Decision triggers for using off-paddock facilities during autumn and spring

Research trials at Telford by AgResearch have established that restricting the time cows spend grazing on wet soils in spring and autumn will reduce N leaching and pugging damage.

Intensive dairy cattle grazing on wet soil can have a negative effect on the physical quality of soil and pasture production. This may increase the risk of sediment and nutrient losses via overland flow, and reduce future pasture production.

Reducing the time cows spend grazing pastures during autumn, irrespective of soil water content (SWC), can lower soil nitrate (NO_3^--N) concentration (owing to less urine N return) at a period when pasture growth is limited by low temperatures, and a large surplus of rainfall creates drainage and leaching.

Off-paddock facilities may be used to confine cows periodically during spring and autumn with the intention of protecting wet soils from treading damage (spring) and reducing nitrogen leaching losses (autumn). Strategies aimed at reducing the time cows spend grazing pastures in spring and autumn have been investigated as part of the P21 research programme at Telford Dairy Farm, South Otago.

Key points from the P21 Southern Dairy Systems trial

1. To reduce pugging damage during spring, take cows off when soil water content is at or near field capacity (a 3mm soil water deficit is recommended).
2. Average pasture growth rate on protected soils in spring was 56kg DM/ha/day compared to 51kg DM/ha/day on unprotected soils.
3. To maximise pasture utilisation and reduce pugging, two short grazing events (e.g. 4 hours/grazing) per day are recommended.
4. Use of off paddock facility during April and May led to a ca. 10% decrease in N leaching risk.
5. Investing in off-paddock facility increases a farm's capital and operating expenditure.

DairyNZ

Why is it important to protect wet soils?

During early spring, soils tend to have high moisture content (i.e. are at or near field capacity) and are prone to animal treading damage in the form of soil compaction and pugging. Pugging takes place when soils are typically very wet and air pores likely to be filled with water. In comparison, soil compaction results in a reduction or compression of soil pore (air) space, and can occur at lower soil moisture content i.e. on moist rather than wet soils. Poor soil drainage may compound this wet soil issue.

When soils are wet, the pressure under the cow hoof causes a breakdown of soil aggregates (particles of soil clumped together), reducing soil drainage and aeration. This in turn increases the risk of sediment, pathogen and nutrient losses via overland flow and reduces soil biological activity. A loss in pasture production (5kg DM/ha/day) occurs due to direct damage caused to the pasture sward and root system, while a long-term reduction in pasture growth rate may occur due to poor soil physical conditions.

Figure 1: Mild (above) and significant (below) treading damage to pastures due to cow grazing during 'wet' periods.

How can pugging damage be reduced?

Soils that are most prone to treading damage include those with a high clay content that drain slowly. Soils on the Telford farm are dominated by Pallic soils that are highly susceptible to structural damage due to high clay content and impaired drainage characteristics. In these soils grazing time should be reduced when soil water content is at or near field capacity.

In the first year of the P21 research at Telford, a soil water deficit threshold of 3mm was used; if deficits fell below this value, cows were stood off for 13 hours a day. For soils with low clay contents (i.e. < 10% clay), a higher soil water content can be maintained (i.e. sometimes above field capacity) before the effects of treading significantly affect pasture production at a farm scale.

Reducing the time cows spend on wet soils will reduce pasture damage.

Treading events that occur in spring and early summer will have significantly greater effect on total pasture production than those that happen in autumn due to the relative differences in seasonal pasture production.

1. Assessing when to take cows off

Worm Test

Monitoring soil water content can be useful to guide decisions about when to take cows off pasture. In most instances, knowledge of the farm and the degree of soil wetness on a given day will be sufficient to guide this strategy. For most clay-based soils, the 'worm' test can be used as a guide to indicate when treading damage will occur. If soil can be rolled out into a thread of approximately 3mm dia. without crumbling then treading damage is likely. However, if the soil crumbles before this point is reached, paddocks are likely to be sufficiently dry to avoid damage.

Calendar Approach

Alternatively, a simple calendar-based approach (i.e. cows removed for a period of every day in spring) may be preferable in locations with predictable seasonal climate conditions where it is logistically easier to plan and implement such an on-off grazing schedule. In the second and third years of farmlet experimentation at Telford, a calendar-based approach was adopted whereby cows were restricted from accessing paddocks for 13 hours every night of spring until late November.

