Individualised feeding
Does it stack up?
1 Individualised supplementation of grazing cows – how does it stack up?
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4 Pasture renewal in the upper North Island – what are the benefits?
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7 How to protect your cows against facial eczema this summer
Facial eczema (FE) is costly and can damage New Zealand’s dairying reputation, while sub-clinical FE damage is estimated to be a problem on at least a third of dairy farms in the North Island. Research shows that while zinc remains the best protection tool against FE, most farmers are under-dosing.

10 Science snapshots
Snippets of hot science.

For full versions of the papers presented in this edition of Technical Series In Brief visit dairynz.co.nz/techseriesdec15.
New Zealand farmers are investing in in-shed feeding systems capable of individual cow feeding with the expectation of improved animal performance. However, a DairyNZ-led project indicates that individualised feeding does not improve milk production or profitability. The project was initiated by farmers and conducted by a team of scientists, developers and farm consultants.

Key findings

- Research indicates individualised feeding does not improve profitability or the milk response to supplements.
- Farmers report operational benefits such as managing specific cows differently (e.g. low or high BCS cows, transitioning on to feed).
- Individualised feeding systems are more expensive to set up and more complex to manage than flat-rate feeding.

New Zealand farmers feeding supplements are increasingly using in-shed feeding systems to improve feed utilisation and labour efficiency.

While most in-shed feeding systems provide equal availability of feed to all cows, systems with individualised feeding capability take supplement feeding a step further. They allow cows to be fed individually or in groups according to pre-defined criteria, such as individual cow milk yield.
Does individualised feeding work?

The theory behind individualised feeding is that it is more efficient to offer more supplement to cows that have a greater potential response to the feed. While this theory sounds feasible, there is no evidence that individualised feeding improves milk production response or profitability in a grazing situation, compared with flat-rate feeding.

Current use of individualised feeding

In-shed feeding systems are installed in about one third of New Zealand dairies\(^1\) and most of these systems deliver equal amounts of concentrate supplement to each cow – often referred to as flat-rate feeding. However, around a quarter of in-shed feeding systems (seven percent of all New Zealand farms) are capable of feeding cows individually (individualised or differential feeding). Individualised feeding capability is likely to increase as electronic identification systems (EID) become more common and farmers invest more in animal monitoring technologies (e.g. milk meters, automated weighing systems). Individualised feeding systems represent a larger capital investment and result in more management complexity than flat-rate feeding.

A study funded by the Ministry of Primary Industry’s Sustainable Farming Fund and DairyNZ has investigated the potential benefits of individualised feeding. The project examined individualised feeding in New Zealand, reviewed international literature, modelled individualised feeding options and assessed a common individualised feeding strategy in an on-farm experiment.

International research

International research relevant to New Zealand’s rotational grazing management does not support the practice of individualised feeding in place of flat-rate feeding\(^2\).

Recent research of cows in a loose-housed barn set up in Ireland\(^3\), compared flat-rate feeding with individualised feeding of supplement to cows, according to milk yield. The study found no significant difference in total dry matter intake, milk yield, milk solids yield, or energy balance. A similar study in the UK\(^4\), but with grazing dairy cows, concluded that individualised feeding in a pasture-based system had little effect on animal performance when pasture was relatively unrestricted (grazing residuals – 6 cm).

Modelling individualised feeding strategies

The use of a range of individualised feeding criteria was compared with flat-rate feeding using the DairyNZ Whole Farm Model (WFM).

Modelling simulations were undertaken for Farming Systems 3, 4 and 5 over five consecutive years and replicated with ten herds, where all herds received the same total amount of supplement. Herds in the WFM were either flat-rate fed (3kg DM/cow per day) or individually fed. Individually fed cows were assigned to one of three groups according to their ranking in the herd (top 25%, middle 50% and lowest 25%) for each of the following criteria: BCS, milk solids, genetic merit or age. These groups were fed up to 6kg DM/cow per day according to a matrix of feed allocation rules, including simulations where the highest ranked cows received the most supplement and simulations where the lowest ranked cows received the most supplement. The total amount of supplement fed was the same for all the herds (average 3kg DM/cow per day). The key performance measures were operating profit (OP, NZ$/ha per year), milk solids (kg/cow per year), mean lactation length (days), total pasture intake per year (kg DM/ha) and empty rate per year (%).

