Pasture and grazing management: Pastoral 21 experience

The P21 project applied three principles to reduce nutrient loss; decreasing nitrogen (N) inputs, capturing urinary N and managing critical source areas.

A 'low N input, high efficiency' (future approach) was tested in Waikato and Canterbury. This document summarises the experiences and results of these sites.

The farmlets each reduced N fertiliser and imported supplementary feed inputs. This resulted in less total feed in the system. Therefore, to maintain the fundamentals of the pasture-based production system, where pasture is the predominant feed source, stocking rate was lowered so that demand matched feed supply with minimal supplement required.

With Overseer nitrate leaching estimates being sensitive to the amount of imported N (N fertiliser and imported supplements), reducing N input is a viable strategy for meeting nutrient loss limits.

Production and profit were maintained through efficient management of reduced inputs and known grazing principles.

The following information looks at the key aspects of grazing and pasture management for both approaches.

What did the research show when timing limited N fertiliser application to pasture growth?

1. In Canterbury and Waikato, farms can achieve substantial reductions in nitrate leaching and stay profitable by reducing N inputs (supplements and N fertiliser)
2. A lower N system requires regular feed budgeting as less N fertiliser is available to fill any feed deficits
3. Trust the feed wedge as an indicator of feed supply
4. Per cow production can exceed 500kg/MS from a pasture dominant diet
5. Pastures can appear visibly N-deficient (urine patches showing), however, this might not be negatively affecting growth rates
6. Grazing residuals exceeded recommendations of 7 to 9 clicks in late spring (Waikato) and summer (Canterbury), due to rye grass going reproductive and 'stemmy'.

Key points when considering a lower N system

- Run lower N input scenarios using the comparative stocking rate (CSR) tool to balance feed supply and demand, i.e. if N fertiliser applied is reduced, then pasture supply is reduced
- Are you prepared to manage cows to maximise pasture quality and quantity?

What were the pasture and grazing management rules?

The research trials undertook regular farm walks at least once a week, using either calibrated visual assessments or a plate-meter. At critical times this could be twice a week (e.g. post balance date in spring).

Pasture management

- Use the farm walk data to create a feed wedge and make decisions on managing deficits and surpluses
- Conserve surplus pasture as silage when growth exceeds cow requirements
- Make weekly decisions on when to apply N fertiliser, based on the feed wedge, average pasture covers and predicted cow demand. Aim to use nitrogen to keep pasture supply up to the demand curve.

Feeding management

Grazing management followed standard industry decision rules for both regions. Aim for the post-grazing residual of about 1500-1600kg DM/ha (7-8 clicks on a rising plate meter or 4 cm in height) and to return cows to the same area when a minimum of two leaves had appeared on the majority (>66%) of perennial ryegrass tillers (approximately 2,500kg DM/ha in spring, 4,000kg DM/ha in summer and 3,000kg DM/ha in autumn and winter).

Autumn winter grazing management

- From the start of Autumn use the Autumn rotation planner
- In the Waikato when winter pasture growth rates are expected to exceed herd feed requirements from 15 May to 15 July the daily grazing area shall not exceed 1/20th, 1/30th, 1/40th and 1/60th of the total farm area during March, April, May, and June, respectively
- In Canterbury, all cows were wintered off-farm on forage crop.

Spring grazing management

- From the planned start of calving use the Spring Rotation Planner to reach a rotation of 20 days at balance date
- If pasture intakes at target rotation < 18kg DM/cow/day then feed supplement
- Grazing area can be increased beyond that calculated above if the average herbage mass of the farm increases for two consecutive weeks
- After pasture growth exceeds herd requirements, pasture conservation is used to maintain a post-grazing herbage mass of 1500, 1750, 2000kg DM/ha, in September, October, and November, respectively
- Monitor residuals - if residual above 1400/1500kg DM/ha minimise or eliminate supplement, or if no supplement then consider holding previous week's rotation to minimise pasture wastage.

