Title: The fate of fertilizer nitrogen in a ryegrass/kikuyu dairy pasture system.

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Dairy pasture production is reliant on fertiliser to supply nitrogen (N); however, fertiliser N-use efficiency (FNUE) is low and N can be lost to the environment.

Objective. The objective of this study was to track the fate of N fertiliser applied in a pasture system of ryegrass (Lolium multiflorum, temperate grass) oversown into kikuyu (Pennisetum clandestinum, tropical grass).

Methodology. The FNUE of the edible pasture reflects the percentage of applied N fertiliser (input) that is removed by the animal during a grazing event (output). Fertilisers labelled with ^{15}N can be used to trace the fate of fertiliser N through the soil–plant system over time and they enable the N applied in fertiliser to be distinguished from the N derived from soil. ^{15}N labelled urea was used to track the residual plant uptake of a one-off application of ^{15}N over three pasture cuts subsequent to the first cut in the kikuyu growing season from February 2018 to April 2018 (Experiment 1), followed by total soil and plant recoveries of ^{15}N over a 12-month period (Experiment 2). Total N treatment rates were 0, 120, 240, and 480 kg N ha^{-1} year, consisting of application events of 40 kg N ha^{-1}. In Experiment 1, ^{15}N was applied only at the first fertilisation, whereas in Experiment 2, ^{15}N-labelled urea was applied at each fertilisation event.

Results. In Experiment 1, the uptake of residual ^{15}N fertiliser in the pasture biomass was <6%. In Experiment 2, FNUE ranged from 29–32%, soil-derived N ranged from 65–233 kg N ha^{-1}, and unaccounted ^{15}N fertiliser ranged from 22–142 kg N ha^{-1}, across the 120, 240, and 480 kg N ha^{-1} year treatments. **Discussion.** Recovery of ^{15}N residual fertiliser did not increase with N rate and was attributed to the mass increase in soil ^{15}N recovery. FNUE in the pasture did not decrease with the N rate. Unaccounted ^{15}N increased with the N rate, whilst soil-derived N increased with the N rate and was attributed to an Added Nitrogen Interaction (ANI). **Conculsions.** Existing and alternative N and pasture management strategies, such as clover and multi-species pasture, need to be implemented and explored to reduce the amount of unaccounted N in dairy pasture production.