A simple 15N tracing model to understand nitrogen mineralisation-immobilisation turnover in the animal urine patch

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The urine patch is the conduit through which the majority of nitrogen (N) is cycled in a grazed pasture system. Transformations of N in the urine patch are rapid during the first six weeks after urine deposition, with significant removal of N by plant uptake, volatilisation, denitrification, and leaching. Relatively little is known about the net immobilisation ('locking up') or mineralisation (release) patterns of N during this key period, particularly in soils characterised by high N inputs. Understanding the transformations of N in the soil beneath the urine patch is important for developing interventions to reduce N losses to air and water, and for validating and improving modelled estimates of N losses from the urine patch.

An open incubation experiment was set up to determine the gross and net rates of mineralisation and immobilisation in soils with differing development status, for a 42-day period after urine addition. The experiment used a volcanic soil from three sites (Waikato region, NZ) varying with time under grazed pasture: 8 years ('Forest'), 13 years ('Middle') and 25 years ('Dairy') since its conversion from forest. A 15N isotopic dilution technique enabled process rates to be measured at two day intervals over the 42-day period. The data from the incubation experiment was used to develop a simple mathematical model that describes the transformations of 14N and 15N in soil between 3 pools: 'organic', 'ammonium' and 'nitrate'. Results from the experiment and model will be presented and discussed.