Fate of ^{15}N-nitrogen fertiliser applied in high rainfall zone dairy pastures of south western Victoria

Helen Suter[1], Oxana Belyaeva[1], Graeme Ward[1] and Deli Chen[1]

[1] School of Agriculture and Food, Faculty of Veterinary and Agricultural Sciences, The University of Melbourne, Melbourne, Australia

E-mail: helencs@unimelb.edu.au (Helen Suter)

Abstract

Understanding soil and fertiliser contributions to pasture nitrogen (N) uptake over more than one growth period can help improve N use efficiency in dairy pastures. A field experiment using ^{15}N isotope techniques found that pasture utilised between 34 and 42% of applied urea-N over an 8-13 month period on dryland and irrigated pastures in a temperate zone. Greatest uptake of applied N occurred in the first two harvests post fertilisation. However > 77% of the pasture N came from the soil. These findings suggest that utilising soil N reserves combined with lower fertiliser inputs could improve N use efficiency in dairy systems.

Keywords: ^{15}N urea, ^{15}N recovery, dairy pasture, nitrogen derived from soil

1. Introduction

Nitrogen (N) use efficiency (NUE) from applied fertiliser remains low in intensively managed Australian dairy pasture systems (Gourley *et al*., 2012). Nitrogen fertiliser availability for plant uptake occurs for more than one pasture growth period, as it cycles through the organic pool. Knowledge of the factors that influence this could improve fertiliser use and NUE. This research investigated the fate of applied ^{15}N fertiliser to determine the longevity of N utilisation from a single fertlisation event.

2. Materials and Methods

^{15}N-urea (10 atom %) was applied to microplots (25 cm diameter, 20 cm height) in a field site in southwest Victoria, Australia on April 4th 2017 (autumn) and September 14th 2017 (spring) at 40 kg urea N ha^{-1} under dryland and irrigated conditions. Pasture harvested simulated grazing and recovery of ^{15}N was recorded until 1st May, 2018 (maximum 12 harvests).

3. Results

^{15}N recovery in pasture over 8 months (spring application) to 13 months (autumn application) totalled 34-42% of that applied (Table 1). The majority (20-29%) was recovered in the first two harvests post fertiliser application, with greater recovery in spring. Of the N taken up by the pasture at the first harvest event, >77% was derived from the soil in both seasons.

4. Conclusions

Nitrogen from a single fertilisation event continues to contribute to plant growth in the longer-term. Pasture N uptake combines soil derived and fertiliser N, with varying contributions between seasons. This information can be used to strategically apply N to better utilise soil N reserves.

Acknowledgements

This project is supported by funding from the Australian Government Department of Agriculture, Water and Environment as part of its Rural R&D for Profit program, The University of Melbourne and Dairy Australia.

Table 1: ^{15}N fertiliser recovery (%) in pasture harvests after application of 40 kg N ha^{-1} on April 4th (autumn) and September 13th (spring) 2017.

	Harvest 1*	Harvest 2*	Total pasture* on 1st May 2018
Autumn			
Dryland	20.57 ± 2.61	5.31± 2.0	32.6 ± 3.50
Irrigated	26.17 ± 2.40	7.41± 0.61	42.1 ± 3.5
Spring			
Dryland	21.15 ± 5.11	12.60 ± 1.03	34.42 ± 4.45
Irrigated	22.22 ± 2.48	13.02 ± 1.00	40.32 ± 1.33

*Harvest 1 and 2: 27th April and 5th June (autumn), 13th October and 1st November (spring). Total pasture recovery includes all harvests from application to 1st May 2018.

References

Gourley, C.J.P., Dougherty, W.J., Weaver, D.M., Aarons, S.R., Awty, I.M., Gibson, D.M., Hannah, M.C., Smith, A.P., Peverill, K.I., 2012. Farm-scale nitrogen, phosphorus, potassium and sulfur balances and use efficiencies on Australian dairy farms. Animal Production Science 52, 929-944.