Summer grazing management

- If pasture growth rates are expected to be less than 80% of herd requirements from 1 January to 31 March, the daily grazing area will not exceed 1/35th of the total farm area from 15 January until 31 March
- Irrespective of feed requirements and previous management, at the conclusion of a summer moisture deficit exceeding 250mm (from 1 November to 28 February) daily grazing area shall not exceed 1/35th of the total farm area.

Use of conserved pasture supplements

- After balance date feed supplements when herd feed requirements are expected to exceed pasture growth rates.

Waikato trial

This trial compared a traditional Control farmlet, using standard farm management, with a Future farmlet using a stand-off pad, restricted N fertiliser and including grain in the diet.

The strategy for the Future farmlet was to grow as much as possible with limited N, harvest any surplus as silage, and carry the silage over to late season for extending the lactation. This was achieved by;

- Shifting all N use to spring and not using any N in autumn
- Additional use of Gibberellic Acid, being used during the first round in spring to give another pasture boost without N.

Results

N inputs for the Future farmlet were reduced by more than 50% compared to the Control. The results in Table 1 showed the Future system having;

- $227/ha less profit ($7.30/kg MS), in a large part due to the cost of the stand-off pad
- Produced 68kg MS more per cow and 50kg MS less per ha
- Grew 1.5t DM/ha/yr less pasture, due to the reduced amount of N applied.

Table 1: Description of Waikato farmlets results (means of five lactations).

Farmlet	Current	Future
Stocking rate (cows/ha)	3.2	2.6
Comparative stocking rate (kg live weight/t feed offered)	89	79
N fertiliser on pasture (kg N/ha/yr) 1	135	60
Pasture growth (t DM/ha/yr)	16.9	15.4
Total silage made (t DM/ha)	0.6	0.7
Pasture eaten (t DM/ha/yr)*	14.2	13.0
Total imported supplement offered t DM/ha/yr)	1.2	1.4
Milk solids production kg/ha	1201	1151
Milk solids production kg/cow	372	440
Days in milk	244	263
Estimated operating profit ($/ha/yr)2	4310	4083
N leached (kg N/ha)3	60	34

2 At a milk price of 7.30/kg Milk solids

3 From modelling, approximately ½ of the leaching is due to the use of the stand-off pad

The Future farmlet compared with the Current farmlet had an average higher grazing residual, despite the target residuals being similar for both herds. Grazing residuals on average were 0.4 RPM clicks (0.2cm) higher over the 4 years (Table 2). The future farmlet had higher residuals in early spring, late spring, summer and autumn, indicating the herd was unable to reach cow intake targets.

Table 2: Grazing residuals (RPM clicks1). (Average 4 years of data).

RPM	Current	Future
Whole year	**8.2**	**7.8**
Winter	7.7	7.6
Early Spring	7.7	7.4
Late Spring	9.1	8.4
Summer	8.5	8.1
Autumn	7.5	7

1 A RPM click is 0.5cm compressed height

Pasture on the Future farmlet had an average of 0.2MJ lower than the Current farmlets pasture, with the difference being significant in early spring (Table 2).

Table 3: Pasture metabolisable energy (MJ ME/kg DM) (means of five years).

ME	Current	Future
Whole year	**11.8**	**11.6**
Winter	12.2	12
Early Spring	12.7	12.5
Late Spring	12.3	12.3
Summer	11.2	11
Autumn	11.8	11.6

Grazing intervals (days) in Table 4 were similar, reflecting the similar management rules that were used for both farmlets. Autumn and spring rotation planners were used to make area allocations for these seasons.

Table 4: Seasonal rotation length for the Waikato farmlets (means of five lactations).

	Current	Future
Winter	90	98
Early Spring	34	34
Late Spring	23	24
Summer	23	24
Autumn	58	56

Applying the above grazing management and focusing on N fertiliser applications when pasture was growing the fastest enabled similar growth rate patterns as shown in Figure 1.

Figure 1

Average pasture growth and N fertiliser applications for Current and Future farmlets in Waikato P21 (2011/12 to 2014/15).

