

Fate of soil N when long-term pasture soil was chemically-fallowed for 13 years

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Long-term bare fallow experiments can provide valuable information on the dynamics of soil N in the absence of plants. In 2000, a 13-year field trial was established in Lincoln, Canterbury, NZ that included a bare fallow treatment. Prior to the trial, the site, on a Wakanui silt loam, had been under sheep-grazed pasture for many years, so the soil was in good structural condition. The fallow plots (9 x 28 m; three replicates) were kept plant-free using herbicides (not cultivated or fertilised during the trial). Plots were sampled regularly to determine the total stock of N (to 25 cm depth) and N in labile organic matter fractions (particulate organic N and microbial biomass N). Each year, nitrate leaching was measured during winter (May-September) using suction cups placed at 60 cm. The trial also included a control treatment where replicated plots represented the original grass-clover pasture. Pasture plots were grazed using sheep (typically 10 times per year; 20 sheep per plot). Both the pasture and fallow plots were irrigated during summer (leaching was not measured over summer). Under bare fallow, total N in the top 25 cm decreased by an average of 112 kg/ha each year (total N declined by ~20% during the trial). Relatively large losses of N occurred from the labile fractions; collectively, particulate organic matter and microbial biomass accounted for about half of the N that was lost. Total leaching loss of nitrate-N from the fallow plots during 13 successive winters was ~1000 kgN/ha (annual leaching loss ranged from ~15 to 230 kgN/ha, depending mainly on winter rainfall). In contrast to the large leaching losses of N from fallow plots, minimal leaching of N (total ~40 kg/ha over 13 winters) occurred in the pasture plots. These results highlight the important role of plants in maintaining soil organic matter and in mitigating nitrate leaching losses from soil.