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**NITROGEN LOSS THROUGH DENITRIFICATION
IN SOIL UNDER PASTURE IN NEW ZEALAND**

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ABSTRACT

Denitrification is an important process in the N cycle that can affect the efficiency of use of soil nutrients and also the impact of agricultural activities on the wider environment. There have been few studies on the losses of N by denitrification from pasture soils. The current study was undertaken to investigate N loss through denitrification in a New Zealand pasture, and to examine relationships between denitrification and other environmental and soil factors. Denitrification was measured using the acetylene inhibition technique by incubating soil in a closed system.

A study on the effect of storage concluded that a soil's moisture status and the duration of storage can affect the denitrification activity, as measured by a short-term assay. This effect can operate by changing both denitrification enzyme activities and the availability of substrate.

Denitrification activities were greatest in the surface soil and generally decreased with depth in the soil profile. The decrease in denitrification activity with depth could be also attributed to both a decrease in enzyme activity and also decreasing availability of C and NO_3^- -N.

High coefficients of variation (CV) and skewed distributions of denitrification rate were always observed in the field. The log-normal distribution generally provided a better fit than the normal distribution for denitrification rates measured in the field. The variance in denitrification rate changed temporally, and depended on the soil moisture content and the grazing pattern. Amendment of soil cores with NO_3^- -N and soluble-C, either singly or together, substantially decreased the skewness of the frequency distribution of denitrification rates.

Denitrification rates varied according the location in the paddock. Highest rates were detected in the floor of a gully and in a gateway area.

Denitrification rates followed a marked seasonal pattern, with higher rates being measured

during the wet winter and lower rates during the dry summer. Higher denitrification rates were also observed during brief periods after rainfall events in the summer. An annual N loss of about 4.5 kg N ha^{-1} through denitrification was estimated in this dairy-farm paddock. Block grazing with cows at a high stocking rate increased the denitrification rate between 3 and 14 days after grazing under seasonally moist conditions. However, the total N loss through denitrification induced by grazing during that period was still very small, compared with the N returned by the grazing animals.

Correlation and multiple regression analyses revealed that relationships between single core measurements of denitrification rates and other edaphic factors in the field were poor for the combined data set. However better relationships between denitrification rate and NO_3^- -N concentration in the individual soil cores existed at high soil moisture contents, and better relationships between denitrification rate and respiration rate existed at low soil moisture contents. Mean denitrification rates from individual dates were positively correlated to soil moisture content. Regression equations derived from the mean-value data for each sampling date improved the prediction of the observed denitrification rate, compared to those from the individual data sets. Soil moisture content and NO_3^- -N concentration accounted for 51% of the observed variability in denitrification rate in the field.

Experiments conducted to obtain insights into factors regulating denitrification, by removing possible limitations to denitrification during the incubation, found that the addition of NO_3^- -N solution to soil cores stimulated denitrification rates in all seasons. This result suggested that the NO_3^- -N concentration, or more importantly, the accessibility of NO_3^- -N to the denitrification sites in the pasture soil may have limited denitrification. Denitrification rates also increased when soluble-C was added to the soil cores, but the magnitude of the effect depended on other edaphic factors

A separate study demonstrated that the presence of acetylene during the denitrification measurement also inhibited the nitrification process, and consequently could affect the NO_3^- -N availability for denitrification in the soil. However, this study also indicated that inhibition of nitrification by acetylene did not affect short-term measurement of denitrification rate.

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