



Brendon Malcolm¹

Shane Maley¹
Steven Dellow¹
Anna Taylor²
Brendon.Malcolm@plantandfood.co.nz



Are catch crops an effective mitigation for nitrate leaching in Southland?

¹ Plant & Food Research, Lincoln, New Zealand
² AgResearch, Lincoln, New Zealand

plantandfood.co.nz

The New Zealand Institute for Plant and Food Research Limited

Context

- Forage crops (e.g. brassicas, fodder beet) are an important source of high-quality feed for livestock in Southland winters.
- The risk of nitrate leaching from winter-grazed forage crops is high, because of:
 - High nitrogen (N) return in urine patches at high stock densities;
 - Bare soil with no plant N uptake for long periods in winter-early spring.



Catch crops

- Catch crops are fast-growing short-term species (e.g. oats, Italian ryegrass) that establish quickly and utilise soil N in winter-early spring, used primarily to reduce nitrate leaching.
- Research in Canterbury has shown that catch crops following winter forage crops work well, reducing N leaching from urine patches by up to 50%.

But what about Southland?

- Southland soils are generally heavier and wetter.
- Winter temperatures and growth rates are lower.
- Cultivation to establish catch crops might release even more N and increase loss risk.

Objectives

- Test whether oat catch crops could reduce N leaching losses from grazed winter forage paddocks in Southland.
- Test whether cultivation enhances the risk of N leaching and compromises the effectiveness of catch crops.

Methods

We ran repeat experiments over two years (2021 and 2022) using 50 cm diameter x 70 cm deep soil monolith lysimeters (intact columns of soil). Lysimeters have a concaved base plate and tubing that collects all drainage water.



Procedure

- 1 Collected Waikivi soil from a nearby field site (in both years).



- 2 Installed lysimeters into an outdoor facility at Southern Dairy Hub (SDH).

- 3 Pugged soil in winter to simulate intensive grazing.



- 4 Applied 2 L of fresh cow urine (equivalent to 200 kg N/ha) in late July/early August.

- 5 Assigned treatments:
 - Fallow control (no cultivation).
 - Early cultivated (late July/early August) – split to 10 or 25 cm depth.
 - Late cultivated (late September) – split to 10 or 25 cm depth.

- 6 Sowed oats in 50% of all cultivated lysimeter treatments.



- 7 Drainage water was regularly collected for approximately 4 months and analysed for mineral N (ammonium and nitrate).

- 8 Cut herbage at green-chop stage (Nov/Dec).

- 9 Analysed herbage for N content.

Results

- Early-sown oats reduced N leaching by 35–61% compared to the fallow control (Figure 1A) – nearly all N leached was nitrate-N.
- Delayed sowing until late September achieved similar reductions in N leached (28–54%).
- Cultivation increased N leaching in some non-seeded plots when compared to the fallow control (by up to 76%), attributed to enhanced N mineralisation.
- Oats yielded between 2.7 and 12.8 t DM/ha and N uptake was 62–137 kg N/ha (Figure 1B).
- Oat yields and N uptakes were greater with early sowing than late sowing (by 6.1 t DM/ha and 35 kg N/ha on average, respectively).
- N leaching was notably lower in 2022, with 70 mm drainage measured by mid-October, compared with 230 mm in 2021.