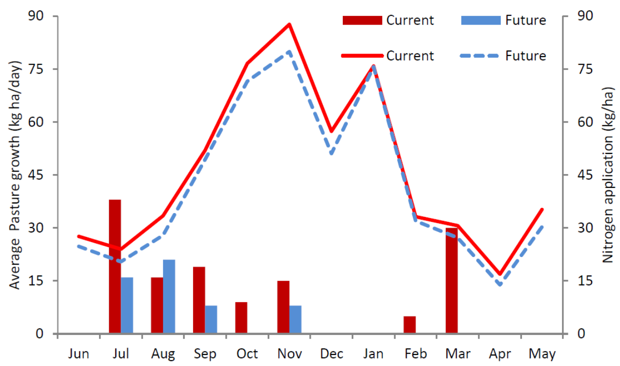
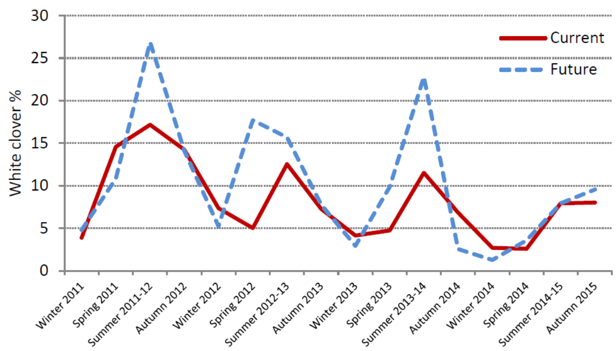


Figure 2

White clover as a % of the total pasture yield.



Canterbury trial

This trial compared two future scenarios - one where intensification continued on-farm (high stocked efficient or HSE) and one where existing stocking rates were capped at the Canterbury average, but N inputs were reduced (lower stocked efficient or LSE).

HSE followed the historical trend of increasing milk production through increased inputs;

- 300kg N fertiliser per hectare was applied to pasture between August and April
- 20% of total feed required for lactation was imported
- Stocking rate increased to 5 cows/ha (2500kg live weight/ha)
- Rigorous pasture and animal monitoring and decision-making were applied to convert inputs to milk.

LSE aimed to reduce N leaching by reducing total inputs of N fertiliser and feed on the milking platform.

- 95% of feed required for lactation was supplied by grazed pasture, with a limit of 150kg N fertiliser per hectare
- Stocking rate was held at the Canterbury regional average (in 2011) of 3.5 cows/ha (1800kg live weight/ha)
- A strong focus on pasture monitoring and allocation were implemented to achieve high levels of pasture utilisation and efficiency of use of the limited amount of N fertiliser to grow grass
- With the irrigation available, LSE aimed to retain enough N (from the 150kg) to extend grass growth later in the season and extend lactation with minimal use of supplements.

Results

N inputs for the Future farmlet were reduced by more than 50% compared to the Control. The results in Table 5 show that the LSE system had;

- $140/ha less profit ($6.30/kg MS)
- Produced 33kg MS more per cow 596kg MS less per ha
- Grew 1.4t DM/ha/yr less pasture, due to the reduced amount of N applied and lower stocking rate.

Table 5: Description of Canterbury farmlets results (mean of four lactations).

Farmlet	Current	Future
Stocking rate (cows/ha)	5	3.5
Comparative stocking rate (kg live weight/t feed offered)	84	83
N fertiliser on pasture (kg N/ ha/yr) 1	299	151
Pasture growth (t DM/ha/yr)	17.7	16.3
Total silage made (t DM/ha)	0	0.3
Pasture eaten (t DM/ha/yr)*	16.3	15.1
Total imported supplement offered t DM/ha/yr)	5.6	0.9
Pasture eaten %	73%	94%
Imported supplement %	26%	6%
Milk solids production kg/ha	2378	1782
Milk solids production kg/ cow	476	509
Days in milk	256	267
Estimated operating profit ($/ ha/yr)2	4345	4205
N leached (kg N/ha)3	46	34

1 Calculated at a milk price of $6:30

2 modelled with Overseer version 6.2

The LSE farmlet compared with the HSE farmlet had higher average post - grazing residual, despite the target residuals being similar for both herds. Grazing residuals on average were 0.7 RPM clicks (0.35cm) higher over the 4 years (Table 6). The LSE farmlet had consistently higher residuals across all seasons, with target range (7 – 9 clicks) being achieved in spring and autumn. Both farmlets exceed target range in summer, due to ryegrass plants going reproductive and stems elongating, holding up the plate meter. Visually these pastures were grazed consistently and evenly in the target range.

