Deferred Grazing Handbook

Messages from the Sustainable Farming Fund Project *Pasture Management in a Volatile World*

July 2017 - September 2020

Acknowledgments

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Cover Image

Allen Coster in front of our primary research field site, Mataiwhetu Station, Lower Kaimai, Bay of Plenty

2018

Executive summary

'Deferred grazing' is a management tool to maintain pasture quality on pastoral farms from mid-spring onwards. It involves dropping some paddocks out of the rotation to optimise grazing pressure on the remaining paddocks, so pasture quality is maintained.

In the deferred paddocks, perennial ryegrass produces seeds. New tiller buds that form at the base of existing plants remain dormant over summer and develop into new tillers in autumn. The deferred pastures are grazed to low residuals at the end of the deferred period over one or two grazings (e.g. to 1500 kg DM/ha) so that the ryegrass seedlings and new ryegrass tillers are given access to light. They are treated as renewed pastures and are grazed carefully with light stock for short periods.

Approach and results

1. We compared deferred grazing to rotational grazing in field plot and split-paddock trials on three sheep and beef hill country farms:
   - Mataiwhetu Station, Lower Kaimai, Bay of Plenty (summer wet)
   - Otorohaea, near Pukemiro, north western Waikato (summer dry)
   - Pukekauri Farms, near Katikati, Bay of Plenty (summer wet).

   Compared to standard rotational grazing, deferred grazing improved pasture performance by increasing:
   - Ryegrass ground cover and tiller densities
   - Topsoil moisture at the summer dry site
   - Anaerobically mineralisable nitrogen (amount of N potentially available for plant uptake)

   and reducing:
   - Weed content
   - Facial eczema spore count

   While there was a reduction in nutritive value in the deferred paddocks during the deferred period, pastures rapidly recovered after the deferred period. The decline in quality of the deferred pastures was not enough to offset overall farm-scale profitability.
2. The impact of simulated 'deferred grazing' on root mass was investigated in a glasshouse study. Root mass in the glasshouse study was much greater under 'deferred' than 'conventionally grazed' ryegrass plants when plants were manually trimmed to simulate the two grazing regimes. These results need to be validated in field studies.
3. FARMAX was used to explore how deferred grazing affected livestock performance and farm profitability at the summer dry site. There was an 8% increase in total farm and per-hectare gross margins when 15% of the farm was deferred.

Further investigation

More work is needed to quantify the effects of deferred grazing on:

- Roots under deferred pastures (mass, depth, changes over time)
- Environmental impacts (e.g. effect on nitrogen leaching losses, phosphorus runoff and sediment losses from deferred pastures)
- Soil biology under deferred pastures (N-fixation rates, soil respiration and enzyme activity)

The trial site on Mataiwhetu Station - deferred and grazed plots

Project

Project purpose

This project was initiated by some hill country farmers in the project team that had used deferred grazing for more than a decade. They could see benefits for both the deferred pastures and for the rest of the farm and wanted to quantify those benefits through a science-led project. Specifically to:

1. Quantify the impact of deferred grazing on the pastures and soil at a plot and split-paddock scale
2. Establish decision 'rules' to help farmers identify when deferred grazing was appropriate in their farm system, and
3. Model the effect of deferred grazing on livestock performance and profitability (using FARMAX Red Meat Version 8.0.1.04)

"Build resilience into your farm system, combat drought, regenerate pastures, improve stock health, mitigate against sediment loss, reduce cost and take the stress out of farming. Deferred pastures might look ugly before grazing but the result is outstanding and put $$$ in your pocket. Yeeeeehaaaa let's go surfing!!!!!"

- Rick Burke, Project team member

Project duration

3 years July 2017 – September 2020

"Deferred grazing is a vital and proven management practice in my farming operation.

It has been a privilege to be chair of this valuable project which has put science credibility behind our farmer hunches and experience.

It has been a real team effort and as this workbook shows a very productive project.

If you are a pastoral farmer, I challenge you to experience the benefits of this highly profitable summer management tool."

- Allen Coster, Project Chair

Core project team members

- Farmers: Allen Coster, Brian Thomas, John Vosper, Jon Sherlock, Rick Burke
- Waikato Regional Council: Bala Tikkisetty
- Bay of Plenty Regional Council: Paul Greenshields
- Ballance Agri-Nutrients: Ian Power, Ian Tarbotton
- Ministry for Primary Industries: Janet Van Polenen
- Plant & Food Research: Karin Müller
- AgResearch: Katherine Tozer
- B+LNZ: Maria Shanks

Deferring a paddock

How do you defer a paddock

Deferred grazing is the practice of resting pastures from grazing from mid-spring until late summer / early autumn. In this handbook, 'deferred paddocks' refers to the paddocks taken out of the rotation in mid-spring and not grazed during the late spring/ summer period.

The project team developed this useful checklist:

1. Select 10 - 15% of farm area – the paddocks most suited to defer. For example, paddocks that need rejuvenating (e.g. ryegrass not performing well) and that fit in with farming operations (e.g. select paddocks that are not a stock corridor)
2. Select paddocks that were not deferred in the past couple of years
3. Select paddocks that contain high fertility pasture species (e.g. ryegrass and clover) and that are not overrun with weeds
4. Monitor pasture cover so you know when a surplus is emerging
5. Take the deferred paddocks out of the grazing round from mid-spring when pasture is just starting to send up seed heads until the end of summer / early autumn after seeds drop
6. Break feed the deferred paddock back into the grazing rotation with cattle or a large mob of ewes. Be aware that pasture utilisation could be as low as 50%
7. Treat these paddocks like new pasture and graze them lightly again prior to winter
8. Consider deferring different paddocks the following spring and repeat the above process

Over the deferred period, the deferred paddocks will look ugly but do not be put off by this!

Benefits of deferred grazing

Benefits of deferred grazing include:

- **Maintaining pasture quality over the whole farm:** By removing some paddocks from the grazing round, the stocking rate is increased over the rest of the farm. As a result, the spring feed surplus is better utilised and pasture quality is maintained.
- **Providing a feed wedge at the end of summer:** This avoids the cost and workload of buying and feeding out supplementary feed. A standing feed wedge available at the end of summer is particularly useful in drought years.
- **Increases pasture persistence:** Resting perennial ryegrass and other species from grazing from mid-spring until late summer / early autumn enables the desirable species to reseed and produce new plants in the following autumn. New tillers are also produced from the existing plants. This leads to an increase in the tiller density of desirable pasture species and can increase pasture persistence (Figure 1).
- **An increase in clover populations after a long deferred period:** Other research has shown that when deferred pastures are grazed and 'opened up' in late autumn, competition can reduce grass tiller densities, and the content of clover can increase. We did not test the impact of a long (late-autumn opening) deferred period on grass or clover in this study.

Figure 1. *Snapshots of a grazed (left) and deferred (right) section of a paddock at Otorohaea. Photos were taken in May 2019 three months after the deferred period ended.*

The field sites

Mataiwhetu Station (a place to see the stars), Lower Kaimai, Bay of Plenty

Farmed by Allen Coster, grandson of the original Coster farmers and owners for 55 years. Allen operates an all-grass system and runs a sheep and beef unit, as well as dairy support. He regularly uses deferred grazing as a management tool. Allen has represented the Bay of Plenty (BoP) region on the Mid-Northern North Island B+LNZ Farmer Council and B+LNZ Monitor farm programme 2006-08, was Supreme Winner of the 2007 BoP Ballance Farm Environmental Awards and won the 2017 People in Agriculture Award and Livestock Farm Award.

Otorohaea, Waingaro, north-western Waikato

Farmed by Jon and Fiona Sherlock, who are the third generation of the Sherlock family running the property. The property includes 45 ha of rolling ash country, runs 3200 breeding ewes and winters 250 trade beef heifers. Jon was an owner and director of IFARM, a livestock market information and analysis business and has represented the Waikato region on the Mid-Northern North Island B+LNZ Farmer Council. Before this project, Jon had not used deferred grazing as a management tool.

Pukekauri Farms, Kaimai Ranges, Bay of Plenty

Farmed by Rick Burke and Jan Loney, running sheep, bull beef and dairy grazers. In the past 20 years, Rick has worked through a Farm Environment Plan and redesigned the farm to improve profitability, freshwater quality and biodiversity and mitigate greenhouse gas emissions. Rick has used deferred grazing for many years as a tool to maintain quality during the spring – summer months, rejuvenate paddocks and build resilience into the farm system. Rick has represented the Bay of Plenty region on the Mid-Northern North Island B+LNZ Farmer Council. Rick and Jan were Supreme Winners of the 2014 BoP Ballance Farm Environment Awards.

