



Forage systems to reduce nitrate leaching

There is potential for substantial growth in the economic value produced by New Zealand agriculture^{1,2}. In the livestock industries, this growth will require increases in feed production for animals from grazed pastures, plus a greater contribution from forage crops, but within nutrient discharge limits set by regional councils.

Key findings

- Reducing the amount of nitrogen (N) excreted in animal urine and improving the efficiency of N uptake by plants will reduce the amount of N leached from soil.
- The 'Forages For Reduced Nitrate Leaching' programme aims to develop pasture and crop solutions that reduce surplus N in animals' diets and/or increase N uptake by plants to reduce the N leaching footprint of dairy, sheep and beef, and mixed (arable plus livestock) farm businesses.
- Researchers and developers will work with leading farmers and industry representatives to develop options that can be readily integrated into farm systems.



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Growth in both pastoral and cropping sectors must come within the nutrient discharge limits set by regional councils under the National Policy Statement for Freshwater Management.

The new DairyNZ-led programme 'Forages For Reduced Nitrate Leaching: a cross-sector approach' will address this challenge by providing new knowledge, tools and technologies for forage production that:

- reduce livestock urinary nitrogen (N) excretion
- sustain high levels of forage and animal production
- improve plants' N uptake efficiency to reduce reliance on N fertiliser and the amount of potentially leachable N
- maximise yield and N use efficiency in forage crop phases of arable crop rotations
- can be readily integrated into arable, beef/sheep, dairy or mixed-farming systems.

The programme is addressing three main areas, highlighted below.

Benefits of alternative plant species in pastures

This work will focus on pasture species and pasture management options (irrigation, grazing and fertiliser) that can reduce N excretion from livestock and improve the uptake of N from soil.

Diverse pastures (including herbs such as chicory and plantain, and grass species other than standard perennial ryegrass) have been reported to reduce urinary N excretion^{3,4} or increase the efficiency of plant uptake of soil N⁵.

Pasture species now available to farmers will be systematically compared for yield, N content in the dry matter and N uptake. The effects of management on these processes will also be investigated before simulation models, animal studies and grazing experiments are used to develop options for testing at commercial farm scale (see below).

Productive and N-efficient crop management

The production and urinary N excretion of animals grazing forage crops with high nutritive value, but relatively low N content in the dry matter, will be investigated. High yielding crop rotations will be developed to maximise N-use efficiency and minimise N losses.

Crop and effluent management systems will be developed to reduce N losses from continuous cropping, while reducing reliance on fertiliser N inputs.

For example, the use of manure (from dairy milking platforms and support blocks) to replace some fertiliser used on mixed-cropping farms⁶ will be evaluated to gauge the potential for improving the N use efficiency of both enterprises.

Improved N-use efficiency and reduced nitrate leaching losses

Farm systems that incorporate the best options for improving N-use efficiency and reducing N leaching (as identified in the first two research aims) will be developed in this part of the programme.

Farm system modelling will help identify potential risks and test how well the results hold in situations beyond those encountered in the research trials (for example, in different climatic zones and on different soil types). Ten leading farmers in Canterbury (representing dairy, beef and sheep, arable and mixed farm systems) will participate in the programme to co-develop, test and demonstrate successful options.

The farmers will also assist in developing communication material, decision support tools and extension of the results. The involvement of farmers, researchers, developers and farm consultants is an important point of difference for this programme.

It will create better opportunities to bring the knowledge of all participants to bear on the challenge and should substantially improve the chances of successful change occurring on-farm.

Forages for Reduced Nitrate Leaching is a partnership between DairyNZ, AgResearch, Plant & Food Research, Lincoln University, Foundation for Arable Research and Landcare Research. The principal funder is the Ministry of Business, Innovation and Employment. All partners co-fund the programme.

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