The results indicated that there was no benefit in individualised feeding over flat-rate feeding using any combination of feed allocation and feeding criteria. The difference in operating profit (excluding depreciation on the in-shed feeding systems) between flat-rate feeding and the best performing individualised feeding simulations in each farming system is presented in Figure 1 for a milk payout of $6.05 per kg MS.

The reliability of the modelling results was tested by replicating an individualised feeding experiment on a DairyNZ research farm (see next section). There was close agreement between the model predictions and the experimental results, providing confidence in the modelling study.

Figure 1: Comparison of operating profit for flat-rate feeding (black bars) and individualised feeding criteria (coloured bars) in Farming Systems 3, 4 and 5. Each coloured bar represents the best outcome from a matrix of feeding allocations for that criteria.

(Milk price $6.05)
DairyNZ individualised feeding experiment

The experiment compared the milksolids response to concentrate supplements using flat-rate and individualised feeding on a typical New Zealand dairy farm in spring. For individualised feeding, more of the supplement was fed to higher yielding cows and less to lower yielding cows. The total amount of supplement offered was the same for all herds.

The experiment was conducted at the DairyNZ WTARS Research Farm at Hawera, Taranaki, in spring of 2014. Eight herds were formed by ranking all cows into three production groups according to milk yield (high, moderate and low), and randomly assigning cows from each production group to each herd. The average daily milk yield was 32, 28 and 24L/cow per day, for high, moderate and low production groups, respectively.

During the four week experimental period, four of the herds were offered concentrate supplement at a flat-rate of 4kg/cow per day. The four individually fed herds were offered an average of 4kg/cow per day of supplement, with high, moderate and low production groups offered 6, 4 or 2kg/cow per day, respectively. Herds were grazed in the same paddocks separated by electric fences, where the pasture was of equivalent sward height, mass and quality (>12 MJ ME/kg DM). Pasture allocation targeted a pasture intake of 15kg DM/cow per day. Supplement was allocated through a computerised in-shed feeding system where feed offered and refused was measured. Milk yield was recorded at every milking session and herd testing, liveweight and BCS were recorded weekly.

Results

There was no increase in herd milk production, liveweight or BCS using individualised feeding. There were also no significant differences between individualised and flat-rate feeding for the production groups, apart from a small difference in milk yield for the moderate production group. The mean daily milksolids production for flat-rate and individually fed herds is presented in Figure 2.

Estimated pasture eaten was the same for flat-rate and individually fed herds (Figure 3). The results by herd feeding strategy (flat-rate and individualised feeding) and production group (high, moderate and low yield) are presented below. Within each production group, milk production was the same and therefore, where more supplement was eaten, less pasture was consumed, resulting in the same dry matter intake.

**Figure 2:** Mean daily milksolids per cow for flat-rate and individually fed herds over the 4 week trial period.

**Acknowledgements**

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**References**


Pasture renewal in the upper North Island – what are the benefits?

Concerns over pasture persistence, pests and drought have created some skepticism from upper North Island farmers about the benefits of pasture renewal. But a five-year study of 24 pastures on Waikato and Bay of Plenty farms found substantial benefits.

AgResearch senior scientist Katherine Tozer led the project, working with Warren King, Grant Rennie and Natalie Mapp.

Key findings

- Pasture production for the first three years was greater on average (+1.7 t DM/ha per year) in renewed pastures than on the same farm’s unrenewed (control) pastures.
- There was more clover and sown grasses, and less broadleaf weeds in renewed pastures, compared with unrenewed pastures (% of total DM).
- Approximately half of the yield benefit occurred from greater production over summer, when the economic value of the feed produced is high.
- The average payback period for the direct costs associated with pasture renewal was under two years.

Concerns over pasture renewal

Farmers have expressed concern that pasture renewal benefits are not being realised on-farm. This is particularly the case in the upper North Island, where frequent droughts have occurred and where pastures have been subjected to severe insect pest and weed pressures. In addition, farm systems have become more intensive, with higher stocking rates and heavier livestock, placing further stresses on pastures.

There is also concern that yield benefits from modern cultivars grown in commercial trials do not correlate well with on-farm
results. This has led to scepticism regarding the purported benefits of pasture renewal and concerns regarding pasture persistence. In a survey of 776 Waikato and Bay of Plenty dairy farmers, poor pasture persistence was given as one of the main factors limiting farm performance. Farmers became less satisfied with their pastures as they aged from one to three years after sowing.