Farm facts for the three sites

Farm facts	Mataiwhetu Station	Otorohaea	Pukekauri Farms
Farm size	235 ha	660 ha	300 ha
Effective size	217 ha	575 ha	190 ha
Primary use	Dairy support, steer finishing, sheep breeding / finishing	Sheep breeding, heifer finishing	Bull beef and steer finishing, sheep breeding / finishing and dairy support
Stock numbers	Dairy heifers (185), steers (60), breeding ewes (863), hoggets (300)	Breeding ewes (3200), R1 heifers (125), R2 heifers (125), hoggets (800) - wintered on another property	R1 bulls (200), R2 bulls (58), R1 steers (51), R2 steers (26), ewes (322) and hoggets (40)
Terrain type	67% flat to rolling, 33% steep hill country	8% rolling, 92% steep hill country	64% easy rolling, 36% steep hill country
Pasture production	12 t DM/ha/yr (+ annual pastures)	7.5 t DM/ha/yr	12 t DM/ha/yr
Annual rainfall	1,800 mm	1,300 mm	1,900 - 2,000 mm
Soil type	Kaharoa / Waihi ash	Dunmore silt loam, Waingaro hill soils	Waihi ash
Critical feed time	January – February	Late winter/early spring (early lactation) and dry summers	January - February
Goals	• To obtain the best possible return per kilogram of dry matter ($/kg DM) in an all grass system • Utilise an intensive grazing system to effectively control the quality and quantity of pasture • Improve the farm's pasture species composition and productivity • Care for the soil, water, pasture, stock and biodiversity	• Run a profitable and sustainable farm business with a long-term view • Farming to fit the land	• Consistently in the top 10% EFS/ha for our land class • To maximise $ return on DM production • To manage our landscapes in a sustainable manner, focusing on working within ecosystem health limits, while improving, soil health, water quality and biodiversity.
Biggest challenge	Optimising quality feed production to match demand from capital stock and contract dairy grazers	Adapting our farming system to climate volatility, with dry summers becoming more frequent	Remaining resilient during increasingly difficult climatic conditions

Project outline

1. Compared standard rotational grazing and deferred grazing in replicated plot studies at two sites:
   - Mataiwhetu Station (2017-2019) – a summer wet property and
   - Otorohaea (2018-2020) – a summer dry property.
   - The deferred treatment was not grazed between mid-October and the end of summer / early autumn (depending on the farm) but was rotational grazed after the deferred period for the remainder of the trial.
2. Compared the effect of standard rotational grazing and deferred grazing in a replicated split-paddock study on all three farms (Mataiwhetu and Pukekauri Farms (summer wet) and Otorohaea (summer dry)).
3. Set up a glasshouse study to help understand the mechanisms that lead to ryegrass growth and survival under deferred grazing.
4. Carried out FARMAX modelling of Otorohaea to quantify the effect of deferred grazing on pasture quality and farm profitability.

Top: Replicated plot study on Otorohaea during a summer-autumn drought. Deferred land in rectangles. Bottom: Split-paddock study on Otorohaea. Grazed split-paddock to left of line, deferred split-paddock to the right. Both photos taken 21 February 2019 at the end of the deferred period.

Plot scale studies

Effects of deferred grazing on pasture performance (Mataiwhetu Station and Otorohaea)

Soil characteristics

Key messages:

- Effects of deferred grazing on soil chemical, physical and biological parameters were short-term only.

Measurements:

- Soil chemical and biological properties were measured by removing three bulked topsoil (0-10 cm) samples, each comprising seven samples, from each plot. Samples were transferred to the laboratory and standard laboratory methods used to measure mineral nitrogen (N), mineralisable N, hot water extractable carbon, dehydrogenase activity, soil water repellency and pH.
- Bulk density, total porosity and the soil water retention curve were measured for each of five intact cores (7.5 x 10 cm) removed from each plot.
- Topsoil temperature was measured at a depth of 8 cm at 90-minute intervals during the deferred period.
- Volumetric topsoil (0-10 cm) water content was determined with a portable TDR (time-domain reflectometry) probe at 30 locations, along a transect in each plot, at least monthly during the deferred period.

Results

- At both sites, mineral N was significantly [1] higher for the deferred than grazed treatment. This is most likely due to a higher litter content in the deferred treatment leading to enhanced mineralization of organic matter.
- In January, the topsoil temperature was lower in deferred than grazed treatment by an average of 0.3 °C at Mataiwhetu Station and 1.3 °C at Otorohaea. The rank pasture in the deferred treatment during the deferred period kept the soil slightly cooler in late summer (Figure 2).
- There were no other significant effects of deferred grazing on any of the soil characteristics at either site.

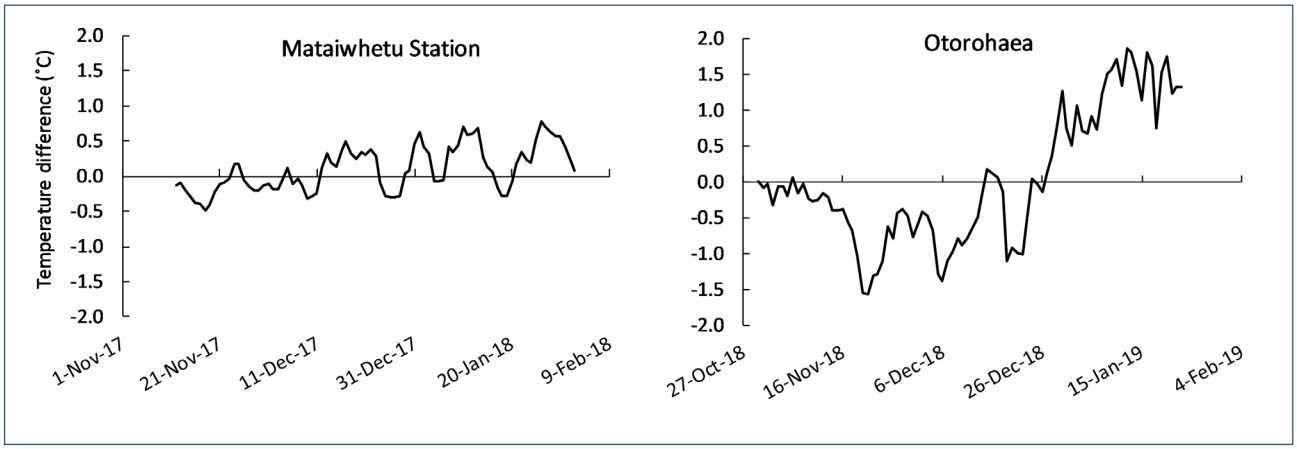

Figure 2. *Differences between the grazed and deferred treatment in average daily topsoil temperature (8 cm depth) at Mataiwhetu Station and Otorohaea. A positive value indicates that the topsoil in the deferred pasture was cooler; a negative value indicates that the grazed pasture was cooler.*

[1] Throughout this handbook 'significant' is defined as P<0.05

Ryegrass tiller densities

Key messages:

- Deferred grazing increased perennial ryegrass tiller densities after the deferred period. This occurred through:
  - Production of new tillers from existing plants (particularly in the summer wet site)
  - Reseeding (particularly in the summer dry site).
- Timing is critical. To increase the tiller population of perennial ryegrass and other desirable perennial species, rest the pasture from grazing to let the desirable pasture species set seed. The timing will vary depending on the region (e.g. northern North Island vs. southern South Island) and year (e.g. in a dry year, ryegrass may set seed earlier in the season).
- Typically, stop grazing the pastures in mid-spring and rest them from grazing until late summer / early autumn.

Measurements:

- Tiller densities were determined by removing 30 soil cores from each plot, transferring them to the laboratory and counting all perennial ryegrass tillers and seedlings in each core.

Results:

At Mataiwhetu Station,

- Deferred grazing increased tiller densities by approximately 70% in the autumn and spring after the deferred period (Figure 3a).
- In this summer wet environment, most of these new tillers came from existing ryegrass plants (Figure 3b).
- Tiller densities remained higher in the deferred than grazed treatment for 18 months after deferring, but by 21 months after deferring tiller densities in both deferred and grazed treatments were similar.