Table 6: Grazing residuals (RPM clicks1). Average of three years of data.

RPM	LSE	HSE
Whole year	**8.4**	**7.7**
Winter	0.0	0.0
Spring	7.6	6.3
Summer	10.5	10.2
Autumn	7.0	6.7

1 A RPM click is 0.5cm compressed height

There were no biological differences in pasture content between farmlets pastures (Table 7).

Table 7: Pasture metabolisable energy (MJ ME/kg DM) (means of three years).

	LSE	HSE
Whole year	**11.7**	**11.8**
Winter	12.0	12.2
Spring	11.9	11.9
Summer	11.2	11.3
Autumn	11.6	11.7

Figure 3 below shows the average amounts of N applied per month for three years of the trial (solid bars, corresponding to the left-hand axis of the graph). In general, more N was used in September (getting the season cranking), December (driving ryegrass out of its post-flowering slump) and March (supporting the move to longer round lengths) than in other months as shown in **Table 8.**

Figure 3

Average pasture growth and N fertiliser applications for LSE and HSE farmlets in Canterbury P21 (2012/13 to 2015/16).

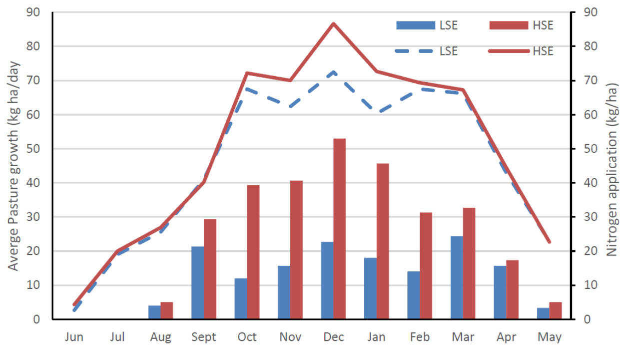
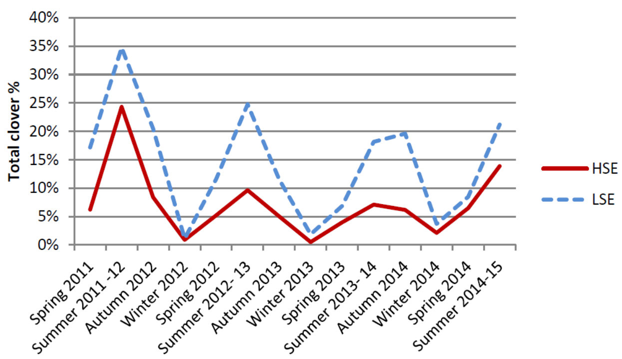


Table 8: Seasonal rotation length differences in the Canterbury farmlets has means of three lactations.

Rotation Length	LSE	HSE
Winter	0	0
Early Spring	58	43
Late Spring	29	23
Summer	23	22
Autumn	41	41

Figure 4

White clover as a % of the total pasture yield.



Conclusions

The results from both trial sites have been achieved in controlled demonstration farmlets under a very high standard of management.

There are many management combinations, including lower inputs and standing cows off pasture, that can be implemented on commercial farms. The combinations tested in the Waikato and Canterbury P21 projects has so far delivered results very similar to those predicted from pre-experimental modelling, showing that these strategies can effectively reduce nitrate leaching losses while retaining high levels of physical and financial performance when optimally managed.

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Te Ahuwhenua, Te Kai me te Whai Ora. Tuatahi