

Withholding grazing after irrigation reduces nitrous oxide emissions and soil damage

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Greater use of irrigation has led to large increases in pasture production in regions such as Canterbury and Otago, New Zealand. This has been matched by a similar increase in dairy production. However, for irrigated grazing systems, the impact of dairy cows on soil compaction and associated environmental concerns such as nitrous oxide (N₂O) emissions is poorly understood. We have observed situations where dairy cows graze pastures simultaneously with the application of irrigation i.e. surface soils are near or at field capacity when grazed. When soils are wet, treading pressure will more likely cause compaction and deformation of soils that in turn will reduce soil aeration and drainage, thereby promoting N₂O production and emission. The objective of our study was to investigate whether the timing of dairy cow grazing in relation to irrigation can be manipulated to reduce soil treading damage and associated N₂O emissions from urine patches. To achieve this objective, we conducted a field trial where irrigation was applied weekly to a poorly drained soil under pasture. N₂O emissions were measured from soils that had been compacted and treated with urine either 0, 2 or 6 days following irrigation. The trial was conducted beneath a rainfall shelter to exclude rainfall inputs. Compaction increased soil bulk density and reduced total porosity and macroporosity in the top 50 mm, with the level of damage decreasing with increasing withholding period. Compaction and urine application 0 and 2 days following irrigation produced relatively high N₂O emissions, with corresponding emission factors (EF₃) of 2.9% and 2.6%, respectively. In contrast, delaying compaction and urine until 6 days after irrigation substantially reduced EF₃ to 1.5% due to a lower soil water content at the time of urine deposition. Our study suggests delaying grazing until 6 days after irrigation can reduce N₂O emissions and soil damage.