Contents

LUDF Budget and Expenses to date:

Year ending May 31		2011 -12 Actual	2012/13 Budget	Act to end Jan	Budget to End Jan	Variance (Act—budg)	Notes
Milk production (kgMS)		297740	315075	198441	204106		
	160ha	1,861/ha	1,969/ha	1,240/ha	1,276/ha		
Peak Cow Nos and Prod.		630cows	630cows				
Staff		3.7 FTE's	170cows/FTE				
<u>**Income**</u>	Milksolid Payout	$6.08/kgms	$5.50/kgms				
	Dividend /share	$0.22/share	$0.33/share				
	Milksolid Revenue	$1,810,259	$1,732,912	$838,524	$785,808	$52,716	
	Dividend	$65,503	$103,975				
	Surplus dairy stock	$152,415	$139,031	$81,797	$48,132		
Stock Purchases		-$22,400	-$21,600	-$25,470	-$21,600	-$3,870	
Gross Farm Revenue		**$2,005,777**	**$1,954,317**	**$894,851**	**$812,340**	**$82,511**	
<u>**Expenses**</u>							
Cow Costs	Animal Health	$59,775	$62,462	$42,792	$41,089	$1,703	
	Breeding Expenses	$53,895	$41,900	$45,623	$35,359	$10,264	**5**
	Replacement grazing & meal	$173,982	$151,493	$107,395	$112,531	-$5,136	**4**
	Winter grazing - Herd incl. freight	$123,295	$141,126	$118,247	$108,140	$10,107	**6**
Feed	Grass silage purchased	$69,720	$86,800	$93,492	$86,800	$6,692	**8**
	Silage making & delivery	$11,902	$12,480	$9,087	$12,480	-$3,393	
	Eco-n & Giberillin	$74,620	$60,240	$35,895	$40,200	-$4,305	
	Nitrogen	$112,916	$116,740	$82,283	$74,067	$8,216	**7**
	Fertiliser & Lime	$43,405	$28,670	$33,288	$37,670	-$4,382	
	Irrigation - All Costs	$49,041	$70,600	$38,004	$43,330	-$5,326	**3**
	Re-grassing	$29,449	$29,688	$14,790	$29,688	-$14,898	**1**
Staff	Employment	$205,593	$241,341	$144,398	$157,214	-$12,816	**2**
Land	Electricity-farm	$23,397	$23,500	$15,222	$14,860	$362	
	Administration	$19,315	$24,700	$11,016	$14,539	-$3,523	
	Freight & Cartage	$0	$800	$2,368	$3,582	-$1,214	
	Rates & Insurance	$19,020	$21,020	$0	$0	$0	
	Repairs & Maintenance	$61,936	$48,500	$43,976	$40,359	$3,617	
	Shed Expenses excl. power	$11,091	$11,850	$5,826	$9,505	-$3,679	
	Vehicle Expenses	$22,371	$23,550	$21,140	$16,080	$5,060	**9**
	Weed & Pest	$972	$500	$905	$500	$405	
Cash Farm Working Expenses		**$1,165,695**	**$1,197,959**	**$865,747**	**$877,993**	-$12,246	
		$3.92	**$3.80**				
Depreciation est.		$105,000	$116,000				
Total Operating Expenses		$1,270,695	$1,313,959				
Dairy Operating Profit		**$735,082**	**$640,358**				
DOP		**4,594/ha**	**4,002/ha**				
Cash Operating Surplus		**$840,082**	**$756,358**				
Cash Operating Surplus per ha		**$5,251/ha**	**$4,727/ha**				

Notes - Lower costs:

1. Budgeted re-grassing included grass to grass in 3 paddocks (approx. 24 ha)and some direct drilling of additional ryegrass into damaged areas in the early spring. Limited damage occurred on the platform reducing the need for this and only 2 paddocks have been re-grassed. The decision not to re-grass the 3rd paddock included consideration of the ability to create sufficient additional yield to cover the re-grassing costs and the need to keep control of overall costs.
2. Little use of casual labour has contributed to a saving to date in Employment costs, as did our third dairy assistant not starting until early July.
3. Irrigation maintenance to the end of January is below budget by $5300, North block irrigation is ahead of budget by $5400 and South Block irrigation is below budget by a similar amount.
4. Fewer replacements are contributing to lower grazing costs, partially offset by more milk powder.

Higher costs:

5. Breeding expenses are over budget due to additional effort to increase 6 week InCalf rates and final empty rates. Kamars were used to aid heat detection in the second round, cows were metrichecked twice, and BVD blood tests were taken from 221 calves.
6. More winter grazing was purchased, primarily in August to protect the milking platform (see October 2012 focus day notes)
7. Nitrogen use to date is ahead of last year and thus ahead of budget.
8. Grass silage purchased is ahead of budget due to timing and availability of high quality silage
9. Vehicle expenses have proved difficult to keep under or on budget with higher fuel costs, more diesel tractor servicing (see mowing expenses below) and vehicle R&M.

Year-end Forecast:

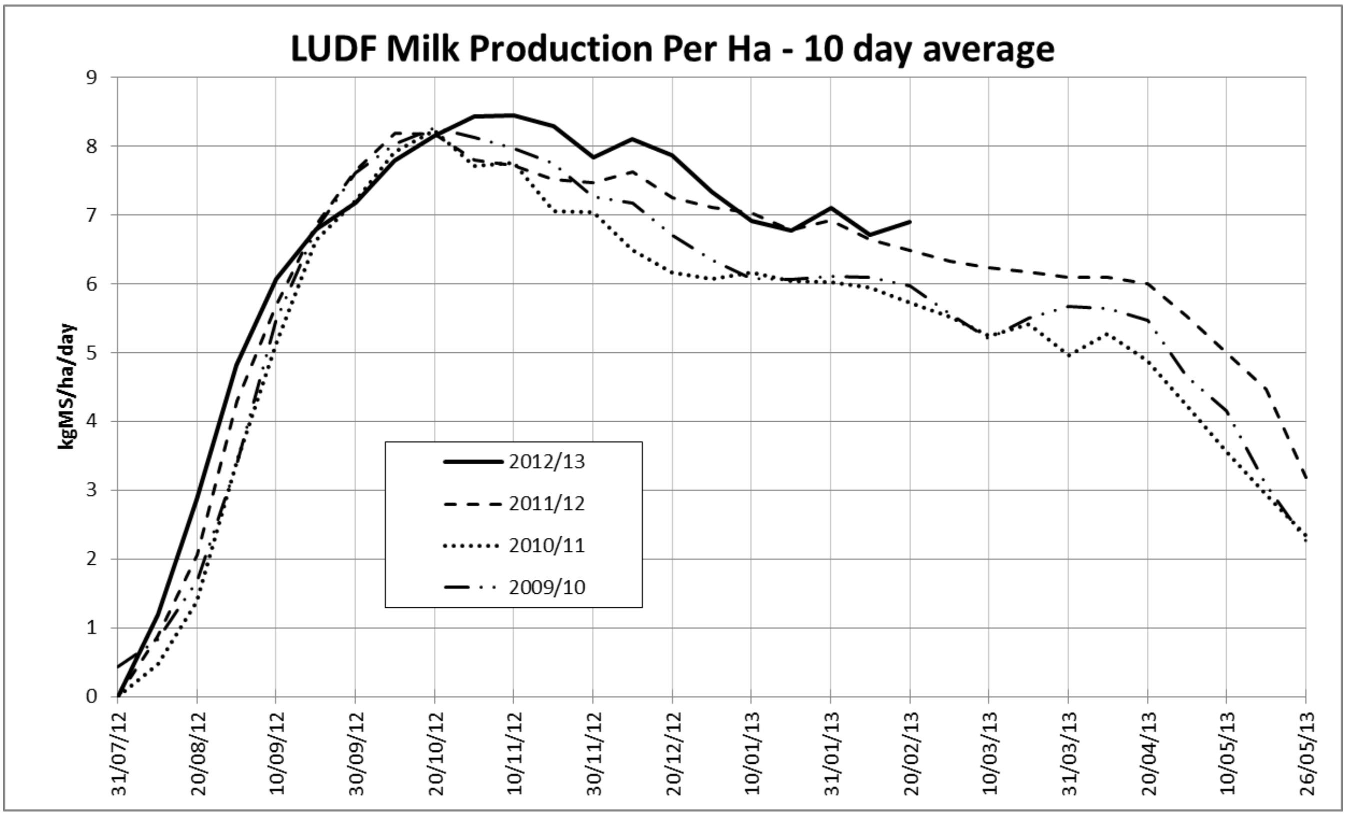
	Full Year Budget	Forecast Year End – as at Feb' 13
Milk Production	315,075 kgMS	307,000 kgMS
Total Farm Working Expenses	$1,197,959	$1,200,000
Farm Working Expenses/kgMS	$3.80/kgMS	$3.91/kgMS

Budgeted Milk production was 6% higher than last year, to date milk production is running at 4% ahead of last year, giving a forecast production of approx. 307,000kgMS.

Farm working expenses are largely on track as described above, whilst there are some savings and budget over-runs, total expenditure is on target to approximately meet budgeted expenses.