**Research on 24 pastures**

To determine the impact of pasture renewal on dairy pasture performance, 24 renewed and unrenewed pastures were monitored across five years (2009-2014) on five dairy farms in each of Waikato and Bay of Plenty.

Most renewed pastures were two years old when monitoring started. On each farm, there was one (control) unrenewed pasture and up to two renewed pastures. The study was undertaken by AgResearch and supported by DairyNZ, the Sustainable Farming Fund, Agriseeds, Agricom and PGG Wrightson Seeds.

**Better performance found from new pastures**

The study showed pasture renewal in Waikato and Bay of Plenty lifted pasture performance through increased grass growth, improved the content of sown species and reduced weed content. While the benefits of pasture renewal declined over time, renewed pastures performed better than the unrenewed controls over the first three years of the study. As a result, the direct costs associated with pasture renewal were recuperated within two years.

Overall, dry matter production was greater in renewed pastures than in the unrenewed control pastures in the first three years, although performance of the renewed pastures, relative to unrenewed, varied between farms and years (Figure 1).

The increase in grass production was, on average, 1.7 t DM/ha per year for the first three years (Table 1). When combined over the five year period, grass production in summer was greater in renewed than unrenewed pastures by 3.1 t DM/ha, in winter by 1.6 t DM/ha and overall by 6.5 t DM/ha. Given these figures, approximately half of the additional yield benefit of 6.5 t DM/ha occurred from greater production over summer, when the economic value of the feed produced is high.

**Figure 1** Effect of pasture renewal on total annual dry matter production from 2009 to 2014 (t DM ha⁻¹) in Bay of Plenty (green bars) and Waikato (black bars). Each bar represents the difference in pasture production between a renewed and a (control) unrenewed pasture on the same farm. A positive number indicates that the renewed pasture produced more than the unrenewed (control) pasture and a negative number indicates it produced less than the unrenewed pasture, within any given farm and year. The order of pasture comparisons is the same for all years.
Table 1. Total annual dry matter production (kg DM/ha) in renewed and unrenewed dairy pastures in Waikato and Bay of Plenty (BoP) from September 2009 until August 2014. SED: standard error of difference. ns: not significant (P>0.05).

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*P = 0.052

More clover and fewer weeds and pests

There was a higher percentage of clover and lower proportion of broadleaf weeds in renewed than unrenewed pastures for at least one of the years assessed, with most benefits occurring in the first year of the study.

In some years, the effect of pasture renewal on the content of sown species depended on the region. For example, there was a higher contribution of clover in renewed than unrenewed pastures in Bay of Plenty (10 percent vs. 1 percent) but a similar contribution between treatments in Waikato (averaging 11 percent of total DM) in 2009-2010.

When combined over the five year period, there was a higher percentage of sown grass in renewed than unrenewed pastures in winter, and a higher percentage of clover in renewed than unrenewed pastures in both winter and spring.

The abundance of some pests, including black beetle, Argentine stem weevil or white fringe weevil, was lower in renewed than unrenewed pastures in at least one of the first three years.

Direct costs recovered within two years

The value of the additional feed from pasture renewal will depend on the establishment costs, as well as the quantity and quality of the feed produced. Farmers on the project team estimated that the direct costs associated with pasture renewal were approximately $1300/ha. If the estimated value of feed produced over the whole year ranged from $0.33–0.39 kg DM/ha depending on the economic values used, and an additional 6.5 t DM/ha was produced in renewed pastures over the five year study, renewal would be profitable. Most importantly, direct costs associated with pasture renewal would be recuperated within two years.

Key factors requiring investigation to better understand the drivers of pasture persistence include interactions between drought, insect pests, defoliation stress and perennial ryegrass with different genetics and flowering dates. This will require a series of controlled studies that can then be extended to field conditions to better understand the impact of farm management, climate, and other factors on persistence.

References


Benefits of pasture renewal

Major differences between regions

The renewal effect was positive for nearly all comparisons in Bay of Plenty for the first three years of the study, but the renewal effect was much more variable for Waikato over the same period. The warmer, wetter and sunnier climate of Bay of Plenty over the study duration favoured perennial ryegrass and clover growth, particularly during summer when Waikato pastures were exposed to greater moisture stress. The lower insect pest abundance in Bay of Plenty in some years was another factor that most likely contributed to greater grass production in this region.
How to protect your cows against facial eczema this summer

Veterinarian Emma Cuttance examines what works and what doesn’t with facial eczema prevention and treatment.