2. How long to stand cows off wet pastures?

Some grazing of wet soils (e.g. 8 hours/day or whatever is practical and allows cows sufficient time to harvest a large percentage of their daily feed requirement), in combination with limited use of the stand-off facility (e.g. 13 hours/day, leaving 3 hours for milking and laneway time), will be more economical than no grazing at all.

Research shows that to maximise pasture utilisation, two short grazing events (e.g. 4 hours/grazing) per day will be more effective than standing cows off only once per day yet for twice the duration (e.g. 8 hours/grazing).

In many cases it may be logistically easier to hold cows off for one entire grazing bout (i.e. during the day or during the night). However, this will increase the quantity of supplementary feed required and therefore costs. Frequent removal of cows from wet pastures will also pose difficulty in managing average pasture cover and pasture quality.

What did the research show?

Two farmlet systems were implemented at Telford, each with a herd size of 110 cows. Treatments included: 1) a Control where grazing was carried out regardless of soil water content, and 2) a Restricted grazing treatment where grazing on wet soils was avoided. During spring, cows in the restricted grazing herd were removed from pasture for 13 hours (overnight) on days when the soil water deficit was less than 3mm (in the Telford soils this approximates to a soil water content of 36%v/v). During spring, the Restricted herd spent approximately 10% less time on pasture compared with the Control herd.

Fertiliser N inputs to the Control and Restricted farmlets averaged 100kg and 75kg N/ha/yr, respectively; pasture growth measured during the 2012-13 (Year 1) and 2014-15 (Year 3) seasons has been corrected for differences in these fertiliser N inputs based on an assumed N response rate of 14.8kg DM per unit of N applied. In Year 1, pasture grown (corrected for N input) in the Restricted farmlet was approximately 18% higher compared to the Control (Figure 2). The average pasture growth rate in spring was 56kg DM/ha/day when wet soils were protected, as opposed to 51kg DM/ha/day. No significant difference in pasture growth was observed between the farmlets in Year 3 of the study.

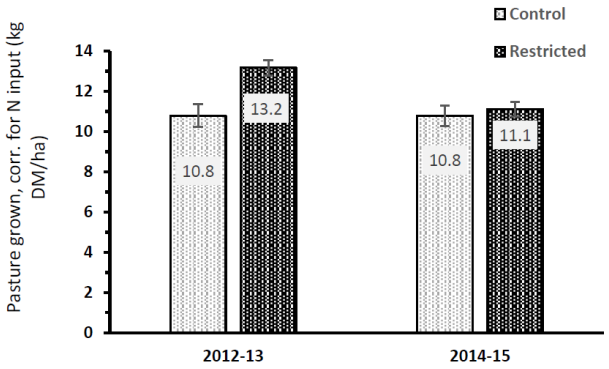

Figure 2: Average pasture grown (kg DM/ha) in the Control and Restricted farmlets in Year 1 and Year 3.

Values have been corrected for differences in nitrogen (N) input assuming an N response rate of 14.8kg DM per unit of N applied. For the control herd, cows remained on pasture regardless of soil water content conditions; in the restricted herd, cows were removed for 13 hours when the soil water deficit fell below 3mm (in this soil this is equivalent to 36%v/v). The stocking rates of the Control and Restricted farmlets were 2.9 and 2.8 cows/ha, respectively. The error bars represent the SEM (n=17 paddocks/farmlet). Paddocks used in this analysis represent a subset of the total number of paddocks within each treatment.

Silage was offered to the Restricted herd at a rate of 5.2kg DM/cow/day when cows were stood off wet paddocks for 13 hours during spring. Grass silage tends to have a lower metabolisable energy content compared to fresh pasture, therefore a higher DM intake may be required to meet the daily energy requirements of a lactating cow.

The relative advantage of removing cows from wet paddocks will vary in response to milk price, soil type and the pasture production that is lost under 'standard' managements where no soil protection is provided. In drier regions, the impact of treading damage across the whole farm will be low and so production and financial gains may often be less than the costs of implementing an on-off grazing strategy. However, there may be valuable environmental gains in terms of contaminant reductions in surface runoff.

Farmers will need to assess the relative impact of treading damage across their farms and estimate the potential increase in productivity likely to be achieved through wet soil protection; Figure 3 can be used as a guide for this assessment.