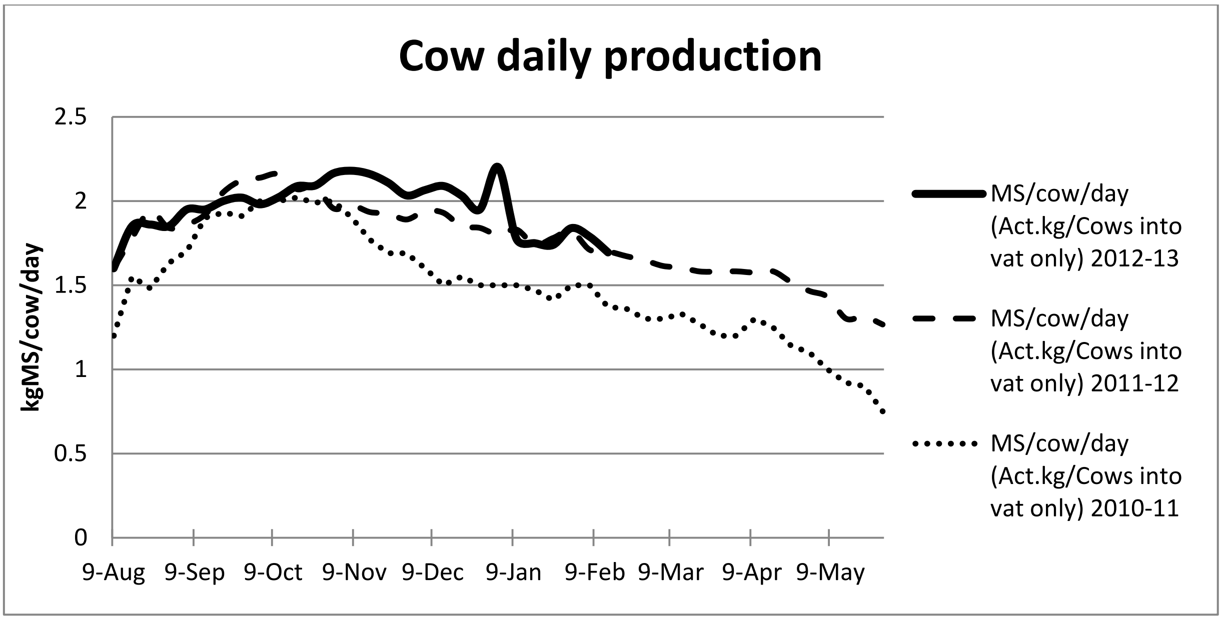
The small reduction in milk production (forecast vs budget) will however add approximately 10 cents/kgMS to farm working expenses.

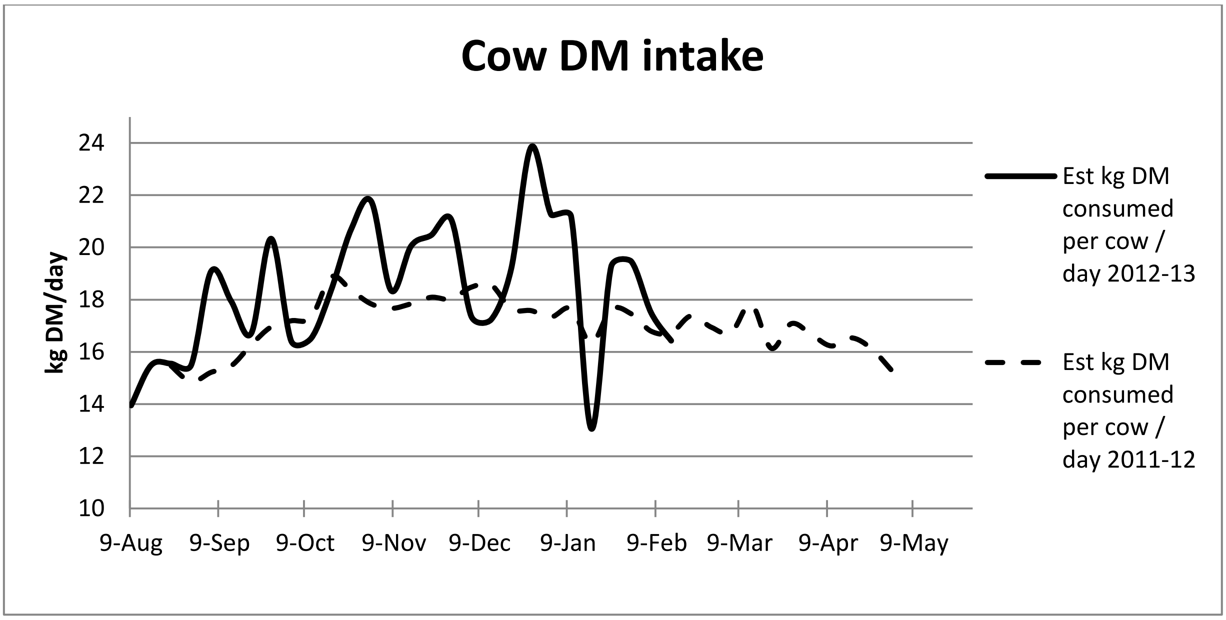
Milk Production (10 day average)



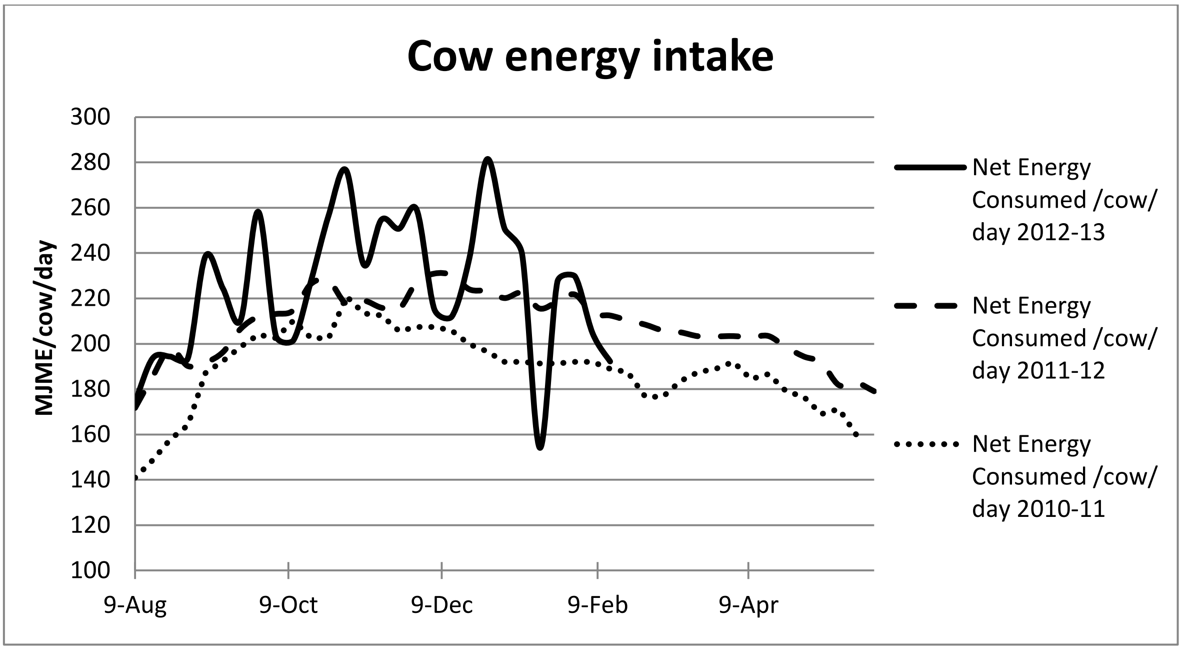
Holding Milk Production when pasture ME declines

The peak did not occur at the same time as last year. Because of low growth rates in September, the farm fed 135 kg DM as silage during late September to mid-October, which cost some milk production. However cows produced well once we had enough pasture growth to drop the silage and get onto a shorter round. Cows peaked at 2.22 kg MS about the 12 of October and produced more than 2 kg/day until the end of the first week in December. As at 19th February they were producing 1.77 kg MS/cow/day average for the last week.