Key points

• Sub-clinical facial eczema (FE) is a problem on at least a third of dairy farms in the North Island.
• Spore counting is good for detecting trends, but to be most relevant, the same paddocks need to be tested each week on your farm.
• Chicory and plantain, planted in pure swards, protect against facial eczema, while tall fescue may have some protective effect.
• Lime has no effect on spore counts.
• Zinc remains the best protection tool but under-dosage is common.
• Farmers need to test a selection of cattle for zinc concentration in the blood and liver damage.

Cause of FE

Facial Eczema (FE) is caused by the saprophytic fungus Pithomyces chartarum which lives on dead and decaying litter at the base of pastures. When weather conditions are warm and humid the fungus produces spores filled with a toxin (Sporidesmin) that, when eaten, causes damage to the liver and bile ducts. Clinical symptoms of FE include photosensitivity in which the skin quickly becomes inflamed and may peel away, particularly on light coloured areas of the body.
The problems

Images of badly affected stock are highly emotive, and present significant risk to New Zealand’s ‘clean green image’ and reputation for sustaining a high level of animal welfare in farmed livestock.

Costs associated with FE arise from deaths, condemnation of carcasses, poor liveweight gain, poor reproduction and lower milk production.

The subclinical effect on milk production is also a concern. Research has shown a much greater proportion of herds have significant liver damage without any obvious clinical symptoms\(^1\).

Recent work on FE

In 2014, a study of 106 North Island dairy herds from nine different FE-prone regions was undertaken to determine the effectiveness of practices to prevent and manage FE.

Results indicated that 32 percent of farms had sub-clinical FE damage. If this figure reflects an average incidence in FE-prone areas, the cost to the industry would equate to $78 million in lost production.

Better spore counting

Spore counting is currently the most widely used method to assess the potential intake of toxic spores by grazing animals, and thus their risk of FE.

The spore counting technique\(^2\) most used by farmers, veterinarians, laboratories and researchers involves collection of 200g of pasture by walking diagonally across a paddock and stopping at 10 points to cut pasture at the base. A 60g sample of pasture is then randomly selected and added to 600 ml of water, then shaken vigorously for three minutes. The pasture is removed, leaving the ‘wash water’. An eye dropper is used to collect a sample of the solution (water aliquot) to read under a microscope at 100x magnification. Depending on the depth of the grids, the total pasture spore counts/g pasture are estimated by multiplying the number of observed spores by 5,000 or 10,000.

In 2013, this method was closely examined by analysing 12,784 spore counts from multiple sites within a paddock on four different farms. Throughout the sampling period, there was a large variation between farms (0-490,000 spores/g pasture) and a large amount of variability between individual sites in the paddock.

It also showed that to increase the accuracy of spore counts, repeat sampling of the wash water is needed. Table 1 shows that we increase our confidence in the true number of spores as we increase the number of samples we count from the wash-water.

Table 1. For example, for a grass sample where the total spore count was 20, the predicted spore counts from individual samples will, 95% of the time, be between 2 and 35, whereas for three samples 95% of the time the predicted count will be between 10 and 29.

<table>
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What this means is that to be most accurate, spore counts need to be taken from multiple paddocks and at regular intervals on the farm concerned. If decisions for managing FE risk are based on the spore count, then at least three aliquots from wash-water for a single sample should be read and an average calculated.

Drenching is one of three effective methods of administering zinc.
Control options

Pastures

The role of pasture species in the control of FE was initially researched on multiple paddocks in Northland, Waikato and Palmerston North from 1997-2000. Results from this study suggested species supporting low levels of *P. chartarum* were chicory, red and white clover, lotus and tall fescue, while the species supporting high levels of *P. chartarum* were ryegrass, cocksfoot, browntop, and Yorkshire fog.

A trial completed on a DairyNZ farm in 2012 showed that mixed pastures that incorporated tall fescue, chicory, plantain and lotus had similar spore counts to ryegrass pastures. This indicates that just including species known to be “FE safe” into pasture is not enough to decrease paddock spore counts. They are only an effective control measure when grown in pure swards.