At Otorohaea,

- Deferred grazing also increased tiller densities (Figure 3a).
- In this drought-stressed environment, most of these new tillers came from reseeding and production of new seedlings in autumn after the deferred period (Figure 3b).
- Tiller densities remained higher in the deferred than grazed treatment in the spring after the deferred period, but the benefits were not maintained over the following summer when there was a severe and prolonged drought.
- 15 months after the deferred period tiller densities were similar in the deferred and grazed treatment.
- By the end of the study, there were more tillers in the grazed than deferred treatment, but the proportion of ryegrass was similar in both. This implies that there were fewer but larger ryegrass tillers in the deferred than grazed treatment.

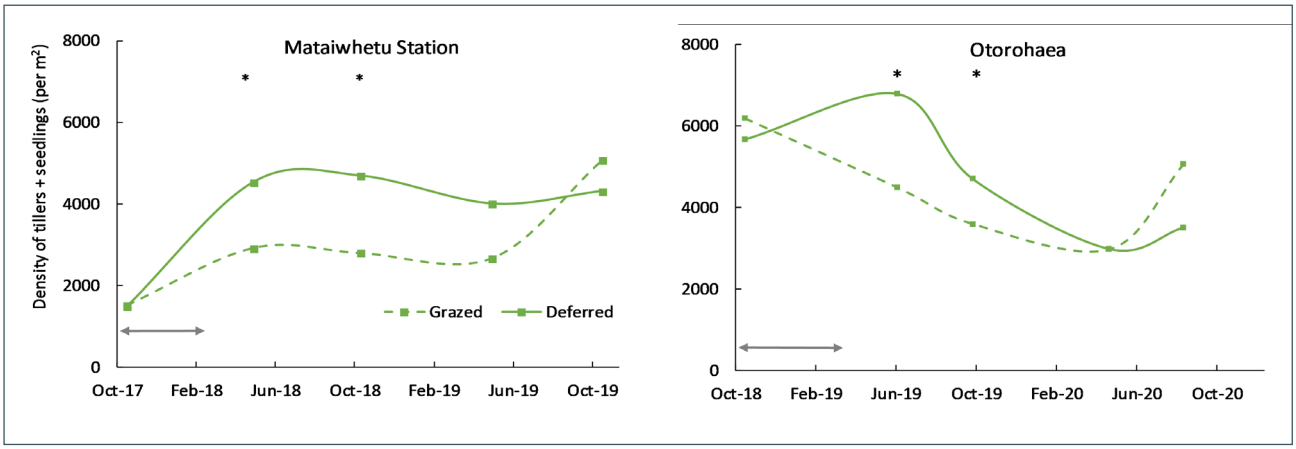

Figure 3a. *Density of tillers and seedlings combined in the grazed and deferred treatments at Mataiwhetu Station and Otorohaea. Asterisks indicate when the difference between treatments was statistically significant.*

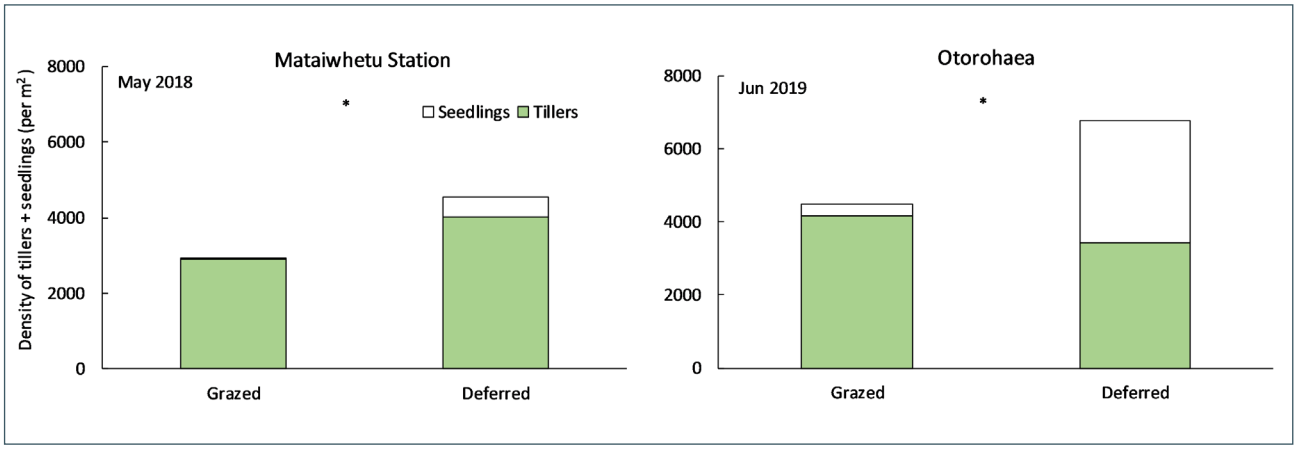

Figure 3b. *Densities of perennial ryegrass tillers (green shading) and seedlings (white shading) per m² at Mataiwhetu Station and Otorohaea in the autumn after the deferred period. Asterisks indicate the densities of tillers + seedlings were significantly greater in the deferred than grazed treatment.*

Herbage production

Key messages:

- When compared to the grazed treatment, the deferred treatment produced less during the deferred period but more after the deferred period. The feed supply curve was changed, but the total amount produced was similar in the deferred and grazed treatment over the measurement period.
- A feed wedge was created in the deferred treatment, which provided drought feed at the end of summer / early autumn.
- Deferred grazing provided farmers with a tool to control feed supply across the remainder of the farm without sacrificing long-term pasture production in the deferred treatment.

Measurements:

- Pasture production was measured before and after grazing with a plate meter or capacitance probe.
- Instruments were calibrated using pasture cuts.

Results:

- The grazed treatment grew more than the deferred treatment during the deferred period.
- The deferred treatment grew more than the grazed treatment after the deferred period.
- Total annual dry matter production was similar for both treatments over 12 months (i.e. three month deferred period + nine months post-deferred - Figure 4).
- The timing of feed supply was altered in the deferred treatment – but not the total amount grown.

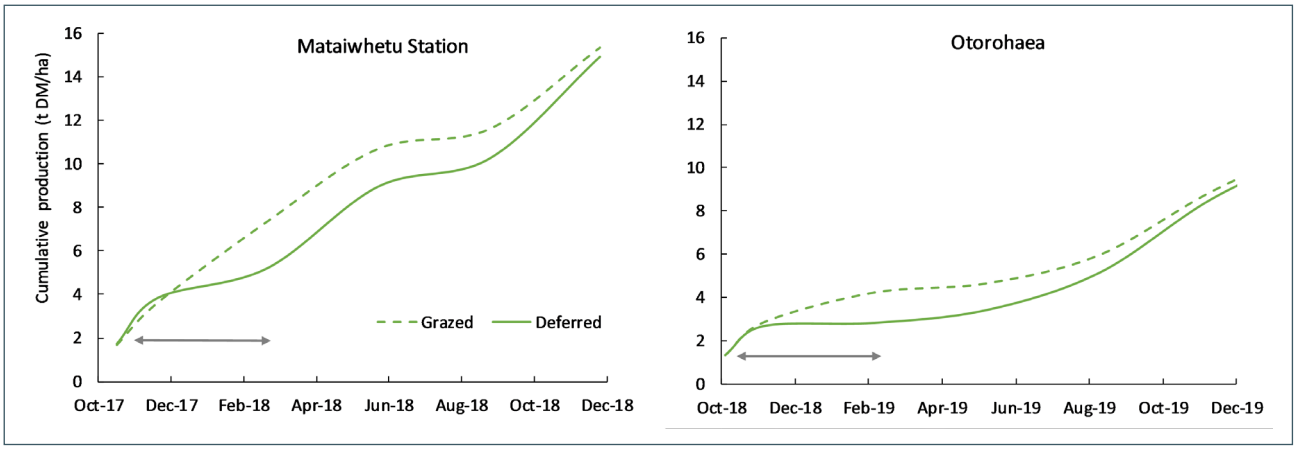

Figure 4. *Cumulative herbage production at Mataiwhetu Station and Otorohaea in the grazed and deferred treatments. Note the pasture grew more slowly in the deferred than grazed treatments during the deferred period. After the deferred period, pastures grew more rapidly in the deferred than grazed treatments. The arrow indicates the deferred period.*

Nutritive value

Key messages:

- At the end of the deferred period at Mataiwhetu Station (summer wet field site where pastures remained green over summer), pasture quality was lower in the deferred than grazed treatment.
- In our FARMAX modelling at Otorohaea, the gain in feed quality across the remainder of the farm outweighed the loss of quality of the deferred pastures. This resulted in higher pasture quality and livestock productivity at a farm scale.