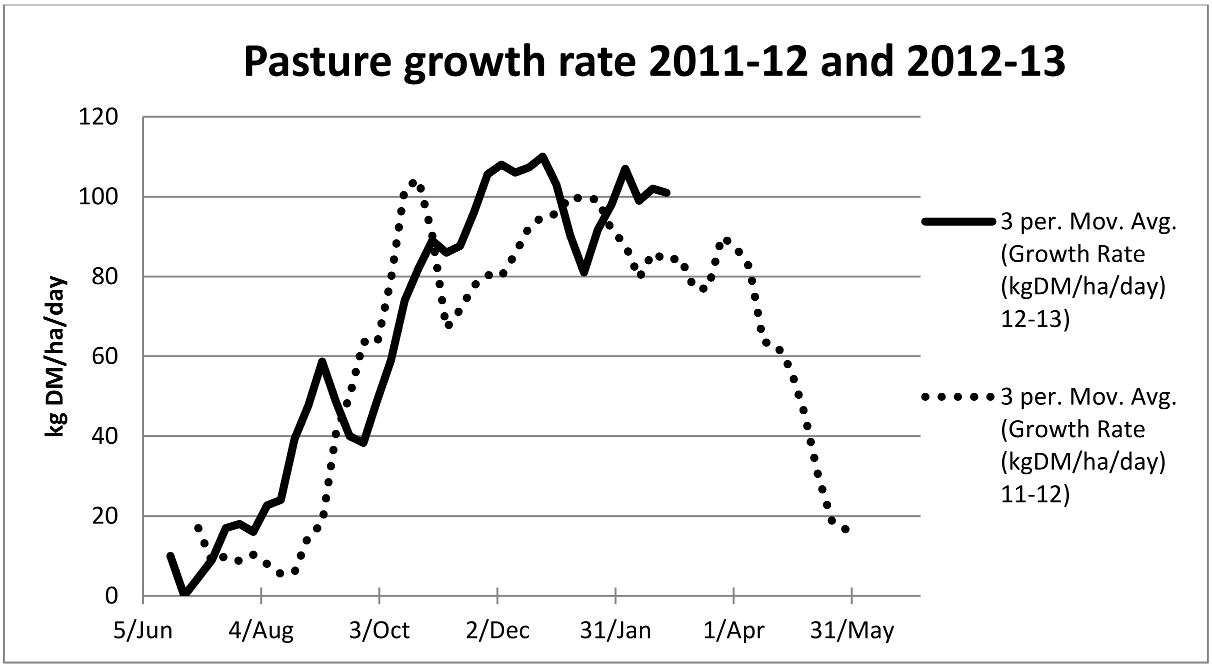




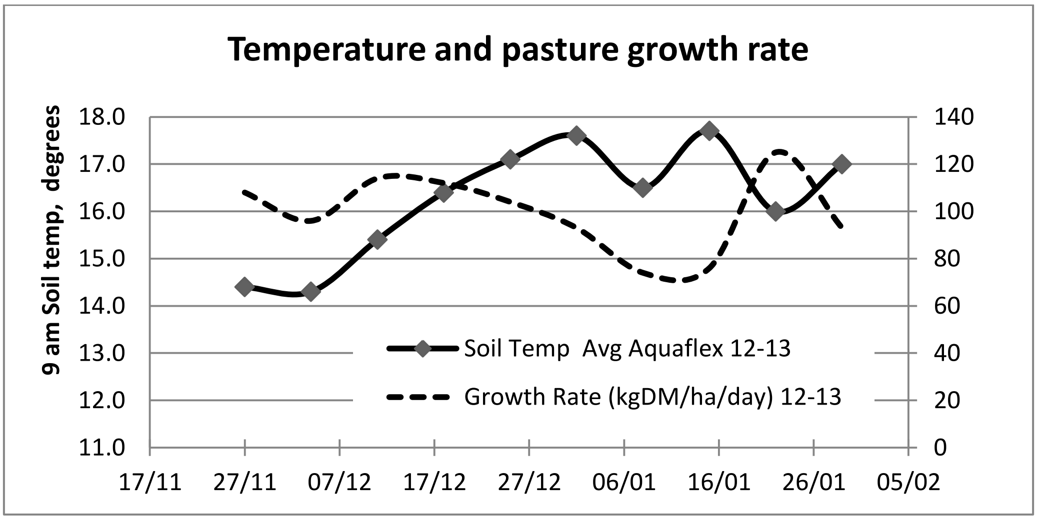
Cow intake total feed intake [including silage when fed] has been consistently higher than last year, with the exceptions of the deficit periods in October and January when we were feeding silage. The spikey nature of this years chart is a consequence of more measured weight gain and one loss period through the season.



From our intake calculations based on DairyNZ requirements for maintenance, walking, pregnancy, milk production and liveweight change the cows are eating considerably more this year than in previous years. The intakes are based on weekly observations, it may be that the cost of weight gain could be spread over a longer period. However, it is apparent from accepted formulae that the cows have for a large part of the season consumed over 220 MJME/cow/day or close to and some times more than 20 kg DM/cow/day.

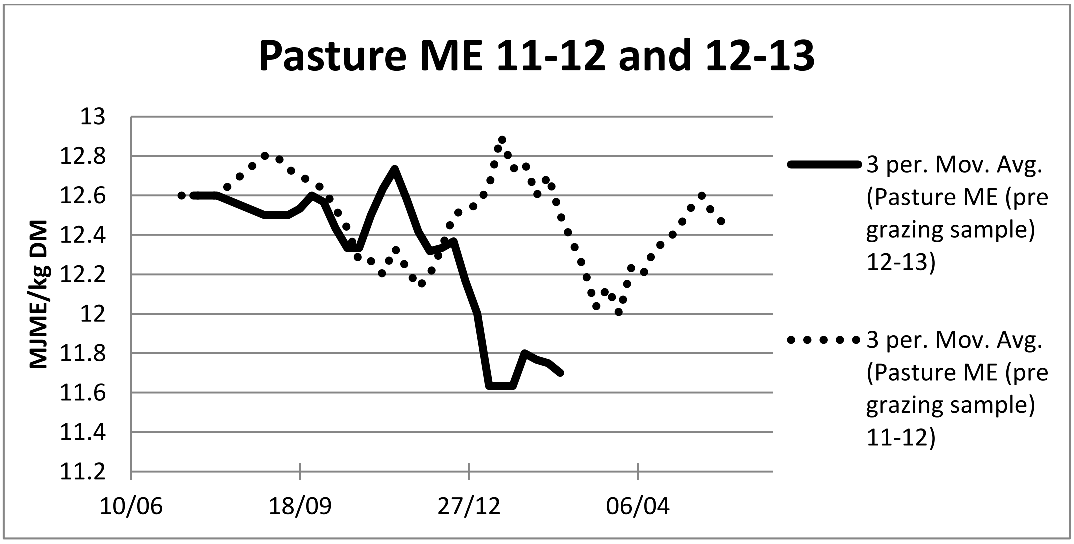


Pasture growth rate has been erratic this year, from a warm August that saw the farm make silage in August then feeding out in September and October to a very hot period starting just before Christmas. The chart below shows a snapshot of pasture growth rate and average weekly 9 am soil temperature over the mid-December to late January period. It appears that as soil temperatures rose, above 17 degrees, pasture growth rates dropped. Most likely this was also effected by the maximum daily soil/air temperatures which were at times over 25 and 33 degrees (respectively). Most of the farm has relatively high water holding capacity soils and in general the irrigation system was able to keep up with ET, with only a few dry patches showing.

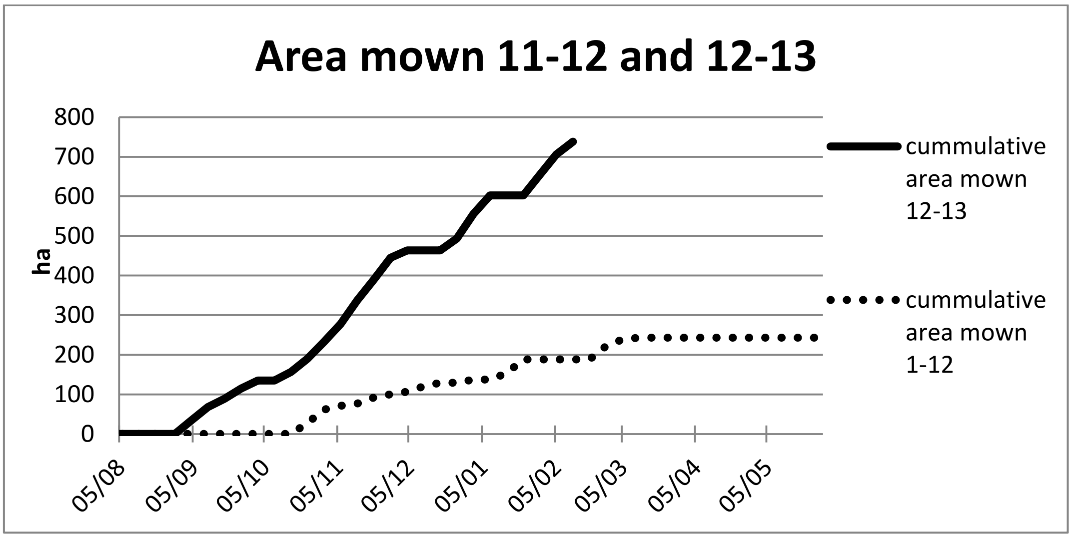


Pasture quality has been a major issue this season. As on many Canterbury dairy farms this season, we have had a lot of stemy pasture (particularly from November to Late January) and late seed head production: signs of stress in the plant. In mid-December the energy content as measured by MJME/kg DM took a step change down from about 12.3 to around 11.8 MJME/kg DM. This is apparently due to the heat stressing ryegrass which is a cool temperate plant. This would be consistent with the findings of Wilson and Minson 1990 in which they found that at as tempertures rise the digestibilbilty and consequently the ME of ryegrass declined relative to temperature. (Wilson JR, Minson DJ (1980) Prospects for improving the digestibility and intake of tropical grasses. *Tropical Grasslands* **14**, 253-259.)

For the farm this has been a considerable challenge sustaining high Dry Matter intakes both because pasture dry matter production was depressed but at the same time so was its energy content.



Mowing in front of cows has been one tool that we have used more this season than last (see the chart below). Season to date we have mown about 760 ha compared to 235 for the whole season last year. Based on experiences last year, we expected to be able to stop mowing at the beginning of December. With different climatic conditions this season, low pasture quality became a challenge to cows both in terms of energy density and the difficulty of grazing (prehension), ie. It is harder work grazing tougher, stemy grass down to 7-9 click residuals. Milk production began to decline faster than what we saw as acceptable from mid-December so the mower has been used again to help cows attain intake on the stemy lower quality pasture. We are expecting that, as the weather cools down, the pasture quality will increase and the cows will be able to attain ME intake targets and residuals through the latter part of the season without the use of the mower.



Reasons for mowing have varied through the season. We have learnt that we need to mow very well i.e. the machine needs to be well set up and attaining the desired residual, the set of the mower will vary depending on the paddock and ground conditions, i.e. soft or hard ground. Sometimes it's a good idea to take a plate meter and check the residual that the mower is getting. At the same time checking by eye that the residual looks okay e.g. no scalping or longer grass in strips.

Below is a breakdown of the mowing done through the season and the reasons behind it.

From a cost point of view we estimate the actual cost to be in the range $42 - $45/ha: this is equivalent to 6200kg/MS at a $5-50 milk price or 38kg MS/ha. We are confident that the tactic has returned well in excess of this.

