

Assessing the relationship between soil Cu and Zn levels and urease activity in dairy-grazed pasture

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The intensification of dairy farming in New Zealand (NZ) has resulted in an increase use of urea nitrogen (N) fertiliser and, consequently, higher ammonia (NH₃) emissions. The urease inhibitor, N-(n-butyl) thiophosphoric triamide (nBTPT), (i.e. Agrotain®), is a promising approach for reducing NH₃ emissions when applied with urea fertiliser or cattle urine. However, nBTPT inhibition of NH₃ emissions is short-lived (7-14 days). Micronutrients such as Cu and Zn also have potential to inhibit soil urease enzyme activity (UEA) and reduce NH₃ emissions over a longer duration than nBTPT.

This study used 24 dairy farm soils, collected from the Waikato region, with contrasting inherent Cu and Zn status and soil carbon (C) to determine the relationship between these soil properties and soil UEA. Although soil C showed a significant positive correlation with soil UEA, there were no significant negative correlations between soil UEA, and inherent Cu and Zn levels. This result suggests that either there is an inability of these tests to adequately represent the bioavailability of these metals or the observed levels of bioavailable metals have limited effect on UEA. A subsequent laboratory incubation study was conducted using 4 dairy farm soils with contrasting soil C levels to quantify the effect of adding different amounts of Cu and Zn to soils on UEA. These metals were applied at the rates of 5, 10, 20 mg Cu kg⁻¹ soil and 5 mg Cu + 5 mg Zn kg⁻¹ soil. The application rates were within the expected Cu (5-39 mg kg⁻¹) and Zn (13-129 mg kg⁻¹) measured in NZ dairy-grazed pastoral lands. There was no significant reduction on soil UEA by any of these treatments. This is potentially attributable to the high organic C content of the pasture soils used, which promote immobilisation of Cu through adsorption and chelation causing, reduced bioavailability. Although most of the Zn added was bioavailable, the observed levels of bioavailable metal had no effect on soil UEA.