Measurements:

- 20 snip samples were cut to ground level in each plot, bulked, snap frozen in liquid nitrogen and stored at -20°C until being analysed for metabolisable energy (ME) at Hills Laboratories using near-infrared spectroscopy.

Results:

- At Mataiwhetu Station, by the end of the deferred period, ME values were lower in the deferred than grazed treatment (Figure 5). As the summer was exceptionally wet, grazing was delayed to avoid pugging. By the time the field site could be grazed, the pasture had fallen over and started to rot. Photos of the deferred and grazed pastures at the end of the deferred period and in the following autumn are shown in Figure 6.
- At Otorohaea, pasture quality declined in both the deferred and grazed treatment over summer and there was no significant difference in pasture quality at the end of the deferred period.
- By winter, pastures had recovered and ME was similar in the deferred and grazed treatments at both field sites.

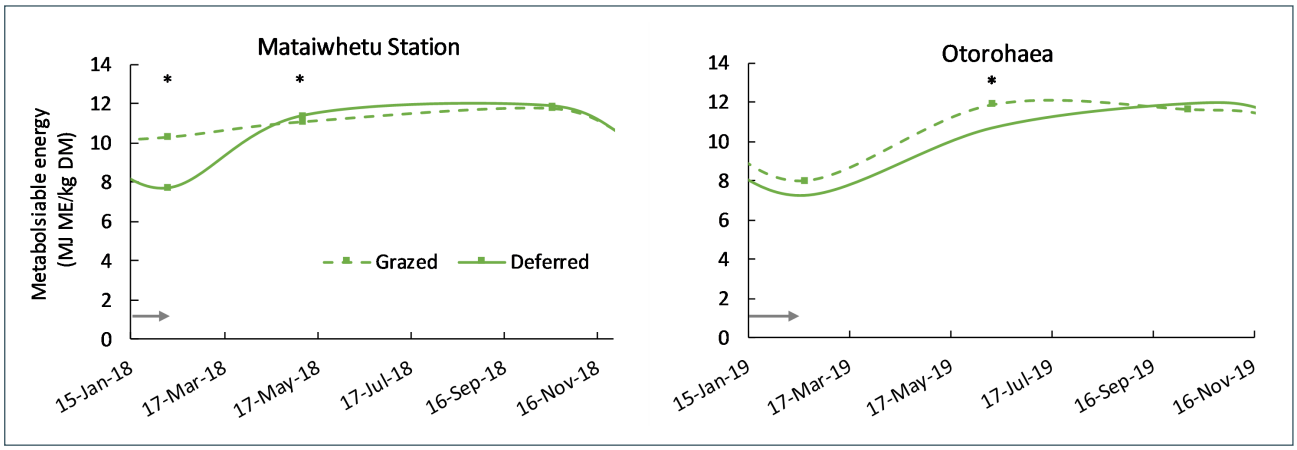

Figure 5. *Metabolisable energy for the grazed and deferred treatments at Mataiwhetu Station and Otorohaea. The arrow indicates the end of the deferred period. Asterisks indicate when differences between treatments were statistically significant.*

Grazed | Deferred


7 February 2018 - end of deferred period


15 March 2018 - after first grazing


10 April 2018 - immediately before second grazing


7 May 2018 - between the second grazing and third grazing

Figure 6. *Photographs of typical pasture in the grazed and deferred treatments at Mataiwhetu Station between February and May 2018.*

Vegetation cover

Key messages:

- Deferred grazing increased total vegetation cover (which mainly comprised perennial ryegrass (Figure 6)).

Measurements:

- Vegetation cover was visually estimated in four 2 x 2 m² quadrats in each plot by the same observer on nine occasions.

Results:

- Total vegetation cover was higher in the deferred than grazed treatment on five occasions at Mataiwhetu Station and Otorohaea (Figure 7). Perennial ryegrass was the most dominant pasture species.

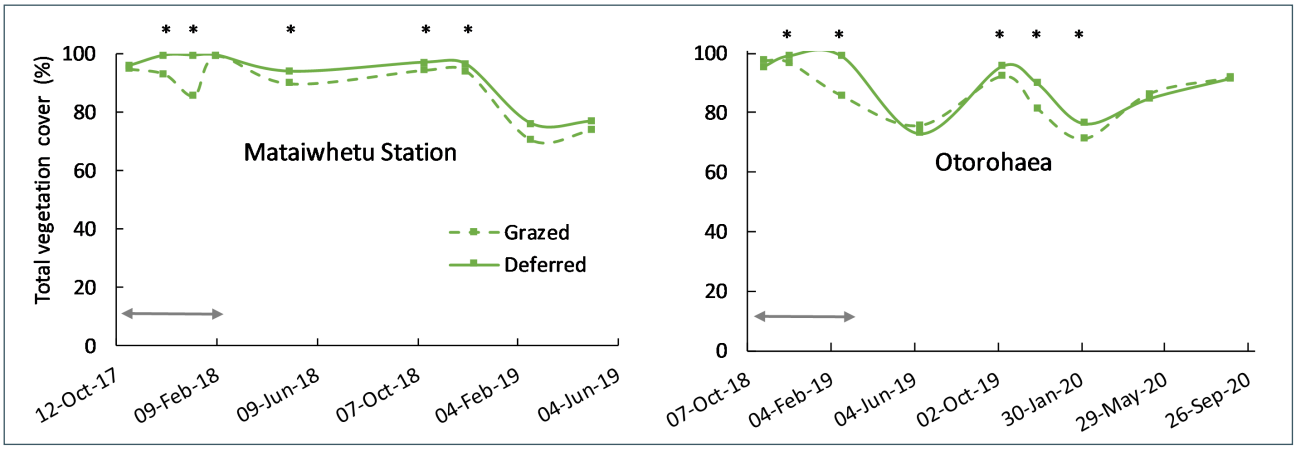

Figure 7. *Total vegetation cover at Mataiwhetu Station and Otorohaea. The arrow indicates the deferred period. Asterisks indicate when differences between treatments were statistically significant.*

Facial eczema

Key messages:

- Facial eczema spore counts were lower in the deferred than grazed treatment at both sites.
- While the risk of facial eczema may be lower in the deferred paddocks than in other paddocks, spore counts may still exceed the threshold above which treatment for facial eczema is necessary.

Measurements:

- Facial eczema spore counts were assessed between January and May using the 'Wash' method (Geenty and Morris, 2017) [1]
- Herbage was cut to ground level at 20 locations and bulked for each plot. Samples were washed in the laboratory and spores in the wash-water counted.

Results:

- At Mataiwhetu Station, the number of facial eczema spores was significantly lower on average in the deferred than grazed treatment (37,000 vs 53,000 spores/g pasture based on a repeat measure analysis), despite there being no difference between treatments on any of the individual assessment dates (Figure 8).
- At Otorohaea, the number of spores was lower in the deferred than grazed treatment in February and April.

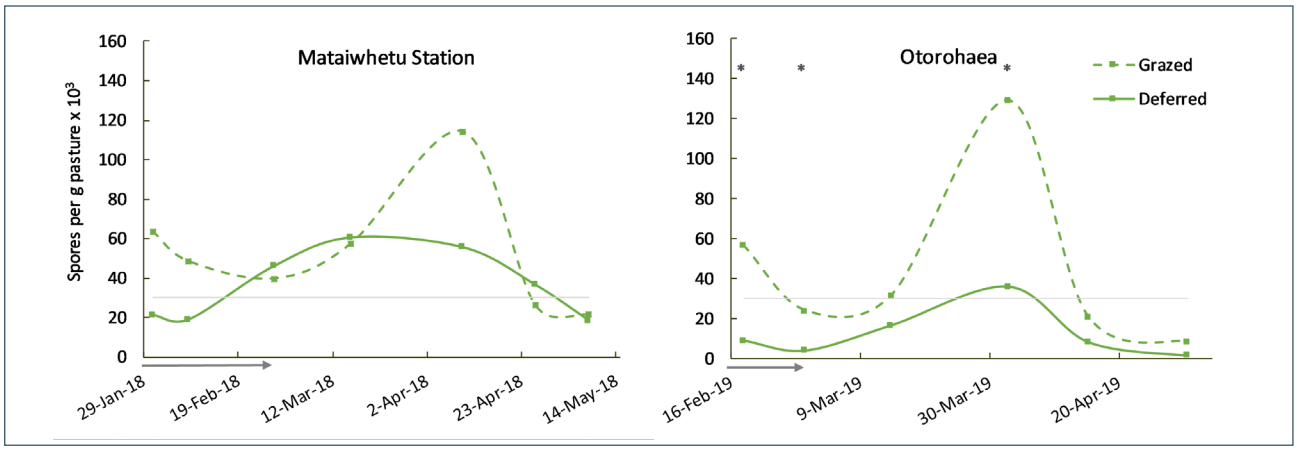

Figure 8. *Facial eczema spore abundance at Mataiwhetu Station and Otorohaea. The arrow indicates the deferred period. Asterisks indicate when differences between treatments were significant. The horizontal line is the risk threshold for facial eczema.*