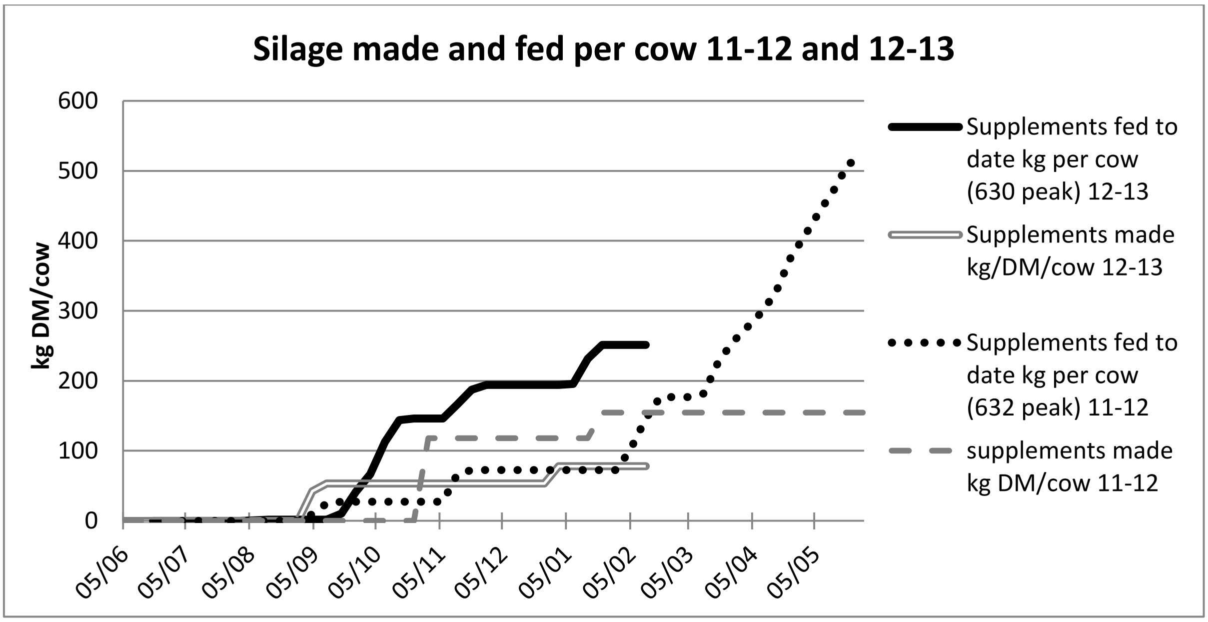
Date	Reason for mowing	Area Mown (ha)
13 Sep - 20 Sep	Fix residuals from first round	22
21 Sep - 23 Sep	Fix residuals from silage mowing	12
24 Sep - 28 Sep	Fix residuals from first round	27
10 Oct - 29 Nov	Increase dry matter and intake	340
20 Dec - 5 Jan	Help with higher covers and increase intake	128
21 - 22 Jan	Topping new grass for weeds	7
22 Jan - 12 Feb	Increase intake	138
29-Aug - 14 Sep	High cover low DM	58
Season to date	Silage	29
	Total ha mown	**761**
	Total hours	**351**

Quick Analysis of Mower Cost			Option 1	Option 2
Purchase Price			$23,500	$23,500
Economic life		years	5	10
Trade in value			$10,000	$5,000
Annual Capital cost			$2,700	$1,850
Interest cost		(7.5%pa)	$1,763	$1,763
Winter Service			$600	$600
Additioanal R&M			$400	$1,000
New blades			$126	$126
Total Annual cost			$5,589	$5,339
Tractor cost		per hour	$50	$50
Staff		per hour	$25	$25
Workrate		ha/ha	2.1	2.1
Tractor & staff cost /ha			$36	$36
Option 1 - 5 year life, $10,000 tradein value				
Area Mown per year (ha)	200	400	600	800
Total Cost of mowing per year	$12,731	$19,874	$27,017	$34,160
Cost per ha	$63.66	$49.69	$45.03	$42.70
Option 2 - 10 year life, $5000 trade in value, extra R&M				
Area Mown per year (ha)	200	400	600	800
Total Cost of mowing per year	$12,481	$19,624	$26,767	$33,910
Cost per ha	$62.41	$49.06	$44.61	$42.39

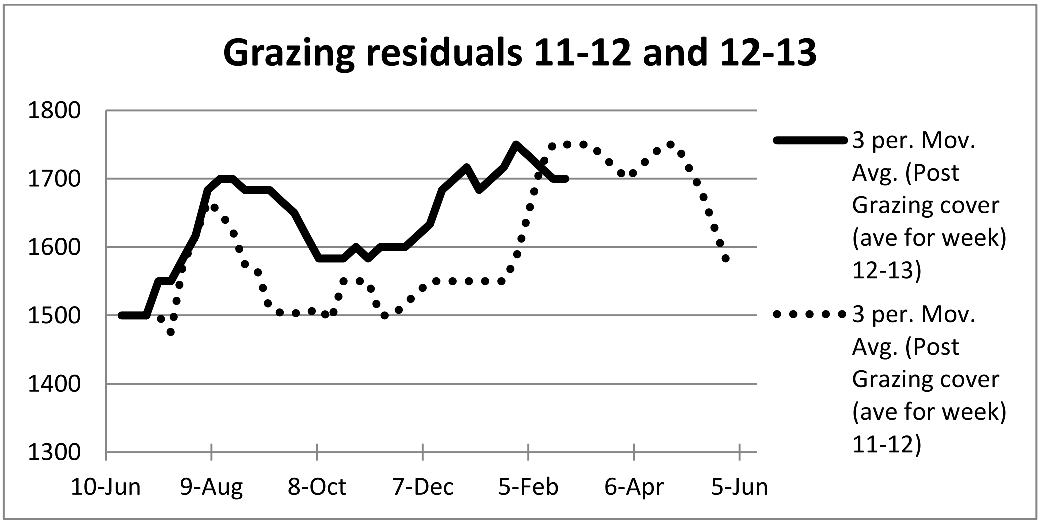
Mowing Comparison – 2011/12 vs 2012/13 (to date)

	2011/12	2012/13	
Area Mown	243	761	ha
Total cost of mowing per year	$15,165	$33,950	$per year
Milk Payout	6	6	$/kgMS
Increased milk production required	2527	5658	kgMS per year
Increase on 2011/12 season		3131	kgMS
Percentage of 2011/12 milk production		1.1%	

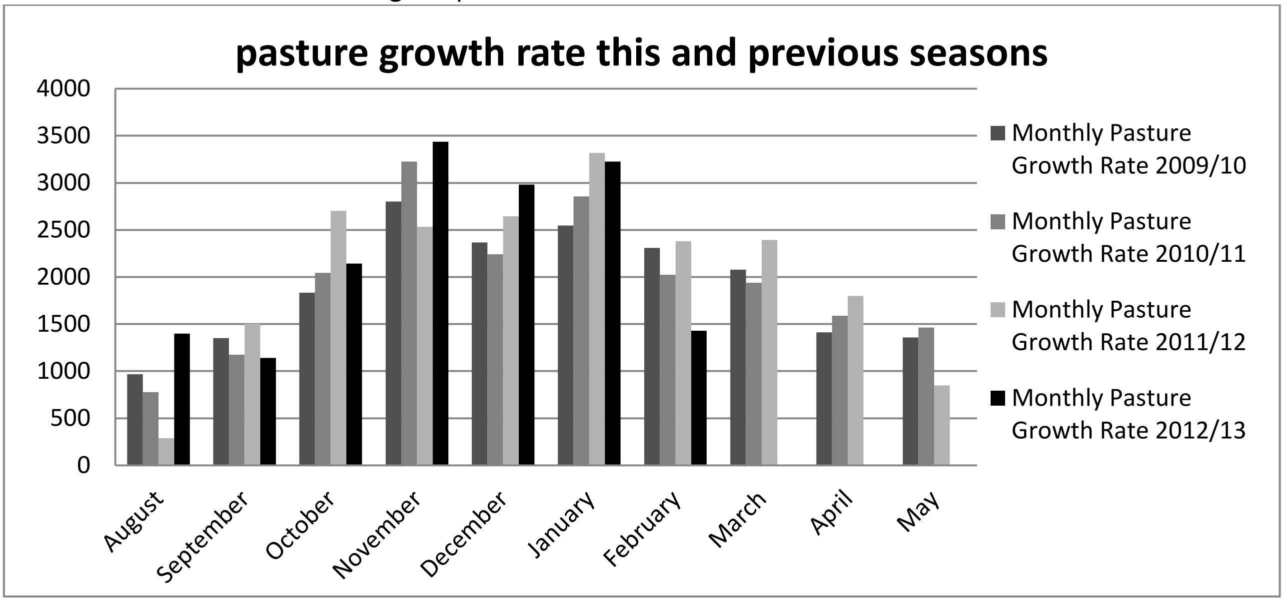
Supplements made and fed. Grass Silage continues to be our only supplement. We have made a little less silage to date and have fed out a lot more. In January as a result of the hot weather depressing feed supply about half of the herd's diet was silage for 9 days.

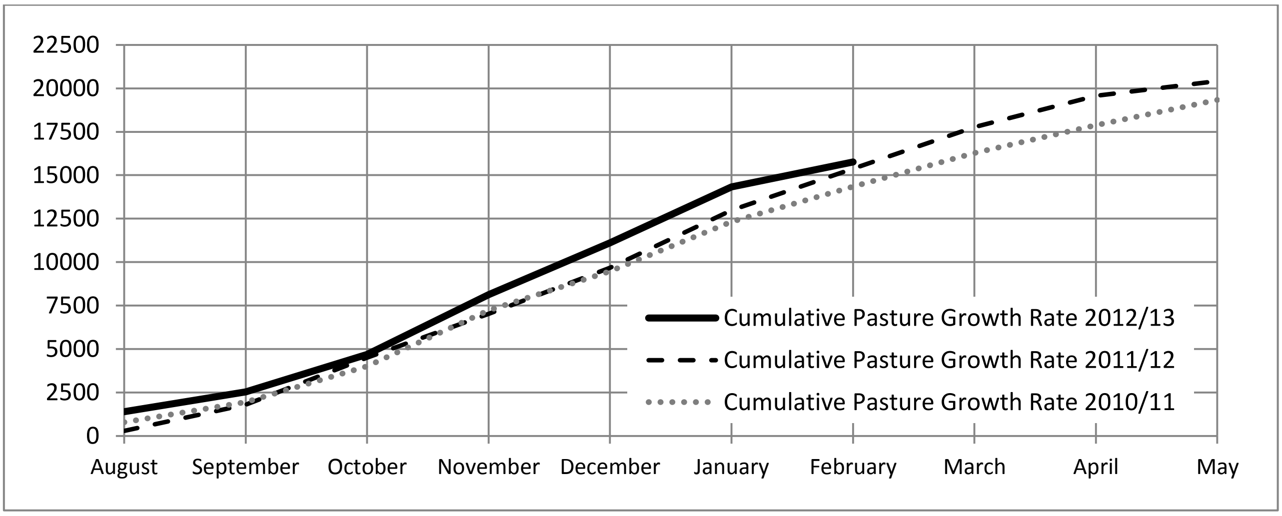


Grazing residuals will stay in the 7-9 click range. This is a vital part of our system driving pasture quality for subsequent grazing rounds.

