Reducing nitrate leaching with forages

When an animal’s diet has more nitrogen than the animal can use, the surplus is excreted in urine. A urine patch can contain 700-1000 kg N/ha, which is too much for plants to take up. This increases the risk of nitrate leaching, especially in periods when plant growth is slower and drainage is higher, i.e. late autumn through to early spring.

Forages for Reduced Nitrate Leaching (FRNL) is a research programme that targets different aspects of the nitrogen cycle to reduce the risk of nitrate leaching: reducing nitrogen content of the animals’ diet, altering the urinary nitrogen excretion, and increasing the nitrogen uptake by pasture or crops. Additionally, production and profit should be maintained, or even increased.

The Forages for Reduced Nitrate Leaching programme targets different aspects of the nitrogen cycle
Results to date

Pasture

- Urinary nitrogen concentration of cows is reduced when plantain is included in their diet. For example, in a Canterbury experiment urinary nitrogen concentration was 56% lower for cows grazing a plantain monoculture than those grazing perennial ryegrass/white clover pastures, and 33% lower for cows grazing 50/50 pasture-plantain.
- Compared with perennial ryegrass/white clover, nitrogen leaching from a urine patch under an Italian ryegrass/white clover/plantain pasture was reduced by 46%, due to greater cool-season growth with water and nitrogen uptake. The reduction was 89% when using urine from cows grazing these pastures, due to the additional effect of reduced urinary nitrogen concentration.

Low-nitrogen crops

- Crops such as fodder beet, maize and cereal silage are low in crude protein (and hence nitrogen). Substituting high-nitrogen pasture in the animals' diet with these crops reduces the amount of nitrogen eaten and excreted in urine. Especially in autumn this reduces the risk of nitrate leaching.
- A diet of 45% fodder beet with grazed pasture reduced nitrogen intake and urinary nitrogen concentration by 30% and reduced urinary nitrogen excretion by 45% in a late-lactation cow, compared with grazed pasture only.
- Fodder beet is high in sugars and low in some minerals, which can lead to animal health problems. Feeding no more than 40% of dry matter intake as fodder beet to cows in mid- to late lactation reduces their risk of acidosis. Feeding no more than 70% of dry matter intake as fodder beet to non-lactating cows reduces the risk of not meeting their nutritional requirements.

Catch Crops

- A catch crop is a fast growing crop in between two main crops, that ensures nutrients are not lost to the environment and the ground is covered to avoid run-off or wind erosion.
- Following a grazed fodder crop, a winter-sown catch crop of oats reduced soil mineral nitrogen and nitrate leaching from simulated urine patches by 22 to 40%.
- Compared with conventional tillage, direct drilling autumn-sown forage crops reduced the compaction that results from winter grazing, leading to as much as a 20% improvement in the yield of a subsequent cereal crop, which in turn increases nitrogen uptake from the soil, reducing the risk of nitrate leaching.

Farm scale effects

- FRNL monitor farms implemented plantain, fodder beet and/or catch crops, and reduced the use of nitrogen fertiliser and high nitrogen supplements, which reduced the whole-farm nitrogen surplus (inputs minus outputs). Overseer-estimated nitrate leaching rates declined on most farms, up to 30% in four years.
- Changes in nitrate leaching on the monitor farms were mostly related to changes in N fertiliser use (arable and dairy farms) and number of cattle grazing on farm, especially on winter crops (mixed livestock farms). Currently Overseer does not fully reflect the effects of plantain, fodder beet or catch crops. FRNL is working with Overseer Ltd to incorporate these farm practices and feed types in the model so their benefits can be more widely recognised.
What can you do?

A profitable farm with a lower environmental footprint can be done. At first, overall farm performance and efficiency must be assessed. An efficient use of inputs (water, fertiliser, feed) is beneficial to both the environment and the farm’s profitability. Then, a mix of actions needs to be identified that is tailored to meet the business goals, including environmental goals, of the farm. There is no single solution that fits all, and the relative profitability of implementing changes will be sensitive to market prices and input costs. Also, the various mitigation options can bring new levels of complexity, which must be able to be managed. Talk to your business consultants, you don’t need to do this alone.

For more information, go to [http://www.dairynz.co.nz/FRNL](http://www.dairynz.co.nz/FRNL)

Forages for Reduced Nitrate Leaching is a DairyNZ-led collaborative research programme across the primary sector delivering science for better farming and environmental outcomes. The aim is to reduce nitrate leaching through research into diverse pasture species and crops for dairy, arable and sheep and beef farms. The main funder is the Ministry of Business, Innovation and Employment, with co-funding from research partners DairyNZ, AgResearch, Plant & Food Research, Lincoln University, Foundation for Arable Research and Manaaki Whenua – Landcare Research.

FRNL finishes in September 2019.