[1] Geenty, K.; Morris, S. 2017. The "wash" method for facial eczema spore counting on pasture. In *Guide to New Zealand cattle farming*. P131. Beef + Lamb New Zealand

Split-paddock study

Effects of deferred grazing on pasture performance (Mataiwhetu Station, Otorohaea and Pukekauri Farms)

Key messages:

- When comparing the deferred to the grazed treatment:
  - Herbage production was similar in both treatments during the deferred period but greater in the deferred treatment thereafter.
  - Pasture quality was lower in the deferred treatment during the deferred period, but it quickly recovered and was similar in both treatments thereafter.
  - Total vegetation cover was greater in the deferred treatment during and after the deferred period.
  - Weed presence (particularly Californian thistle) was lower in the deferred treatment after the deferred period.
  - Soil moisture was higher in the deferred treatment towards the end of the deferred period and thereafter.
- Results from the replicated split-paddock and plot studies were similar.

Measurements:

- Two paddocks were selected on each of the three farms. Each paddock was split into two sections.
- One section was deferred from mid-spring until early autumn and the other was rotationally grazed during that period.
- The whole paddock was grazed in common after the deferred period.
- Pastures were monitored from mid-spring 2018 (one month before the deferred grazing began) until the end of autumn 2020.
- Measurements included:
  - Herbage production
  - Nutritive value
  - Ground cover
  - Soil moisture.

Results:

Herbage production:

- There was a trend towards greater seasonal herbage production in the deferred than grazed treatment after the deferred period, but differences were not significant for any of the individual seasons (Figure 9).
- However, total annual herbage production was significantly greater in the deferred than grazed treatment after the deferred period (autumn 2019 – summer 2019-2020; 8.9 vs 7.7 t DM/ha).

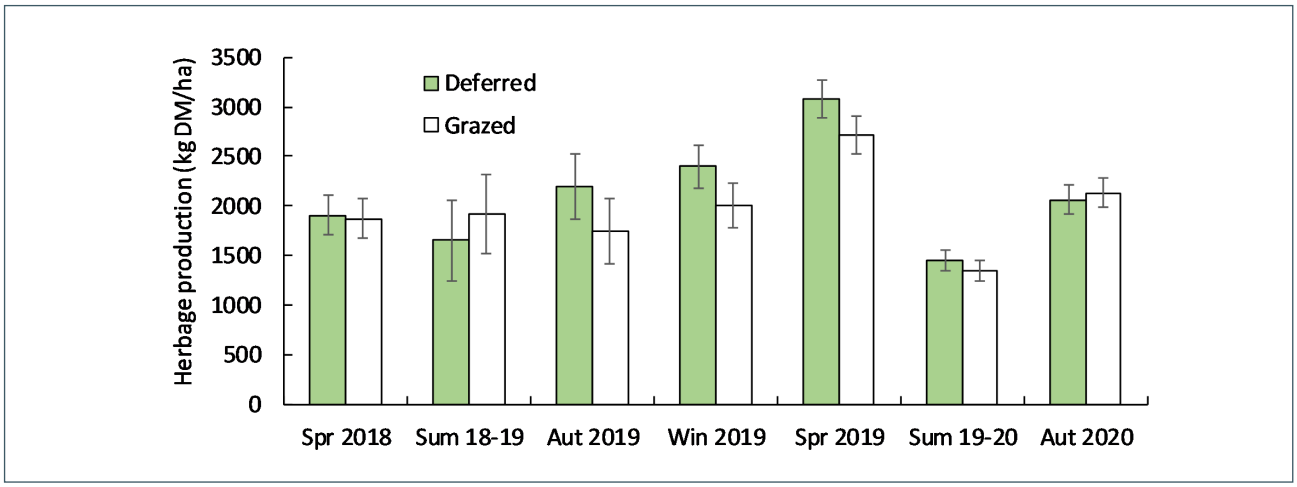

Figure 9. *Seasonal herbage production averaged over six paddocks on three farms.*

Nutritive value

- Deferring had little impact on nutritive value, other than at the end of the deferred period when metabolisable energy was lower in the deferred than grazed treatment (7.0 vs 7.8 MJ ME/kg DM).

Vegetation cover

- Total vegetation cover (% of total ground area covered by vegetation) was higher in the deferred than grazed treatment on six of nine measurement occasions.
- Broadleaf weed abundance was significantly lower in the deferred than grazed treatment. This was particularly noticeable at Pukekauri Farms, where deferred grazing reduced thistle presence (Figure 10).

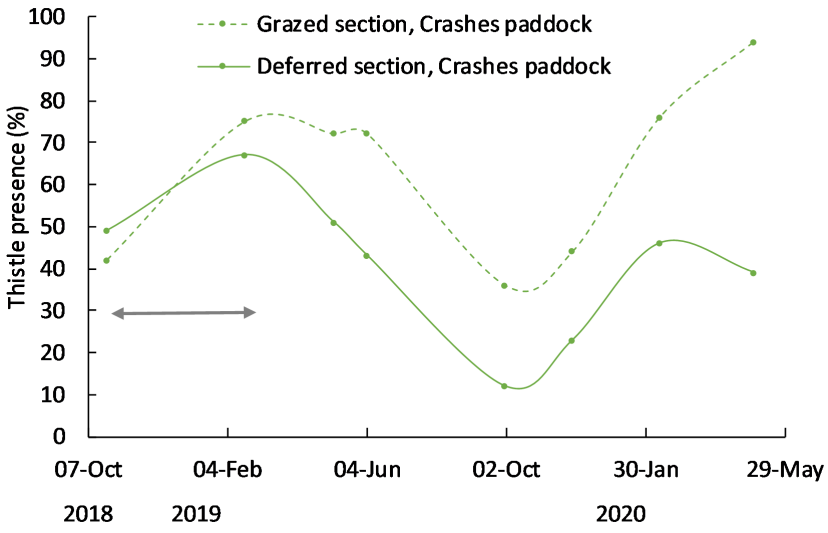

Figure 10. *The graph shows the percentage of rising plate meter locations under which one or more Californian thistle plants were present in Crashes paddock on Pukekauri Farms. Measurements were collected from one Pukekauri Farms paddock in which Californian thistle was abundant. The arrow indicates the deferred period.*

A photo of Crashes paddock taken in June 2019 - deferred section (A), grazed section (B).

Soil moisture

- Soil water content at a depth of 0-7.5 cm was significantly higher in the deferred than grazed treatment based on a repeated measures analysis (Figure 11).

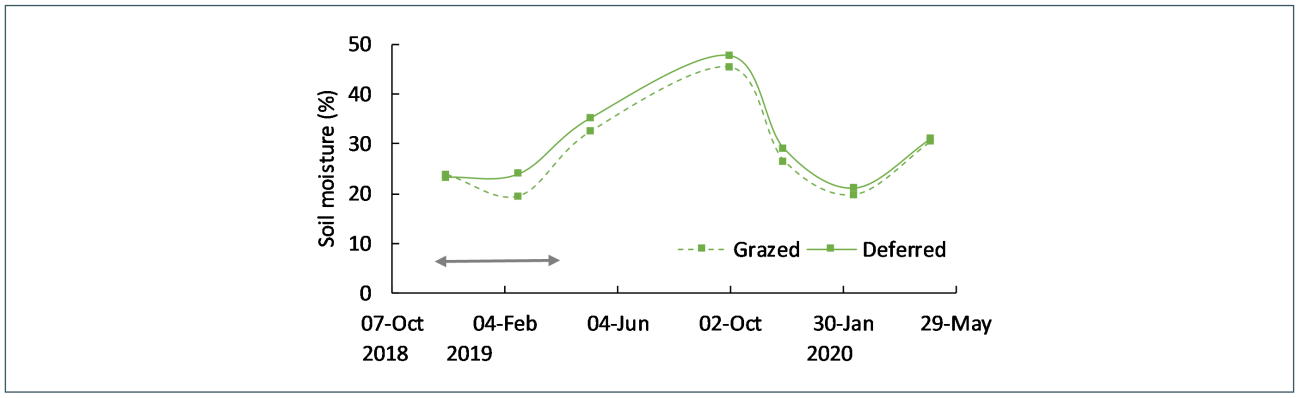

Figure 11. *Gravimetric soil moisture content of deferred and grazed pastures at a depth of 0-7.5 cm averaged over six paddocks on three farms. The arrow indicates the deferred period.*

Grazing a deferred paddock at the end of the deferred period at Pukekauri Farms after a wet summer in 2018-2019 (left) and a different deferred paddock after a dry summer in 2019-2020 (right).