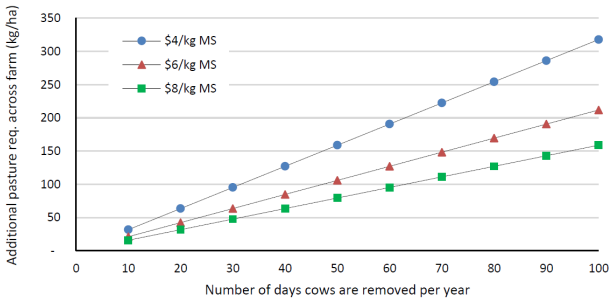

Figure 3. Estimated required increase in pasture production per hectare (all farm hectares), relative to the status quo, to off-set the operational costs associated with using an off paddock facility for cows that are removed from wet pasture for 8 hours per day for a range of milksolids (MS) pay-out prices. It is important to note, estimates of pasture quantity required to off-set the cost of standoff do not include the capital costs. It is based on all farm hectares and a stocking density of 2.9 cows/ha (i.e. for a 172ha farm, $4 MS pay-out price and 60 days standoff, 32.9t of DM is required to off-set the operational cost of standing cows off).

Calculations assume the cost to stand cows off is $0.04 cow/hr; cows are provided 2kg DM/cow/day when stood-off in the form of silage which costs $0.12 to produce ($0.08 to ensile home-grown pasture and $0.04 to feed out); no change in milksolids production due to standing cows off; a pasture energy content of 11MJ ME/kg DM and 7.8kg DM is required to produce 1kg MS (factoring in 5% wastage); Friesian cows requiring 82 MJ ME/ kg MS; and a stocking density of 2.9 cows/ha. Capital cost of the facility is not included in the cost estimate.

What are the implications of taking cows off?

Managing Pasture Quality

When grazing hours are reduced during calving and late spring, managing average farm covers is important to prevent loss of pasture quality and subsequent reductions in net pasture growth rates. For the farmlet study at Telford, a single grazing of 8 hours per day did not provide sufficient time for cows to achieve pasture intakes that were targeted for that period. As a result, the farm struggled all season to speed up the rotation and maximise pasture utilisation, despite conserving 68% of the farm area for silage removal. Achieving lower pasture covers on the farm at drying-off, or strategic grazing of paddocks with high pasture mass during winter, would help to keep pasture covers at a more manageable level.

Maintaining milk production

Other challenges faced in the Telford farmlet included an inability to maintain milk production during extended periods in the barn due to;

- Sourcing insufficient high quality supplements to maintain high per cow production during early lactation when cows were in the facility
- Difficulty managing the barn surface to the standard required for lactating cows, (especially following winter use)
- Complicated daily decision making for the farm team during busy periods

Effluent requirements

Removing cows from paddocks results in an increase in the volume of solid and liquid effluents captured. These effluents must be stored until they can be applied back to land. The collected effluent(s) will typically require increased storage and effluent-treated areas of the farm to be enlarged to account for the additional nutrients that are collected at the off paddock facility.

Animal welfare and health issues

Incidence of mastitis: standing cows off paddock for long periods may increase the risk of mastitis. This is particularly important where the off paddock facility has been used for calving and the condition of bedding material may have deteriorated. However, despite high usage of the shelter during spring at Telford, the risk of mastitis did not increase.

Farmers should aim to minimise cow energy expenditure by reducing the walking distances between paddocks and the off-paddock facility (approximately 1.8MJ ME/cow/d is required per 1km walked). For more information refer to http://www.dairynz.co.nz/farm/farm-systems/off-paddock-facilities/managing-off-paddock-facilities/

Restricted grazing to reduce nitrate leaching

The tactical removal of animals from pasture during autumn and winter has been shown to be an effective strategy for reducing nitrogen (N) loss. Reducing the time cows spend grazing pastures during autumn, irrespective of soil water content, is another potential use of a herd shelter facility that can be considered in locations where reductions in N leaching are sought. This benefit is achieved due to the reductions in urinary N returns to soil at a time when pasture N uptake is limited by declining soil temperatures and the onset of drainage is likely. Farmlet experimentation at Telford indicated that overnight use of the barn (13 hours/day) during April and May led to a ca. 10% decrease in N leaching risk in the farmlet system.

Resources

DairyNZ Off-Paddock Facilities (dairynz.co.nz/farm/off-paddock-facilities/)

- Off-Paddock Facilities guide
- Managing facilities
- Economic & Environmental Analysis of Dairy farms with Barns
- Investment Calculator

DairyNZ Information booklets (dairynz.co.nz/publications/environment)

- Reducing Nitrogen loss: A guide to good management
- Nutrient management on your Dairy Farm: A farmer's guide to understanding how nitrogen and phosphorous cycle through your dairy farm

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