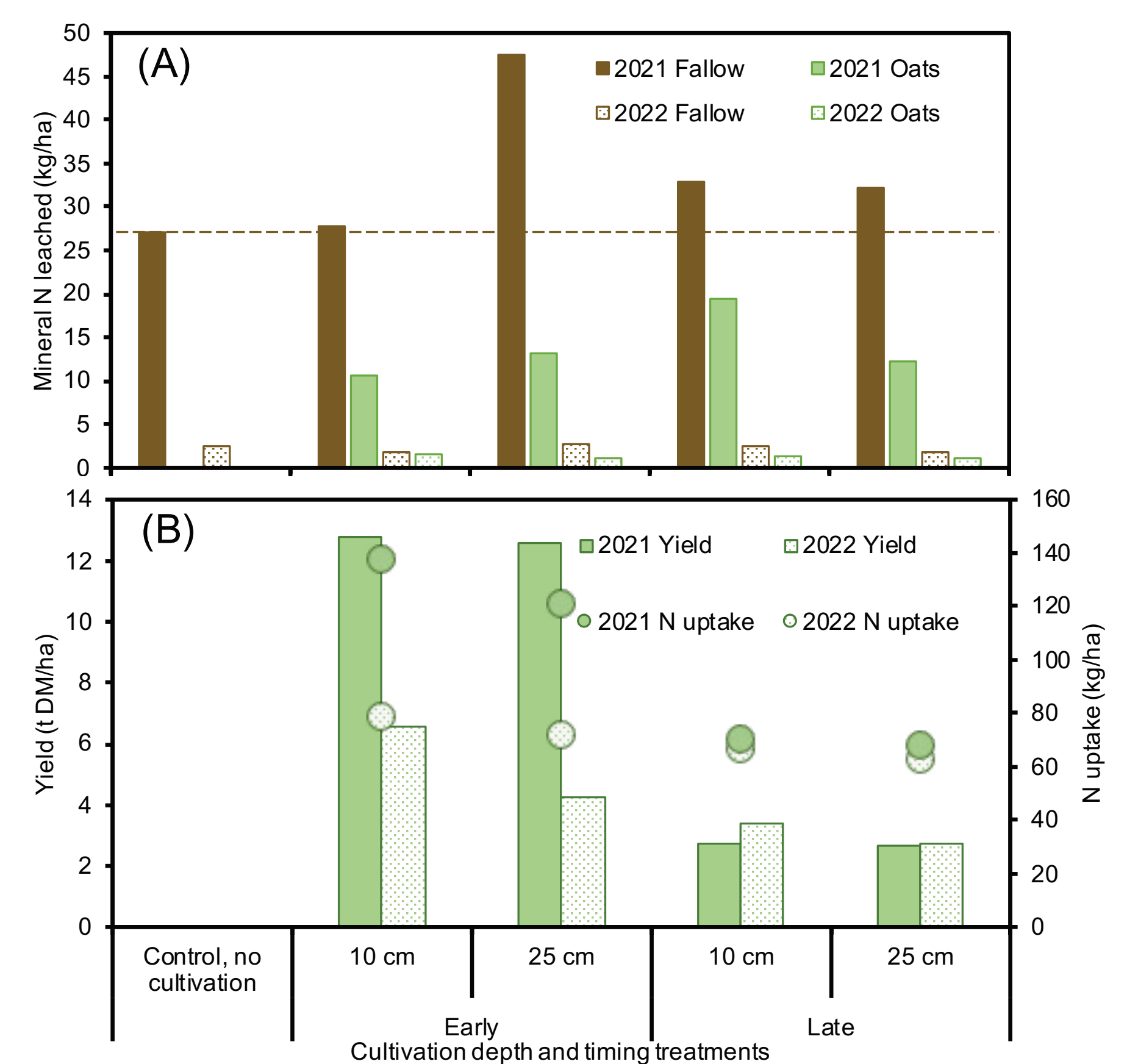


Figure 1. (A) The amount of mineral nitrogen (N) leached (kg/ha) under cultivated fallow, catch crop and control treatments, and (B) dry matter yield (t DM/ha) and N uptake (kg/ha) of oat catch crop treatments. Cultivation depths of either 10 cm or 25 cm and sowings (immediately after cultivation) were imposed shortly after urine application in late July/early August ('Early'), or 8–9 weeks after urine application ('Late').

Conclusions

- Both early (late July/early August) and later (late September) catch crop sowing reduced N leaching in most situations.
- Catch crops of oats were effective at reducing N leaching from urine patches after winter forage crop grazing in Southland by 28–61% compared with bare fallow.
- The increase in N leaching risk due to mineralisation of soil N during cultivation was mitigated by oat catch crops.

Application

- Use a fast-establishing cereal crop such as oats (consider adding Italian ryegrass to the mix)
- Sow as soon after winter grazing as possible to maximise N uptake and herbage yield.
- If sowing is not possible until mid-spring, it is probably better to cancel and focus on establishing the next crop/pasture.

Acknowledgements

The project is a collaboration between Plant & Food Research and AgResearch. Primary funding was through the Ministry for Primary Industries' Sustainable Land Management and Climate Change – Freshwater Mitigation (SLMACC-FM) programme. Financially supported by Environment Canterbury and Environment Southland, with further in-kind support by DairyNZ, Beef + Lamb NZ, Foundation for Arable Research, Environment Canterbury, Environment Southland and Overseer Limited. Southern Dairy Hub supported and hosted the trial work, allowing the development of the new lysimeter facility. Plant & Food Research, AgResearch and DairyNZ technical staff for daily management and data collection.