Glasshouse study

Impact of grazing on ryegrass tillers and mass of shoots and roots

Key messages:

- When compared to simulated 'rotational grazing', the root mass of the simulated 'deferred grazing' regime was three-fold greater (when plants were hand-trimmed, Figure 12).
- Results from a glasshouse study can never be directly related to grazed pasture, but they reflect the general trends. Research is needed to quantify the impact of deferred grazing on the root mass under pasture, how it changes over time and how it affects plant access to water and nutrients.
- Glasshouse studies are valuable because we can learn how roots respond to defoliation, which can be difficult to assess in grazed pastures.

Measurements:

- Measurements began in early spring and continued into autumn of the following year.
- Plants were hand trimmed to simulate 'rotational grazing' (in which the ryegrass was maintained in a green leafy state) and 'deferred grazing' (in which the ryegrass produced seed heads).
- Perennial ryegrass root mass and tiller densities were measured.

Results:

- When compared to the simulated grazed treatment, the root mass of the simulated deferred treatment was three-fold greater at the end of the deferred period. Tiller production was also much greater in the deferred treatment.
- We can infer from the glasshouse study that the root mass under deferred pastures will be greater than under those that have not been deferred. This would contribute to increased tiller production, uptake of nutrients and water, and recovery after drought.
- However, field research is required to quantify the impact of deferred grazing on root mass under pasture and how it changes over time.

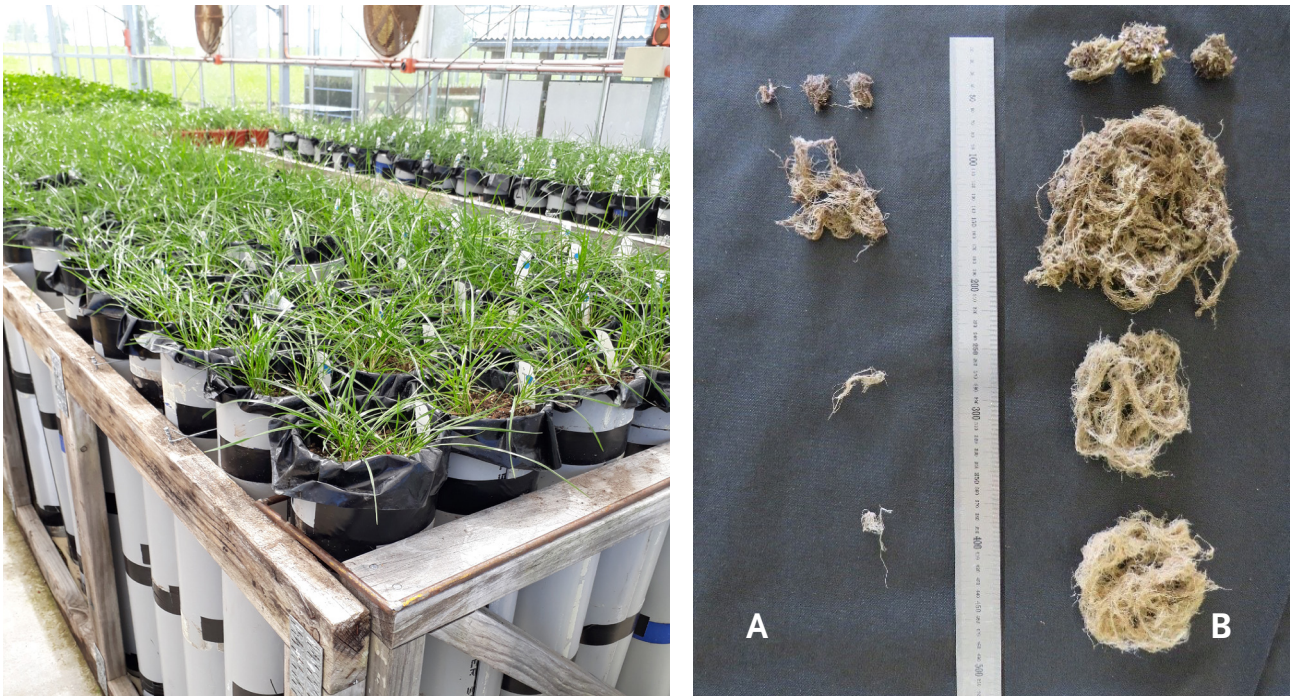

Figure 12. Photos from a glasshouse study comparing the impact of simulated 'deferred grazing' and 'rotational grazing' on the root mass. The photo on the left shows the ryegrass growing in metre-long tubes before treatments were applied. The simulated 'standard rotational grazing' treatment had the smallest root mass (A) and the simulated 'deferred treatment' had a 3-fold greater root mass (B).

Farm-scale analysis

FARMAX findings (Otorohaea)

Key messages:

- Deferred grazing 15% of Otorohaea farm area (from mid-October until mid-February) increased pasture quality across the remainder of the farm which increased per-head stock performance and farm profitability.
- Deferred grazing resulted in an 8% increase in both total farm and per-hectare gross margins, due to the impact of improved pasture quality on stock performance.

FARMAX modelling: steps, assumptions and results:

Step 1: Base model

- Estimate of farm profitability based on having a spring surplus in a typical year and no deferred grazing.

Step 2: Deferred model

- 15% of the farm was deferred (amount selected was based on the potential to utilise the spring surplus available in a typical year).
- Pasture growth was suppressed during deferred period, but there was strong regrowth after the deferred period.
- Scenario assumed no change to stock numbers or per-head performance.
- However, assuming no change to performance is unrealistic as increased grazing pressure on the remaining 85% of the farm would prevent pastures from getting out of control, becoming rank and stemmy and losing quality. Increased grazing pressure enables pastures to be maintained in a green leafy state and increases pasture quality.

Step 3: Deferred grazing with increased performance

- Based on published literature[1], it was assumed that the increased grazing pressure on the rest of the farm led to a lower pre-grazing herbage mass (i.e. the spring surplus was controlled). This improved pasture quality.
- Improved pasture quality led to improvements in per-head stock performance.
- Ewe weights increased by 3 kg/head, which resulted in a 6% increase in lambs weaned and a 1 kg/head lamb weaning weight. This increased by 37% the number of lambs sold that weighed above the target weight.
- This resulted in an 8% increase in both total farm and per-hectare gross margins.

Table 1. Impact of deferred grazing on profitability at Otorohaea.

Farm profitability	Item	Step 1: Base model	Step 2: Deferred grazing (assuming no changes to the rest of the farm)	Step 3: Deferred grazing (assuming changes to the rest of the farm, BUT with increased pasture quality and per head performance)
Revenue ($)	Sheep	563,850	561,687	598,795
	Beef	121,965	124,227	124,227
	Total	685,815	685,914	723,022
Expenses ($)	Crop & feed	101,633	101,662	101,662
	Stock costs	54,529	54,521	54,520
	Interest on capital	64,006	64,216	65,651
	Total operating	220,169	220,399	221,833
Gross margin ($)	Total farm	465,646	465,515	501,189
	Per ha	817	817	879

[1] Waghorn G.C.; Barry, T.N. 1987. Chapter 2. Pasture as a nutrient source. In *Livestock Feeding on Pasture*. New Zealand Society of Animal Production Occasional Publication No. 10. A.M. Nicol. (ed). Pp. 21-37.

Deferred grazing FAQs

What is deferred grazing?

