Terrace Farm Holdings Ltd

<table>
<thead>
<tr>
<th>Figures</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cows/ha</td>
<td>4.0 Crossbreed</td>
</tr>
<tr>
<td>Milksolids/ha</td>
<td>1,446</td>
</tr>
<tr>
<td>Milksolids/cow</td>
<td>366</td>
</tr>
<tr>
<td>Pasture and Crop Eaten</td>
<td>15.1 tDM eaten/hectare in 17/18</td>
</tr>
<tr>
<td>Supplements kg DM/cow</td>
<td>113 Mostly straw</td>
</tr>
<tr>
<td>Fertiliser kg N/total ha</td>
<td>17/18 267</td>
</tr>
<tr>
<td></td>
<td>18/19 193</td>
</tr>
<tr>
<td></td>
<td>19/20 161</td>
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Purchased N Surplus & N Leached

Terrace Holdings: Purchased N Surplus = N Inputs - N Outputs

![Graph showing N inputs and outputs for Terrace Farm Holdings for 2017-18 and 2018-19]
Drivers of N lost to Water

Timing
Reducing N eaten autumn by reducing feed demand; less N fertiliser high risk months aut/winter; low N supplement/crop; catch crops; winter active species; plantain to lower N concentration urine; standoff pad to collect dung & urine, spread when lower risk leaching

Mineral N
Risk of leaching
Sources: N Surplus Soil microbial activity (net mineralisation) N released from cultivation

Drainage
Efficient irrigation that does not cause drainage

N lost to water

Timing Nitrogen Fertiliser

Terrace 2017-18 and 2018-19
kg N/ha/month

Timing N Fertiliser

Terrace 2017-18 and 2018-19
kg N/ha/month

Practical Steps to Reduce our Footprint

12 March 2020
Effluent Blocks - N Fertiliser

![Graph showing Terrace Effluent Area 2017-18 and 2018-19 kg N/ha/month]

Kg N/ha/year
- 2017-18: 199
- 2018-19: 135

Non-Effluent Blocks - N Fertiliser

![Graph showing Terrace Non Effluent Area 2017-18 and 2018-19 kg N/ha/month]

Kg N/ha/year
- 2017-18: 290
- 2018-19: 211

Benefit

<table>
<thead>
<tr>
<th>Nitrogen Fert Used (kgN/ha)</th>
<th>Reduced</th>
<th>Workings</th>
<th>Decreased Expenditure</th>
</tr>
</thead>
<tbody>
<tr>
<td>17/18 267</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18/19 193</td>
<td>74 kgN/ha = 160 kg Urea</td>
<td>160 kg*278ha *$565/t</td>
<td>$25,268</td>
</tr>
<tr>
<td>19/20 161</td>
<td>106 kgN/ha = 230 kg/ha Urea</td>
<td>230 kg*278ha *$565/t</td>
<td>$36,194</td>
</tr>
<tr>
<td>Cumulative Benefit</td>
<td></td>
<td></td>
<td>$25,268 + $36,194</td>
</tr>
</tbody>
</table>

$61,462 saved

Plus 12 kg reduction in N lost to water in 18/19
**Tactical use of nitrogen fertiliser**

Find out how nitrogen fertiliser use can be carefully targeted and managed to assist pasture growth, without compromising the environment or your profits.

**Ina Pinxterhuis**, senior scientist, DairyNZ

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**Nitrogen fertiliser use in New Zealand**

With the limelight on high-input farming systems and nitrogen (N) contributing to water quality degradation and greenhouse gas (GHG) emissions, it’s timely to re-visit how best to use a lesser amount of N fertiliser on grazed pastures.

In the last 25 years, the annual application of N via fertiliser has increased more than six-fold in New Zealand, from 59,000 tonnes in 1990 to 429,000 tonnes in 2015. The dairy sector is the largest user: 63 percent of all N fertiliser used in New Zealand.

This increase has been partly due to an increase in land area used for dairy farming, but annual rates of N used on dairy farms have also increased in general. For example, an average use of 40kg N/ha in the late 1990s has increased to an average use of 45kg N/ha for System 1 farms, and up to 156kg N/ha for System 5 farms (overall average 126kg N/ha) in 2015/16.

**Seasonal considerations**

N fertiliser trials in the 1970s and 1980s showed that well-managed ryegrass/white clover pastures in New Zealand were N deficient, responding well to N fertiliser.

In late autumn to early spring, low temperatures usually restrict clover growth, N fixation and mineralisation, resulting in less N available for the grass. So N deficiency is more pronounced in spring, when soil temperature and moisture don’t limit grass growth, and rapid production responses to fertiliser N can be expected.

Consequently, the tactical use of N fertiliser in autumn and early spring was promoted to maintain the N fixation and feed quality benefits of clover in late spring through to early autumn.

Care needs to be taken to avoid long-lasting shading of clover stolons (runners) in spring by prolonged canopy closure (e.g. with heavy silage cuts). Shading of clover stolons reduces branching. This reduces clover production and, hence, N fixation later in the year, risking lower summer pasture yields.

Response to autumn applications could be too slow to fill autumn feed gaps but could help to achieve desired pasture covers going into winter.