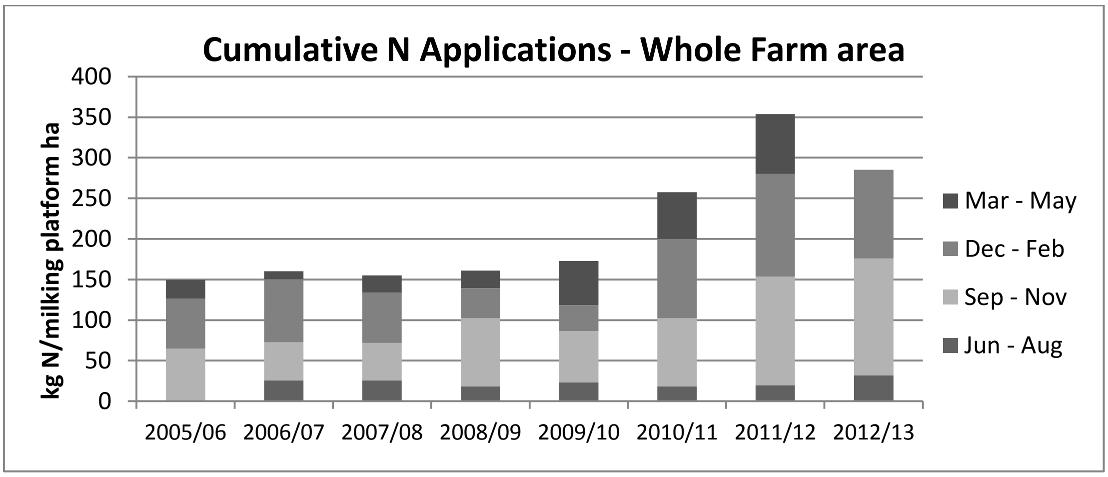


Pasture growth rate this season has been erratic but season to date we are ahead. This needs to be viewed with some caution though as we feel that the very stemy nature and low energy content of pasture this summer is not reflected in the data we collect using the plate meter.

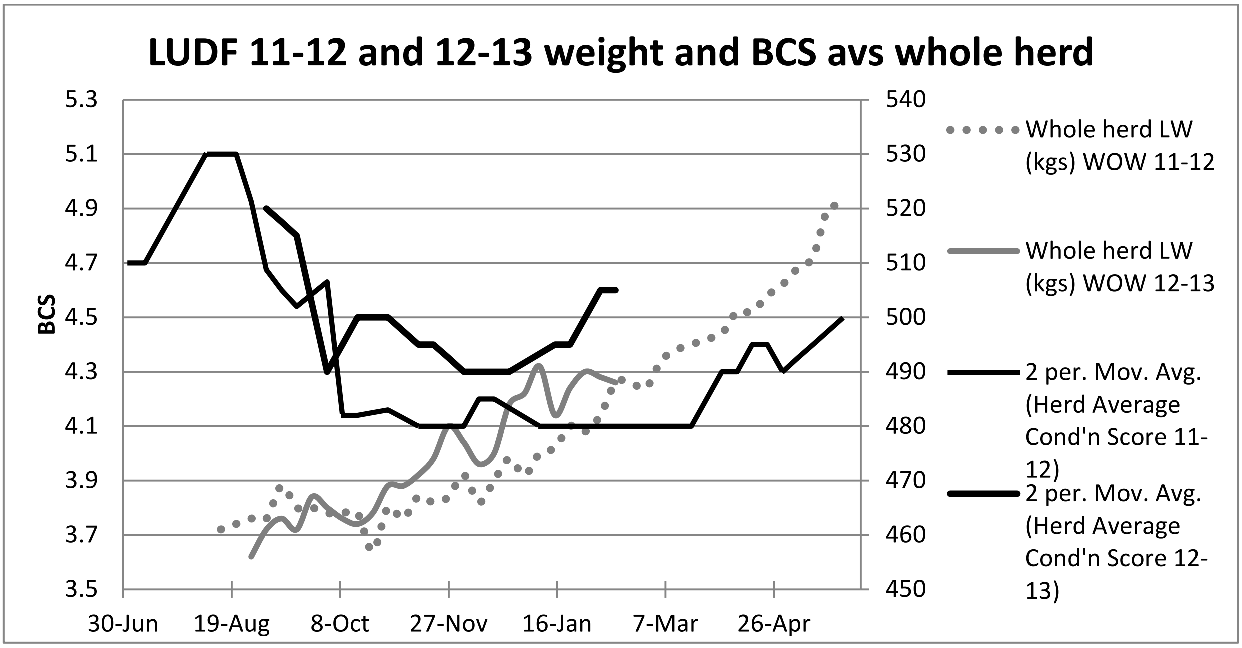




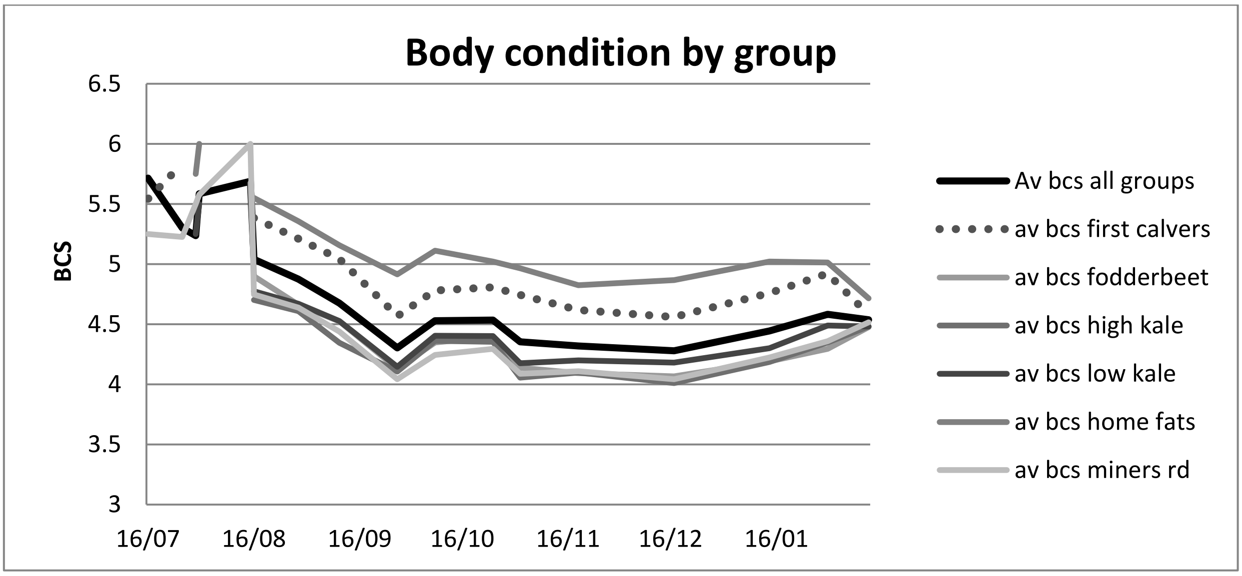
Nitrogen use is about the same as last year



Herd Body Condition through the season: Cows started at about the same average BCS as last year but dropped less condition in the Spring, down to 4.3 compared to 4.1 last season and they started gaining earlier. Average BCS is now 4.6 over all cows. The herd also started gaining weight earlier this season than last, however we have seen a correction in January which currently puts them at about the same weight as they were last year. This may be a consequence of the challenging pasture quality issues and need to feed silage in large quantities in January.



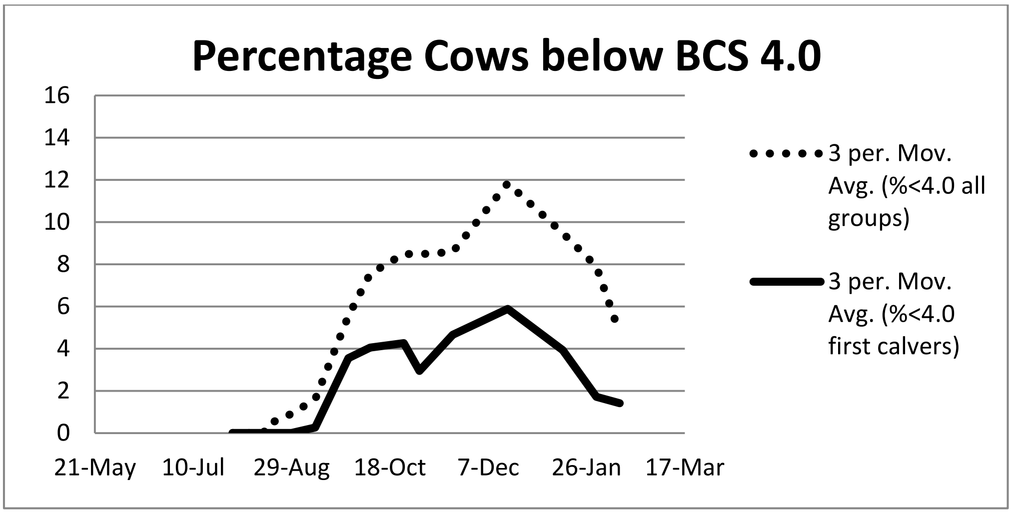
Body condition score of different groups below is a chart showing BCS of the wintering groups fed different crops at Ashley Dene, last autumns 'fat' cows and the first calvers. Interesting there seems no significant difference between the Ashley Dene cows whilst the fat cows and the first calvers have maintained higher BCS until recently.



