



Increasing nitrogen use efficiency in dairy pastures

This project is aiming to increase nitrogen use efficiency (NUE) in dairy pasture systems where direct loss of N has been measured at levels as high as 40%. Previous farm scale work has suggested that small improvements in NUE can provide substantial productivity and profit gains for farm businesses. Past research in N cycling and loss processes have identified a number of options to increase NUE in dairy systems and this project is testing and validating a number of these opportunities. Led by Queensland University of Technology (QUT) and assisted by the NSW Department of Primary Industries (NSW DPI), the project has commenced to demonstrate how improved NUE practices, together with greater water use efficiency (WUE), can provide win-win opportunities for farmers in both environmental and business sustainability improvement.

The research aims

The project aims to test and validate practices to improve NUE and WUE whilst reducing the carbon footprint and increasing the productivity and profitability of Australian dairy farms. Research is:

- Investigating the interactions between nitrogen, mineralisation and irrigation management to develop best management practices (BMP).
- Increasing industry understanding of N losses, particularly from denitrification, and the potential for precision irrigation management to optimise NUE and WUE.
- Developing efficient strategies for reducing denitrification and total soil N losses and optimising synthetic fertiliser inputs.
- Producing recommendations for farmers detailing the optimal application timing and rates of enhanced efficiency fertilisers (EEFs) based on prevailing and climatic conditions.



Pictured: Wayne Clarke, Casino trial site host farmer

Methodology

The project is conducting two key activities:

1. Establishment of two core replicated trial sites – one each in the subtropical and hot/dry dairy regions of NSW- and several satellite farmer based demonstration and research sites:
 - The core sites have used existing research infrastructure operating at Casino (QUT) and Camden (NSW DPI) including variable rate irrigation, intensive soil moisture monitoring equipment and automated chambers.
 - The sites are providing a testbed for BMPs and accurate quantification of N loss pathways under a suite of different nitrogen, irrigation and EEF management practices.
 - Under different N treatments, determination is taking place of the key processes in N cycling (mineralisation, denitrification and total N recoveries) using ^{15}N labelled fertilisers to trace N movements from soil and plant recoveries, and field based mass spectrometer readings. Pasture yield is being measured under each treatment.
 - Quantification of total denitrification losses (N_2O and N_2) using highly enriched (99%) ^{15}N fertiliser and total GHG's using automated chamber technology.
2. Use data and process understanding from activity 1 to test potential BMPs and develop industry benchmarks for NUE by:
 - Measuring N cycling and efficiency over 2 years; and
 - Measuring agronomic efficiency with outputs in units of pasture DM/kg N/ L water.

Project Achievements

In the first year several experiments have been completed examining the impact of irrigation on N losses in the subtropical and warm temperate dairy regions of QLD and NSW. The outcome of this research was presented at the project's farmer field day held in November 2017 at the Casino trial. The topics of NUE, N losses, EEFs and remote sensing technologies were presented by the researchers.

Initial Outcomes

While research is still ongoing, initial results of 2017 indicated a clear threshold in soil water saturation at which losses of N accelerate, creating implications for improving both the optimal rate and spatial efficiency of irrigation. Interestingly, irrigation effects also carry-over to impact upon losses following rain events, emphasising the need to account for short-term rainfall predictions in irrigation scheduling.

Extending the outcomes

Findings will be disseminated to the research, industry and agronomy communities through scientific papers and conference presentations. Progressive outcomes are already being extended to farmers at on-farm field days as well as through the general media and Dairy Australia's programs and resources.



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