**What’s the approach since then?**

From the 1990s on, the increased rates of N fertiliser illustrate a move away from relying on clover N fixation and shifting to frequent N applications (e.g. routinely after every grazing or silage cut). It can be easier to manage N-fertilised pasture than clover-based pasture because of greater predictability of pasture production and less year-to-year variation. Also, when N fertiliser is applied during good pasture growth conditions and additional pasture is utilised to produce milk, N fertiliser use is nearly always economical.
How high is too high?

High rates of N fertiliser achieve pasture production greater than can be achieved with N fixation in grass/clover pastures, when growth conditions are favourable (i.e. no lack of other soil nutrients and water, optimal temperatures, no weeds, no pests and no diseases).

However, if higher pasture production is utilised by grazing animals, total N intake/ha is greater, and more N is excreted in urine. This reduces the efficiency of N use, increases the farm’s N surplus and increases the risk of N loss to the environment (for an example, see Figure 1). Results from DairyBase data presented in an earlier DairyNZ Technical Series article illustrate this.1

Response indicators

There are several indicators available to assess if N fertiliser can be expected to provide sufficient pasture and milk production responses, or if the amount of N in the system poses a risk to the environment.

1. Soil organic matter or soil total N

Soils with a high organic matter or total N content have relatively high soil mineral N and mineralisable N available for plant growth. This reduces the need for N fertiliser. Soil tests and associated recommendations are available commercially.

2. Farm N surplus or surplus of purchased N

This is the difference between N inputs (N in fertiliser and supplements = purchased N) and N outputs in products (milk, meat, crops) and is related to the risk of loss to the environment.

Efficiency gains are possible when a farm’s surplus of purchased N is relatively high, for example compared with the median surplus of purchased N of 130kg N/ha for a System 4 dairy farm, and 70kg N/ha for a System 2 farm.3

Note: Overseer’s N surplus includes N inputs from biological fixation and irrigation water and is therefore higher than the surplus of purchased N.

3. Kg milksolids produced per kg N fertiliser

When production is low for the amount of N fertiliser used (<6kg MS/kg N fertiliser), N fertiliser use efficiency is low and a reduction in N fertiliser rate is likely to be profitable.10

Figure 2 shows this is more likely to occur at annual N fertiliser rates of >200kg N/ha.

Increasing N use efficiency

Earlier publications have summarised good management practice for N fertiliser use, e.g. other DairyNZ Technical Series articles11, 12 and DairyNZ’s Farm Facts on plant nutrition13. A comprehensive overview is the Code of Practice published by the Fertiliser Association of New Zealand.14

Here are some less well-known aspects of N fertiliser use:13, 14, 15, 16:

- Pasture height needs to be above 3.5cm (~1500kg DM/ha) to respond to N fertiliser.
- Within four days after application, pasture does not respond to N fertiliser. This means it could be grazed without a response penalty in the following regrowth period.
- Thereafter, N uptake is rapid if growth conditions are good, but from four to 14 days after application, this is not yet converted to DM yield. Pasture N content is higher in these first weeks and, when grazed in this period, is associated with higher N excretion in urine and, therefore, higher risk of N loss to the environment.
- It takes 20 (spring) and up to 40 (autumn) days after application to get a significant yield response to N fertiliser.

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*Figures and tables are not included in the natural text representation.*
Well-managed ryegrass/white clover pastures are N deficient and respond to N fertiliser.
• At low soil temperatures (<6°C) pasture growth is limited and a response will not occur until soil temperatures increase again.

• High soil temperatures (>16°C) inhibit grass growth, and response to N fertiliser will be limited.

• Grazing should take place at the 2.5- to three-leaf stage of perennial ryegrass to ensure pasture quality is maintained and high growth rates are utilised. However, prolonged shading of the plant base should be avoided because it will reduce clover branching and grass tillering.

How to reduce N fertiliser use

When an assessment as indicated above indicates that a reduction in N fertiliser use might be environmentally or economically beneficial, a stepwise approach can be taken to adjust to a different N fertiliser management strategy.

The following recommendations are based on research cited above and on experiences from farmers participating in the Forages for Reduced Nitrate Leaching Programme*.

• Use applications of maximum 25 to 40kg N/ha. N applications of 40kg N/ha are useful only when conditions for pasture growth are optimal and pasture surplus to requirements for grazing is harvested for silage, to avoid high pre-grazing covers and residuals.

• Ensure round length is not faster than the number of days needed for significant yield response (e.g. 20 days in spring, see above) and that pasture is consistently grazed at the 2.5- to three-leaf stage. This may reduce the total number of grazings per year and ‘automatically’ reduce the number of N applications, if routinely following the cows with fertiliser.

• A longer round length reduces the N content in pasture and, therefore, urinary N excretion.

• Skip a few paddocks from your routine applications when pasture growth rates are high and silage making is not wanted/needed. A weekly farm walk and constructing a feed wedge will help with these decisions.

• Skip N applications on paddocks in summer when clover content is high.

• Reduce or don’t apply N fertiliser in late autumn, when average cover is sufficient and risk of drainage is increasing.

• Ensure N fertiliser is applied to the paddocks targeted. If using contractors, check the application tracking data.

REFERENCES:


* The Forages for Reduced Nitrate Leaching programme had principal funding from the New Zealand Ministry of Business, Innovation and Employment and co-funding from research partners DairyNZ Inc, AgResearch, Plant & Food Research, Lincoln University, Foundation for Arable Research and Manaaki Whenua – Landcare Research. See dairynz.co.nz/fml