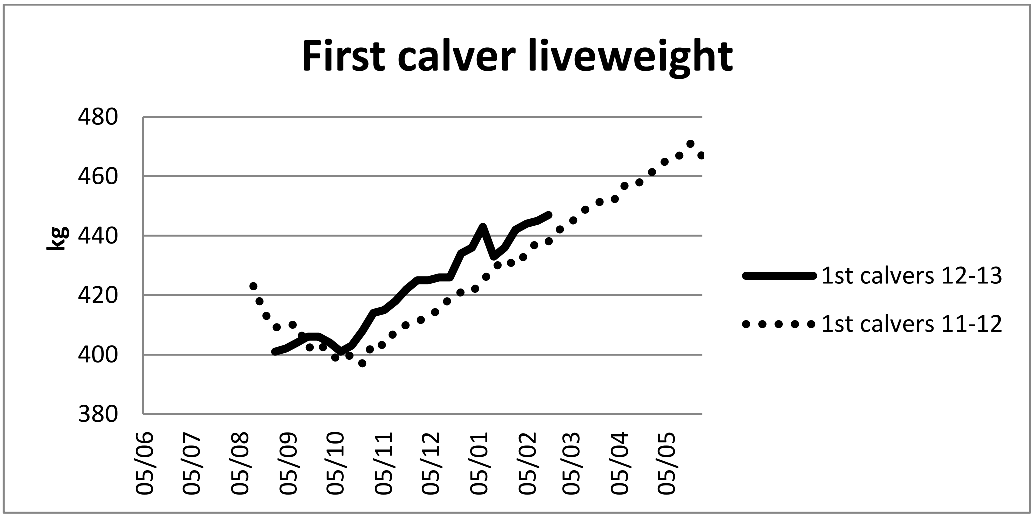
A key part of the cow condition management approach identify and ensure that light condition cows are given the opportunity to stay in milk as long as possible while meeting their dry off targets being BCS 4.5 + 60 day before their due calving date. The cows we look for though the season are those at less than BCS 4.0.

From mid-January the herds were restructured as part of our early preparation for drying off. We intend to meet our dry off BCS targets whilst getting as much MS from days in milk from the herd as we can. To do this we started by removing 100 cows from the small herd i.e. first calvers with BCS of 5 or more, mixed aged cows with BCS 4.5 or more, and late calvers. 82 cows were put into the small herd, i.e. early calvers [first 4 weeks] with BCS less than 4.5.

Thus the small herd will now be used to enable early calving lighter condition cows to gain body condition and stay in milk longer, we intend to milk as many cows as possible to final dry off date as long as feed and ground conditions allow. Note that there has tended to be a lower incidence of light conditioned first calvers and in general we appear to be making good progress in minimising this number across the whole herd, relatively early in the season.

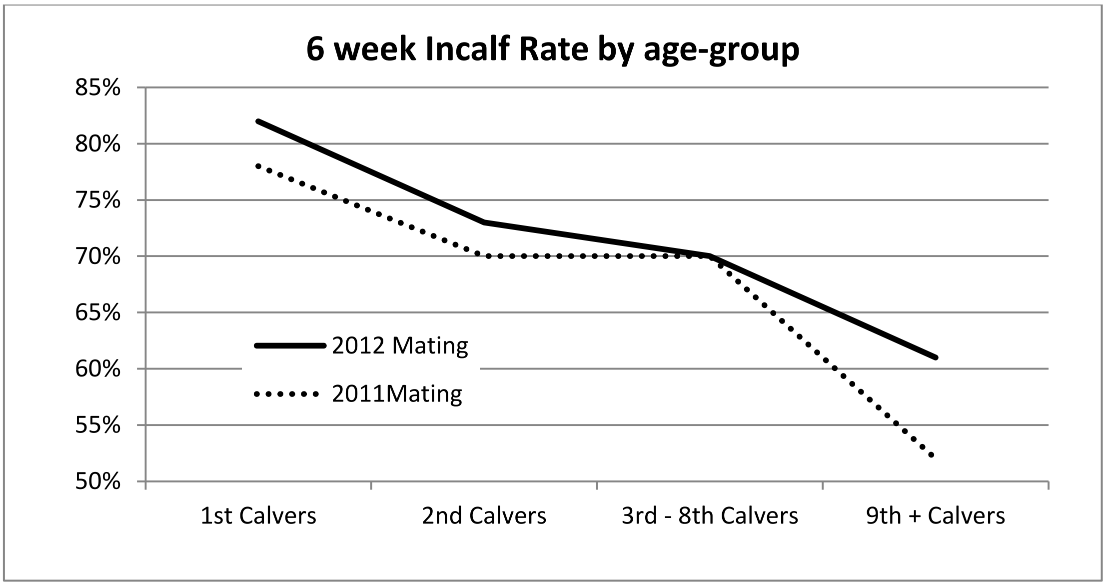


First calver liveweight has tracked parallel to last year with them losing a little less weight in the spring and then maintaining a better BCS through the season and growing to be currently [at 19- Feb 13] 447kg compared to 438kg at the same time last year.



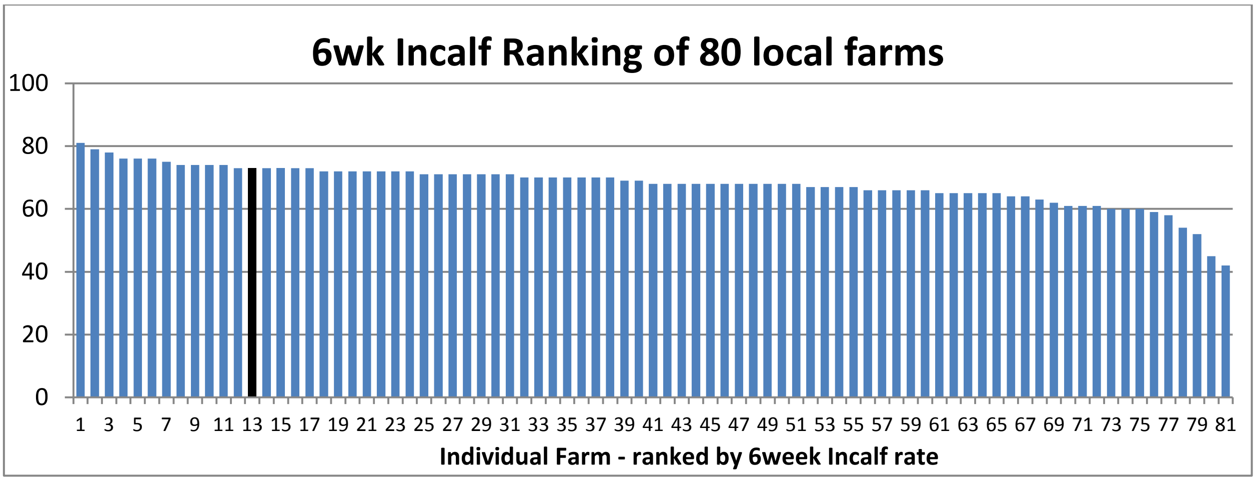
Mating Results:

A pregnancy test carried out on 7th February confirmed a 10 week in-calf rate of 87%, the same as last year. The 6 week InCalf rate (as on the following Fertility Focus Report) shows 73% of all cows were in calf after 6 weeks mating (72% last year). Age group analysis of this shows improved mating performance in the younger cows.



Comparison of LUDF and local farms 6 week InCalf rates:

(courtesy of Selwyn-Rakaia Vets)



Note: Black bar above is LUDF (13 highest 6 week InCalf rate amongst local farmers)

Fertility Focus 2012: Seasonal 19

Lincoln University
C/O The Manager (University Dairy Fa
PO Box 94
Lincoln University Lincoln 7647

Report date:	17/02/13
PTPT:	BQCY
Herd Code:	6/114
No of cows included:	636
These cows calved between:	17/06/12 and 23/12/12
Mating start & stop date: (estimated from AI or rectal pregnancy test data)	25/10/12 - 03/01/13
Planned start of calving:	03/08/13

Version 1.0

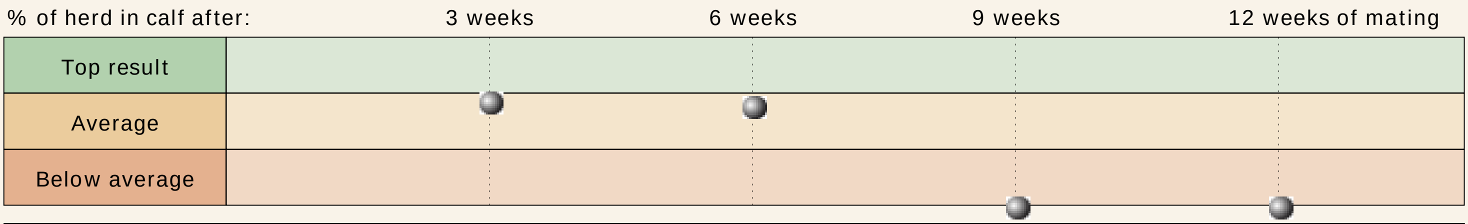
1 Overall herd reproductive performance

6-week in-calf rate
Percentage of cows pregnant in the first 6 weeks of mating

Your herd	72% (72-73%)	☆☆☆
Aim above	78%	

Empty rate
Percentage of cows not pregnant after 11 weeks of mating

Your herd	13% (13-14%)	☆
Aim for	6%	



2 Drivers of the 6-week in-calf rate

3-week submission rate
% of cows that were inseminated in the first 3 weeks of mating

Your herd	90%	☆☆☆☆☆
Aim above	90%	

Non-return rate
% of inseminations that were not followed by a return to heat

Your herd		
Aim above		

Conception rate
% of inseminations that resulted in a confirmed pregnancy

Your herd	54%	☆☆☆
Aim above	60%	

3 Key indicators to areas for improvement

Calving pattern of first calvers
Well managed heifers get in calf quickly and calve early.

Calved by	Week 3	Week 6
Your herd	92%	99%
Aim above	75%	92%
	☆☆☆☆☆	☆☆☆☆☆

Calving pattern of whole herd
Did late calvers reduce in-calf rates?

Calved by	Week 3	Week 6	Week 9
Your herd	70%	87%	98%
Aim above	60%	87%	98%
	☆☆☆☆☆	☆☆☆☆☆	☆☆☆☆☆

Pre-mating heats
A high % of well managed cows will cycle before the start of mating.

Your herd	79%	☆☆☆☆☆
Aim above	85%	

3-week submission rate of first calvers
Well managed heifers cycle early

Your herd	92%	☆☆☆☆☆
Aim above	90%	

Heat detection
A high % of early-calved mature cows should be inseminated in the first 3 weeks of mating.

Your herd	96%	☆☆☆☆☆
Aim above	95%	

Non-cycling cows
Treated non-cyclers get in calf earlier.