Deferred grazing is a management tool to maintain pasture quality over the farm from mid-spring onwards. It involves taking some paddocks out of rotation to optimise the grazing pressure on the rest of the farm. This enables species such as ryegrass and legumes in the deferred paddocks to set seed. In the following autumn, seedlings emerge from the soil seedbank, new tillers are produced from existing plants and pastures are rejuvenated.

Benefits of deferred grazing

What is the financial cost of deferring the pasture?

There is no direct financial cost to deferring. You simply shut the gate. However, long term you are able to maintain pasture quality across the rest of the farm and maintain production.

Is there a financial benefit to deferred grazing?

Yes. FARMAX modelling of one of the trial sites has demonstrated an 8% increase in the farm gross margin.

What are the benefits of deferred grazing?

The main benefits are:

- increased tiller densities of perennial ryegrass or other desirable perennial pasture species after deferring
- increased pasture growth after deferring
- provision of valuable feed at the end of summer; it is especially valuable after a long drought.

A secondary benefit is that you can maintain pasture quality across the rest of the farm and increase livestock production.

How much does deferred grazing impact pasture growth?

During the deferred period, the grazed pastures grew more than the deferred pastures. However, after the deferred period, the deferred pastures grew more than the grazed pastures. The total pasture production was similar for the deferred and grazed pastures when taking the 3-4 month deferred period and the 12 months after deferring into account. The timing of feed supply was altered in the deferred pastures, not the total amount of feed.

Timing of deferring

When should you shut up the area you have chosen to defer?

Ideally, as early as possible and definitely before seed heads have formed. This is generally around mid-October but this will depend on where you farm and the season. If you normally need to make silage and/or hay take those paddocks out first and then decide which paddocks to defer.

How much area should you shut up?

A good starting point is 10% of your farm. However, some farmers shut up as much as 25%, which allows them to sell stock before it turns dry and move feed to the autumn. Start with an area you won't need to graze over the November-February period. Remember, you are effectively making your farm smaller for three months.

Can I defer the same area again next year?

Yes, but it is generally better to defer a separate area the next year so the benefits can be realised on other paddocks. More research needs to be done on the impact of deferring a paddock for two or more summers in a row.

Can I only defer steep paddocks?

You can use deferred grazing on any land class. The principles and benefits still apply. However, you can improve pasture quality on easier slopes by other methods as well. Deferred grazing suits land that is more difficult to rejuvenate.

Pasture quality

Will pasture quality decline after deferring the paddocks?

By the end of the deferred period, the deferred pasture was often of lower quality than grazed pasture. However, by the end of autumn after opening-up and grazing the pasture in the deferred paddocks, the quality was similar to the deferred pasture.

Will deferring a weedy paddock make it weedier in the future?

Not normally. Our experience shows that if you have reasonably good ryegrass and clover in the deferred paddock, annual weeds and many broadleaf weeds will be suppressed in the longer term (Figure 10). You are shutting up the paddock in mid-spring to allow the ryegrass to accumulate dry matter and produce seed heads. That will shade out a lot of weeds that would normally grow during November and December. The heavy seed drop of ryegrass and increased size of existing ryegrass plants will allow ryegrass to become more dominant in your new pastures. You can fence off and defer part of a paddock to suppress the weeds.

Can you sow extra seed on the deferred area to improve pasture species composition?

Oversowing pasture seeds to enhance the pasture quality was not part of the study. However, anecdotal comments from farmers suggest there was a benefit in autumn sowing annual or perennial ryegrass and/or legumes into the sward. If oversowing, don't forget slug bait to control slugs and snails or all your oversowing efforts could be in vain.

Grazing the deferred paddocks

What stock should you use to graze deferred paddocks?

This study used mature dairy grazers or mature beef cattle - and this worked well. However, on steep slopes (i.e. >15°), it may be unwise to use heavy cattle. In this case, ewes can be used.

Can you graze the deferred paddocks with lambs?

Yes. Lambs can do very well grazing the deferred area. However, you may still need to graze with cattle after the lambs, to eat the rougher pasture and trample it into the ground. This trampling helps break down the dead vegetation and improves seed-soil contact and seedling establishment.

How much pasture should you leave after grazing?

You are aiming for at least 50% utilisation and ideally down to around 1500 kg DM/ha. A lot of pasture is trampled into the soil.

How hard should you graze the deferred paddocks?

That depends on the contour, season and stock class. In a drought, you may wish to push for a lower residual. The principle is to eat all the green and flatten the dead matter. The rams will be going out, so ewes can be pushed a little. Cattle do well on deferred pasture, even with eating a bit of dry dead matter. Farmer experience shows that you get around 50% utilisation of total DM grown over the deferred period.

When should you stop grazing the paddocks and take them out of rotation?

Make sure that the last grazing is around mid-spring and definitely before the seed heads develop. You want the seed heads in that pasture to be retained, mature and set seed for germination in the following autumn. Otherwise, the animals may eat of most of the developing seed heads and reduce the benefits of deferring.

Do you use deferred grazing instead of using silage or hay, or as well as?

Using deferred grazing can replace some, or all, of the need for silage and/or hay. Deferred paddocks grazed at the end of summer/early autumn can replace the need for making and feeding out silage or hay over the summer/autumn period. However, if you normally use silage or hay, then you may still need to plan for that and make or purchase some.

When should you graze the deferred paddocks?

Ideally, wait until the end of February, when the seed has set and dropped. This will provide a seedbank for seedling emergence in autumn and allows existing plants to produce new tillers.

If you get short of feed, can you graze the deferred paddocks in December/January?

Yes you can, especially if you need the feed. However, you would ideally wait until the end of February when grass seed has set and dropped. If you graze earlier, you may miss out on the benefits of re-seeding and increased tiller production and pasture growth.

How do I treat the deferred pastures after they have been grazed?

Keep heavy stock off them; treat them like a new grass paddock. You will get another grazing or two from them before winter. You may be keen to return those green paddocks into your rotation but be patient.

Soil impacts

Does deferred grazing improve soil structure?

We assessed structure through measuring bulk density and the soil water retention curve. Results showed no significant differences.

Does deferred grazing impact soil temperature?

On both sites in summer, the soil temperature was lower in the deferred than grazed paddocks. It appeared that the increased pasture cover in the deferred paddocks shaded the soil.

Does deferred grazing impact pasture roots?

Although this study did not look at the impacts on pasture rooting depth in the field, the glasshouse study showed the root mass of the simulated deferred grazing treatment was three times greater than the simulated traditional rotational grazing treatment. This implies that the root mass under deferred pasture will be greater than under the standard rotationally grazed pastures.

Does deferred grazing impact soil moisture?

On average, there was a higher soil water content at the 0-7. 5 cm depth in the deferred paddocks, compared to the grazed paddocks.

Fertiliser application

Do the deferred paddocks need nitrogen (N)?

This was not part of the study. Anecdotal comments suggest some benefit in applying a low rate of N fertiliser in autumn. However, it is recommended that you do not apply N fertiliser in June and July.

Should you still apply your annual phosphate fertiliser on the deferred area?

This study did not look at the merits of applying or not applying phosphate fertiliser on the deferred area. The annual phosphate fertiliser application in this study was spread on the deferred area as per usual.

If you over-sow with grasses and/or legumes, do you need to apply fertiliser as well?

This was not part of the study but, anecdotally, farmers who have over-sown the deferred area with pasture species have also applied a low rate of Diammonium Phosphate (DAP), with good success.

Animal health

Will deferred paddocks be a 'hot spot' for facial eczema when grazed at the end of summer?

Surprisingly, no. This study showed that deferring pastures did not increase the risk of exposure to facial eczema spores. However, total spore counts may still be greater than recommended thresholds, so it is important to measure the spores.

Does deferred grazing affect parasite loadings of the pasture?

The study did not investigate parasite loadings of deferred pastures. However, it could be reasonably expected that the parasite loading will be lower in the deferred pastures because they were not grazed between mid-spring and the end of summer.

Figure 13. A Californian thistle-infested split paddock at Pukekauri Farms. The left side was deferred from mid-spring until the end of summer and the right side was not deferred. The photo was taken in mid-May 2019, three months after the deferred period ended. Research is underway to quantify the impact of deferred grazing on Californian thistle growth and survival in pastures.

Appendices

Appendix 1. Farmer experience with deferred grazing

Deferred grazing has been used by Allen Coster on Mataiwhetu Station and Rick Burke on Pukekauri Farms for more than a decade, while Jon Sherlock from Otorohaea deferred for the first time in 2019. Allen Coster was interviewed in 2018 and Rick Burke and Jon Sherlock in 2020.

