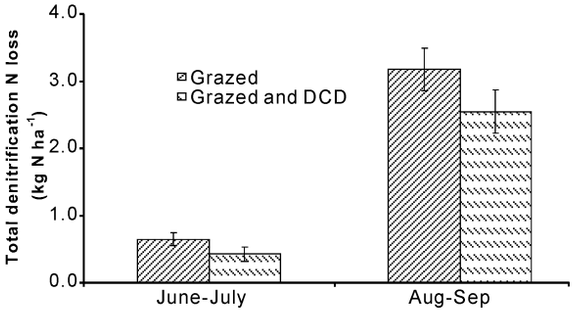

Figure 2 *Total denitrification N losses for 2 months following grazing events in winter 2007 .*

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