Treated	By PSM	Wks 1-3	Wks 4-6
Your herd	0%	0%	0%

Rating	What does it tell me?	What should I do?
☆☆☆☆☆	Top result	Ideal - keep up the good work!
☆☆☆	Average	Getting there - focus on getting the details right.
☆	Below average	Plenty of room to improve - seek professional advice.
	No result	Not enough information provided - seek help with records.

Performance after week 6
If you ran bulls after week 6 of mating, empty rate helps assess bull performance.

	Empty rate	
Your herd	13%	Seek advice
Expected	8%	

Behind Your Detailed Fertility Focus Report

Report period: Cows calved between 17/06/12 and 23/12/12.
This was the most recent period with sufficient herd records that enabled an analysis to be completed.

Calving system: Seasonal
Your herd has been classified as seasonally calving because most calvings occurred in a single batch lasting less than 21 weeks.

Level of analysis: Detailed.
Your good record keeping means a detailed analysis was possible for your herd.

incalf FERTILITY FOCUS
Version 1.0

Report date:	17/02/13
PTPT:	BQCY
Herd Code:	6/114
Calvings up to this date requested for analysis:	17/02/13
No of cows included:	636
These cows calved between:	17/06/12 and 23/12/12
Mating start & stop date: (estimated from AI or rectal pregnancy test data)	25/10/12 - 03/01/13

Part A) Herd records cross check

Check that the herd records in the table are complete and correct.

2012/13	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Total
No. of calvings		83	433	129	19								664
No. of AI matings					200	602	45						847
No. of aged preg tests								469	162				631
No. of non-aged preg tests													0
No. of cows culled or died		1	12	17	3	4	2						39

Part B) Notes on the calculations

Use the following notes to see how your results were calculated.

1 Overall herd reproductive performance

6-week in-calf rate

Your report has been based on the mating and pregnancy test results you supplied. The ACTUAL 6 week in-calf rate is shown for your herd.

Empty rate

The empty rate reported was based on the results of pregnancy testing. The range provides the lowest and highest likely estimate.

2 Drivers of the 6-week in-calf rate

3-week submission rate

631 cows had calving dates in the required range and 90% of these were submitted during the first 21 days of mating.

Non-return rate (1-24 days)

Non-return rate is not calculated when pregnancy test results provide an accurate estimate of conception rate.

Conception rate

841 eligible inseminations were used in calculating your herd's conception rate.

3 Key indicators to areas for improvement

Calving pattern of first calvers

142 cows with eligible calving dates were recorded as calving at less than 34 months of age. The calving pattern of first calvers was calculated from their records.

Calving pattern of whole herd

664 cows had calving dates that were eligible for this report.

3-week submission rate of first calvers

136 first calvers had calving dates in the required range and 92% of these were submitted during the first 21 days of mating.

Heat detection

271 cows at least 4 years old at calving had calved at least 8 weeks before planned start of mating and 96% of these were submitted during the first 21 days of mating.

Pre-mating heats

631 cows had calving dates in the required range and 498 of these had a pre-mating heat recorded.

Non-cycling cows

No cows were identified as being treated for non-cycling. If you did treat non-cycling cows, please supply records to ensure those cows are identified.

Performance after week 6

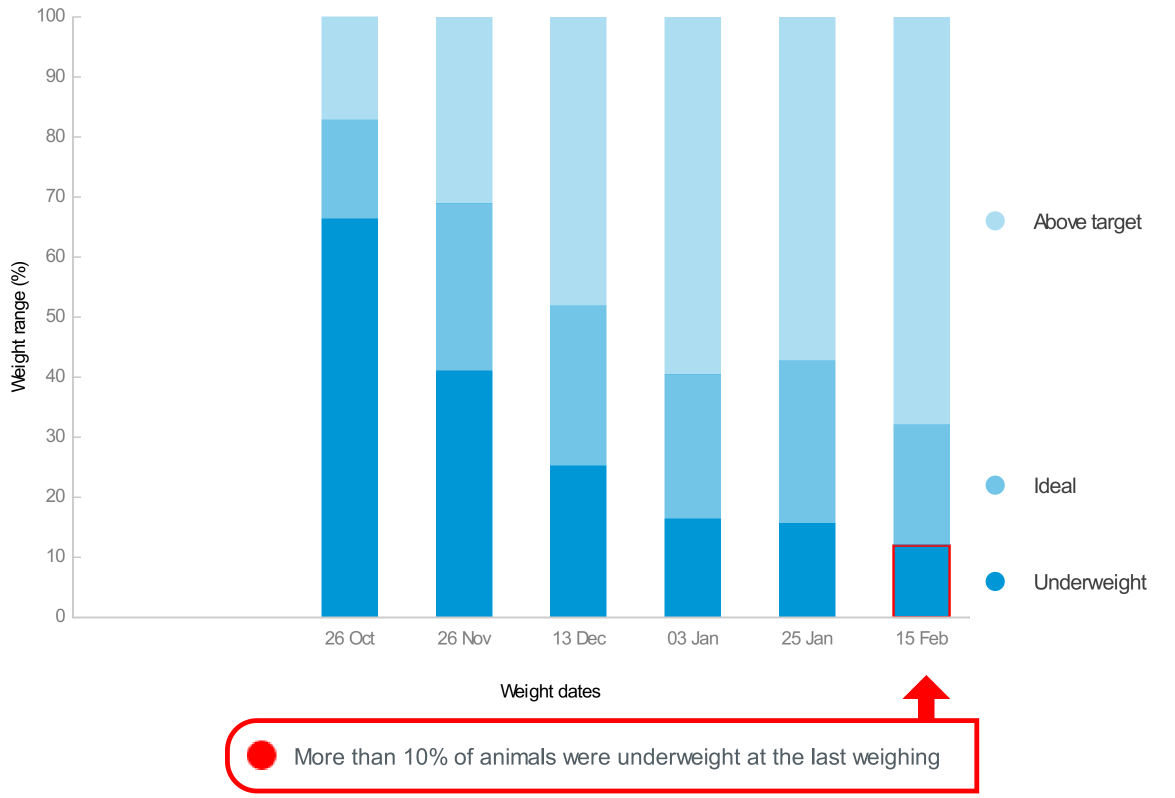
Your herd's empty rate and 6-week in-calf rate were used to determine the success of your herd's mating program after the first six weeks. If bulls were used after week 6 of mating, this gives an assessment of how well they got cows in calf.

Induced cows

No cows were identified as having induced calvings. If you did induce cows, please ensure that they are all identified.

Ranges for 2012 Spring as at 15/02/2013

Weight ranges



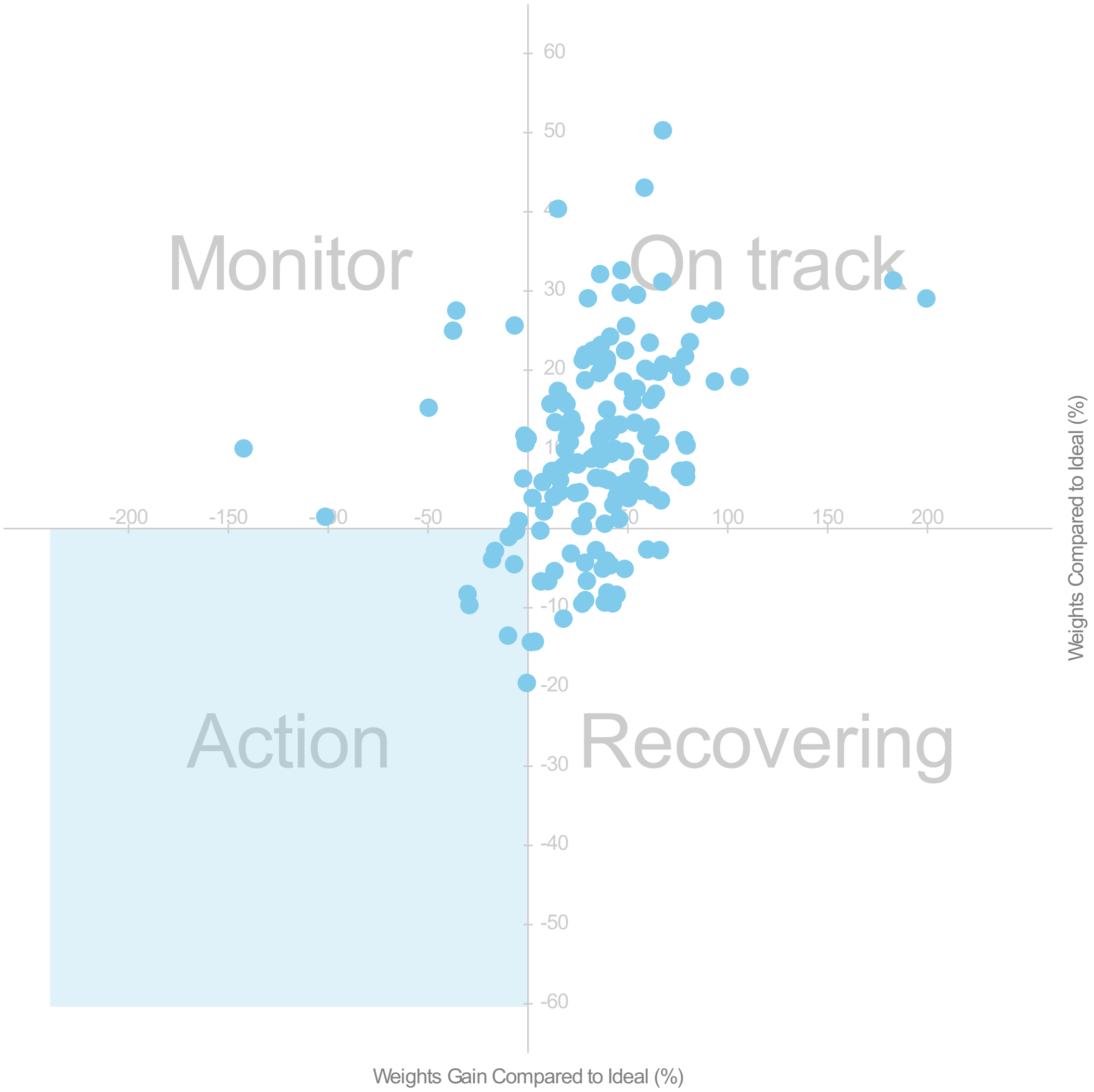
Range	October 2012		November 2012		December 2012		January 2013		January 2013		February 2013	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Above target	27	17.1	49	31	76	48.1	94	59.5	91	57.2	108	67.9
Ideal	26	16.5	44	27.8	42	26.6	38	24.1	43	27	32	20.1
Underweight	105	66.5	65	41.1	40	25.3	26	16.5	25	15.7	**19**	**11.9**
Total animals	158		158		158		158		159		159	