We asked	Mataiwhetu Station	Otorohaea	Pukekauri Farms
What is deferred grazing?	It is the practice of dropping some paddocks (maybe 10%) out of the rotation, once there is a mid-spring surplus.	An opportunity to shut up paddocks and retain pasture quality on the rest of the farm, as well as rejuvenate the deferred paddocks.	Maintain pasture quality through shutting up some paddocks for three to four months. No extra cost.
Why defer?	Maintain pasture quality on rest of farm at "no cost", unlike making hay or silage and then having to feed that out. Provide a spell for the deferred paddocks to rejuvenate. Enable reseeding to increase pasture density To suppress weeds plus other benefits.	Proactively manage pasture quality. To retain soil moisture in deferred areas. Deferring is so flexible, I can take paddocks out early when I sense a surplus is coming, but can bring them back in the rotation – so why not shut up a few paddocks? I have seen the benefit on the easy country and recently also on the steep hill country.	To maintain pasture quality on the remainder of the farm. It makes management easier. An opportunity to sow new legumes and herbs after deferring (late summer-autumn). Helps control weeds. This management tool is very compatible with good environmental stewardship.
When do you start the deferred period?	It varies depending on the season. For me, I typically shut up paddocks from mid-October and break feed them off in early February. Usually a 3 to 4-month period.	Varies between seasons. Typically, mid-spring, which means that by docking time I would group up some mobs which enables me to drop some paddocks out. Often people bring paddocks back into the rotation too late, but this time I brought them back in at the right time and have seen the benefits. Graze off the deferred paddocks in February and then treat it like a new pasture from March onward, as there will be a lot of reseeding.	From mid-spring through to mid-summer. I use cattle to break feed the deferred paddocks. There will be a lot of reseeding and the paddocks are quite "soft" and need to be treated like new pastures.

We asked	Mataiwhetu Station	Otorohaea	Pukekauri Farms
Who is deferred grazing suitable for?	Farmers with a spring surplus they cannot control or want to control without the cost (and workload) of making and feeding hay or silage, or chemical topping. This may be due to preference, contour or financial constraints. Farmers who can't raise their animal feed demand high enough to consume surplus.	Absolutely everyone and suitable for different land classes. We have two quite different management units some easy/early country and some hilly sheep country - I look to shut up approximately 10% of the easy country and 10% of the big country.	Everyone – easy country right through to steeper hill country. Massive potential for much wider use of this management practice.
Who is deferred grazing not suitable for?	Farmers who want supplement to feed out at other times of the year. Those who do not have suitable livestock (need cattle / large ewe mobs) to "break feed" the deferred back in initially.	Those who require supplement to be made to feed out later in the season. They would want to allocate those areas first and then some deferred is extra area.	Those who lack subdivision. Where water supply is not available for cattle when bringing paddocks back in.
Challenges of deferred grazing?	Planning it out. Selecting which paddocks and the timing.	Getting the timing right at both ends. The confidence to take some paddocks out earlier, if possible, as well as getting the timing right bringing them back in (In the past I was doing that far too late). How to bring the big country back in at the paddock scale. I have been able to do this with large mobs of ewes and some temporary fencing.	People often need to see it to believe it and at various stages of the year. Really need to have cattle to be able to bring the deferred area back in.
The importance of deferred grazing?	Deferred grazing is one of my most important management tools and I cannot imagine not doing it as part of my seasonal management.	Such a potentially widely relevant tool that can help with seasonal pasture management.	It works and is efficient to implement. Also will have wider benefits for the environment such as increased ground cover for several months after deferring.

Appendix 2. Deferred grazing – plant processes

The timing of the deferred period is critical. It is beneficial to rest pastures from grazing from mid-spring until late summer / early autumn, so that the ryegrass and other desirable perennial species can reseed and produce new tillers from existing plants.

When pastures are deferred, the following occurs:

Spring and early summer

- Energy reserves (carbohydrates) accumulate primarily in the developing perennial ryegrass seed head, but some reserves also accumulate at the base of the plant (Table 2)
- Perennial ryegrass root mass increases
- Vegetative ryegrass tillers die during late spring due to shading and lack of energy reserves which are prioritised for seed head development
- Production of new ryegrass tillers is suppressed
- Pasture growth slows
- Ryegrass sets seed.

Mid- to late summer

- Ryegrass plants can become semi-dormant in hot dry summers
- Seeds of ryegrass (and other species) fall to the ground ready to germinate when conditions are favourable
- Pasture growth is often negligible
- A wedge of standing feed has accumulated
- The deferred pasture is grazed and the rank vegetation is consumed or trampled
- Cleaning up the rank vegetation is important so a) sunlight can reach emerging seedlings and new tillers and b) pasture quality can be recovered.

Autumn

- With cooler temperatures, shorter daylengths and increased soil moisture, new tillers are produced at the base of ryegrass plants
- Ryegrass seed germinates and emerges from the seedbank
- There is a rapid increase in pasture growth rates.

Table 2. Concentration of water soluble carbohydrate (mg WSC per g dry matter) in different perennial ryegrass plant parts at the end of a simulated deferred period in a glasshouse study (discussed on pages 22).

Ryegrass plant part	Grazed	Deferred	Increase in WSC:
Leaf	35	66	≈ 2 X
Stubble	90	300	≈ 3 X
Crown	39	193	≈ 5 X
Roots	43	84	≈ 2 X

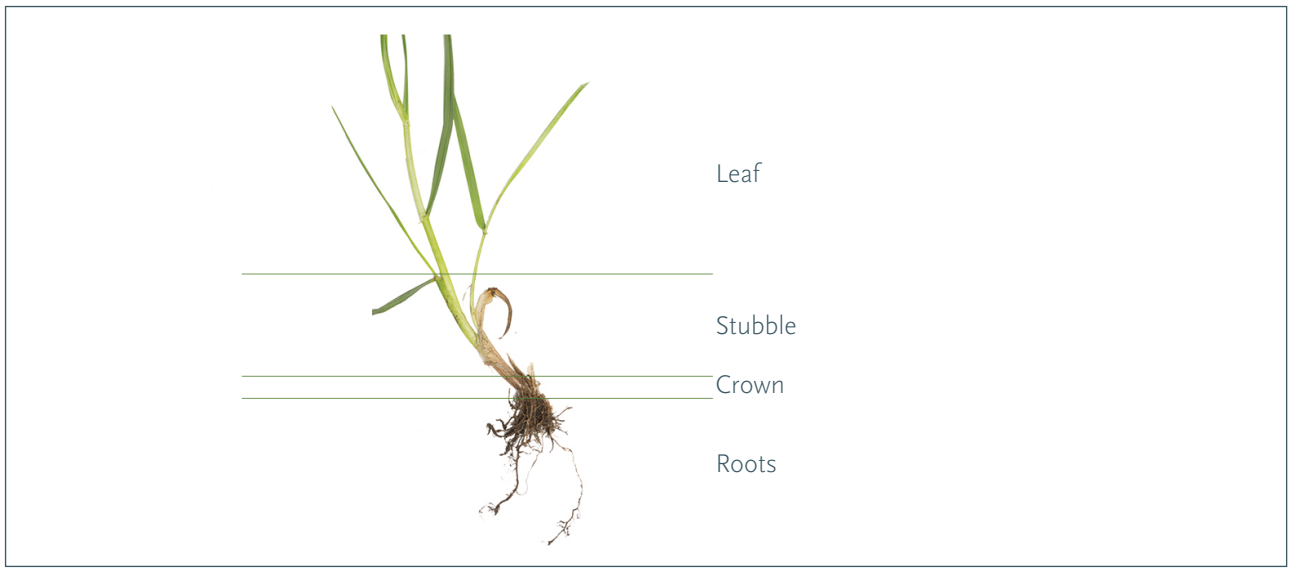

Figure 14. Ryegrass plant showing the leaf, stubble, crown and root portions.

Appendix 3. Further information

These articles focus on quantifying the impacts of deferred grazing between mid-spring and late summer /early autumn on pasture and soil characteristics. They are based on research done on beef and sheep or dairy farms in New Zealand and Australia.

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11. Watson, R.; Harris, S.; Bell, N.; Neville, F. 1996. Deferred grazing to enhance white clover content in pastures. Grassland Research and Practice Series No. 6 154-154. https://www.nzgajournal.org.nz/index.php/rps/article/view/3357


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