Fungicide sprays

Fungicides act on cell division in susceptible fungi and therefore slows down the development and spore production of the fungus. To be effective, spraying needs to be accurate and completely cover the entire paddock which includes fence lines, under shelter belts, around troughs and under trees. The spray prevents the fungus from developing, so if spore counts are high prior to spraying, the fungicide will not perform to expectation.

Zinc dosing

Oral zinc dosing has been known to be an effective way of managing FE since the early 1970s. The most common methods of zinc treatment used by farmers are trough treatment, feed treatment and drenching.

Although all methods of zinc administration can be effective, all methods equally can fail. As a general rule, the more control a farmer has on the amount of zinc a cow receives (drenching, capsules), the more likely it is that the cows are receiving the correct amount of daily zinc.

Why FE control fails

The 2014 study looked for possible reasons for breakdowns in control of FE.

The key findings were:

- Blood sampling of 10 cows per farm showed 32 percent of these herds had experienced liver damage from FE.
- Pasture spore counting was significantly under-utilised as a tool for FE management. Only 33 percent of herd managers reported that they measured spore counts on their own farm.
- Only 31 percent of cows that received zinc supplementation had sufficient serum zinc concentrations to protect against FE. Most farmers were unintentionally under-dosing cows.
- Zinc in the water is the most common method but the least effective at achieving adequate zinc levels in the cows.

Key point:

It is possible for all zinc treatments to work but all methods can fail if the dosage is incorrect. The method is more likely to fail if a cow has control over her intake of zinc (water, feed).

- All FE management strategies had obvious opportunities for error to occur and were likely reasons why blood zinc levels were so low. The main problems identified included: (a) Unknown and wide variation in cattle weights within the same herd, and (b) failure to monitor blood zinc levels and liver damage in cattle which would allow management protocols to be adjusted, if necessary.

Protocol in place

DairyNZ now has a protocol for farmers to follow to give the best chances of protecting against facial eczema damage dairy.nz.co.nz/animal/health-conditions/facial-eczema/. In future, protection against FE will be improved by the selective breeding of dairy cattle for tolerance to sporidesmin (see July 2014 Technical Series). Semen from ‘FE tolerant’ bulls is already available on the market.

However, increasing protection via breeding programmes is a slow process, so zinc treatment will remain the best FE protection tool for some time yet.

References

Chicory is a summer crop that New Zealand dairy farmers may use to support lactation in drier months. Field trials have shown that chicory grows more than ryegrass in dry summers, but more information was needed about the economic value of this crop at the farm level. There are additional costs associated with establishment and a loss of spring pasture production after sowing.

An economic model was used to assess the value of one-year chicory crops on three types of dairy farms in the Waikato. These farms differed in the degree to which supplementary feeding is used. The value of chicory was assessed at milk prices of $6, $7 or $8 per kilogram of milk solids, crop establishment costs varying from $585 per ha up to $1170 per ha, $300/t DM of PKE, $290/t DM of grass silage and calving starting 1-Jul, 14-Jul or 29-Jul. Twenty years of climate data were used, with the yield of chicory estimated at 12±2.5 kg DM/ha.

- **System 1 farm (no imported feed used).** The economic model indicated that it was most-profitable to have around 5% of the farm in chicory. However, this was only $NZ30/ha (over the whole farm) more profitable than just growing grass. If larger areas of chicory were planted, a feed gap was created in early spring when the crop was still developing.

- **System 3 (10-20% of the feed imported) and System 5 (>25% of the feed imported) farms.** The economic model indicated that chicory was not a profitable option on this type of farm. It was more profitable to purchase supplements to cover the summer feed gap, rather than planting chicory, with about 2-5 t/ha of PKE and 0-6 t/ha of grass silage required in the absence of chicory.

- Analysis of systems 3 and 5 showed the negative aspects of chicory, relative to supplement use, were the cost of establishing the crop, lost grass production, and the loss of flexibility because a commitment to chicory must be made in October. The lack of profitability was consistent across milk price, establishment costs, calving date and the relative growth of chicory and pasture due to climatic variation.

At the farm level:
Economic modelling indicated that Waikato farmers may only get a marginal benefit, if any, from the added complexity of establishing and using one-year chicory crops. However, the profitability of using purchased supplement to cover pasture deficits depends on both market price and availability. The choice to use chicory for a single season or to purchase feed should be based on both a cost-benefit analysis and the predicted risk of securing feed at an acceptable price.

**References**