LIC

2012 Spring as at 15/02/2013

Animal performance

All 159 animals in this weighing are displayed



Take action with these animals

Official Id	AE Breed	Current Weight (Kg)	Weight Gain (Kg/day)	Gain Required by PSM (Kg/day)	Variation from Ideal (%)	Previous Category
BQCY-12-138	HF x J	161	0.52	0.60	-1.07	On Track
BQCY-12-149	HF x J	143	0.57	0.70	-13.52	Recovering
BQCY-12-151	HF x J	142	0.33	0.62	-8.26	Action
BQCY-12-188	HF x J	151	0.38	0.68	-9.66	Recovering
BQCY-12-189	HF x J	161	0.48	0.62	-2.83	Recovering
BQCY-12-208	HF x J	158	0.57	0.63	-4.50	Recovering
BQCY-12-214	HF x J	131	0.67	0.73	-19.49	Recovering

P21 Dairy Systems Research: Canterbury

Dairy farming within catchment nutrient limits

What does 'farming within catchment nutrient limits' mean?

Regional Councils across New Zealand are currently setting nutrient limits for lakes and rivers in their catchments, as required by the NZ Government under the National Policy Statement on Freshwater.

The main nutrients of concern are nitrogen (N) and, in some situations, phosphorus (P). Nitrogen is a more widespread issue, since it moves freely through the soil into water whereas phosphorus usually stays bound to particles within the soil.

Regional nutrient plans will probably require dairy farmers to reduce N losses in several catchments. What could emerge from this is a 'target' nitrogen leaching limit to be achieved for different categories of farms, such as 'x' kg N per hectare per year.

Depending on the catchment, soil type, and farm system, 'x' could be a figure that is lower than many farms are currently achieving. In this situation, farm management will have to change. For the dairy industry, and for regional economies, it is important that any possible negative implications of these changes on milk production and farm profitability are avoided.

Pastoral 21 is a collaborative venture among DairyNZ, Fonterra, Dairy Companies Association of New Zealand, Beef + Lamb New Zealand and the Ministry of Science & Innovation. Its twin goals are: (1) a $110/ha/year increase in average profitability from dairy production, with a 30% reduction in nitrogen and phosphorous losses to water; (2) a 3% annual meat productivity increase, while containing or reducing environmental footprint. The collaborating research organisations in the various projects include AgResearch, DairyNZ, Massey University, Lincoln University/Telford Rural Polytechnic, NIWA, Plant & Food Research, Landcare Research and On-farm Research.

Nitrogen: a 'slippery' nutrient

Our 'staple' dairy cow feed, ryegrass/white clover pasture, requires high levels of soil nutrients, including nitrogen, to grow well and provide sufficient feed for high productivity. Ryegrass/clover pasture usually contains a higher concentration of N than cows need in their diet.

Each year, a lot more N is bought in to the dairy farm (through N fertiliser, biological fixation by legumes, and in supplementary feeds) than leaves the farm (in milk, or through animal sales).

Much of the surplus N is lost from the farm in the form of nitrate, which can leach below the plant root zone into sub-surface waters and eventually accumulate in surface water.

Only 25-30% of the N eaten by cows is retained for milk protein or other animal needs. The rest is excreted in dung or urine. It is the N in urine which is the main problem for freshwater quality in agricultural catchments.

Usually, there is a lot more N deposited in a urine patch than the pasture plants in that patch can take up for new growth. The excess N is a major source of emissions to freshwater via nitrate leaching.

The higher the concentration of N in the diet of the animal, the higher the concentration in the urine and the greater the risk of nitrate leaching.

The risk of N leaching from the urine patch is higher for urine deposited in late summer and autumn than for urine deposited at other times. This is because plant growth is often restricted at these times and therefore plant N uptake is low, and because subsequent winter/spring rain usually exceeds the water holding capacity of the soil, so water will drain from the soil taking nitrate with it.

What can we do about nitrate leaching?

There are management practices available that help reduce the risk of nitrate leaching. These include:

- Maximising animal reproductive efficiency, to reduce total animal replacements. This reduces the total number of animals within the system, and therefore total urinary N output

- Lower stocking rate. This works for the same reasons outlined above – fewer total animals, less total urinary N being deposited on pastures or crops

- Reduce N fertiliser, and/or increase the efficiency of N fertiliser use by plants. Over-fertilising leads to high N concentrations in grass, therefore high N concentrations in the cows diet and urine

- Reduce dietary N concentration by using alternative feeds that have low N concentration eg maize silage, fodder beet, or forage herbs such as plantain

- Restrict the time that animals spend on pasture, and therefore reduce urinary N return to pasture during the 'risk' periods of late summer/autumn. This only works if the N excreted while animals are on stand-off areas is captured and cycled efficiently.

- Increase the genetic merit of the herd. Recent trials show that cows with high breeding worth/production worth (BW/PW) put more of the N they eat into milk, and also excrete less N in urine, than cows with low BW/PW

- Maximise pasture growth, so that: 1) as much as possible of the available soil nitrogen is taken up by plants; and 2) as much as possible of the rain or irrigation water hitting the soil is taken up by plants rather than draining below the plant roots, carrying N with it.

So, where to from here?

Many of these practices help improve the overall efficiency of production in the farm system, and should therefore also reduce costs and increase profit as well as reduce the risk of N leaching. Improving reproductive efficiency, N fertiliser use efficiency, and pasture growth are all examples. They are all good for business.

Other practices require substantial change to the system, and could therefore add more costs and/or reduce production. Examples include standing animals off pasture, or reducing stocking rate.

For all of these practices, we need to work out:

- how effective they are for reducing N losses when implemented in a farm system
- how much production risk is involved; and
- the possible consequences for profitability.

We also need to identify the critical management decision rules for the different practices to help **farmers implement changes.**

<u>Hence, the P21 project seeks to develop</u>:

practical dairy farming systems that combine high production and profit with lower environmental emissions.

P21 farmlet research targets

The P21 project has the following production, profit and environmental targets:

- Milksolids (MS) production 1,600 – 2,200 kg/ha/year (compared to Canterbury benchmark of 1,500 kg/ha/year)
- Operating profit $4,300 - $4,800/ha/year (compared to Canterbury benchmark of $3,300/ha/year)
- Nitrate-N leaching 25-35 kg N/ha (all hectares counted).

We compare two management <u>systems:</u>

The P21 farmlets compare two different systems, both with a strong focus on management efficiency: one based on the 'traditional' pathway of intensification through more cows and more inputs (called 'High Stocking Efficient', or HSE), and one based on reducing stocking rate, focussing on high per-cow production through increased pasture intake, and incorporating N loss mitigations such as diverse pastures ('Low Stocking Efficient', or LSE). They are summarised below. The experiment started in September 2011.

Low Stocking rate Efficient (LSE)	High Stocking rate Efficient (HSE)
Milking platform, Lincoln University Research Dairy Farm	
3.5 cows/ha	5.0 cows/ha
BW 140*	BW 133*
Up to 150 kg N/ha/year	Up to 400 kg N/ha/year
22 paddocks on milking platform. Mixtures of white clover and perennial ryegrass: 8 with diploid Arrow AR1, 8 with tetraploid AR37 and 6 with a diverse pasture mix, including chicory, plantain and prairie grass (sown April 2011)	18 paddocks on milking platform. Mixtures of white clover and perennial ryegrass: 8 paddocks with diploid Arrow AR1 sown April 2009, 8 with tetraploid AR37 and 2 with diploid Expo AR1, sown April 2011.
Wintering support block, Ashley Dene	
Kale + green chop silage	Fodder beet + pasture silage

*Actuals for 2012-2013 season

What are we looking at?

<u>Farm scale:</u>

- N and P balance at farm gate
- Nitrate leaching
- Water use efficiency
- Economics

<u>Pasture and crops:</u>

- Production
- Composition, quality
- Animal intake
- Soil structure
- Soil fertility
- Insect damage

<u>Animals</u>:

- Milksolids production
- Body condition, weight, health, fertility
- N partitioning (milk, faeces, urine and blood)

Our 'expectations': Results of modelling

Before starting the experiment, the DairyNZ Whole Farm Model was used to simulate the physical production, financial performance and environmental emissions of the HSE and LSE systems. Some key results of the modelling are shown in the table below. These results represent our expectations of how the two systems will perform. The farmlet experiment will test whether or not these expectations can be met.

Whole Farm Model Results	LSE	HSE
Milking platform		
Stocking rate (cows/ha)	3.5	5.0
N fertiliser application (kg N/ha/year)	150	400
Total pasture harvested (t DM/ha/year)	16.0	18.1
Grain supplement (kg/cow/year)	100	800
MS produced (kg/cow/year)	453	437
MS produced (kg/ha/year)	1,588	2,184
Operating profit ($/ha)	4,334	4,810
Farm gate N surplus (kg/ha)	154	339
N leached (kg N/ha)	24	38
Wintering		
Main winter crop	Kale	Fodder beet
Crop area / 100 cows	8.0	2.2
Other winter feed	Green-chop cereal silage	Pasture silage

Can we achieve these performance levels?

First year results: Milking platform, 2011/2012 (LUDF included for comparison)

	LSE	HSE	LUDF
Total pasture harvested (t DM/ha)	15.7	18.8	17.3
Purchased supplementary feed (kg DM/cow) Silage Grain	 0 20	 515 123	 359 0
N fertiliser used	171	317	350
Days in milk	269	254	272
MS produced (kg/cow)	518	442	471
MS produced (kg/ha)	1,809	2,213	1,861
Estimated operating profit ($/ha)	4,809	4,590	4,850

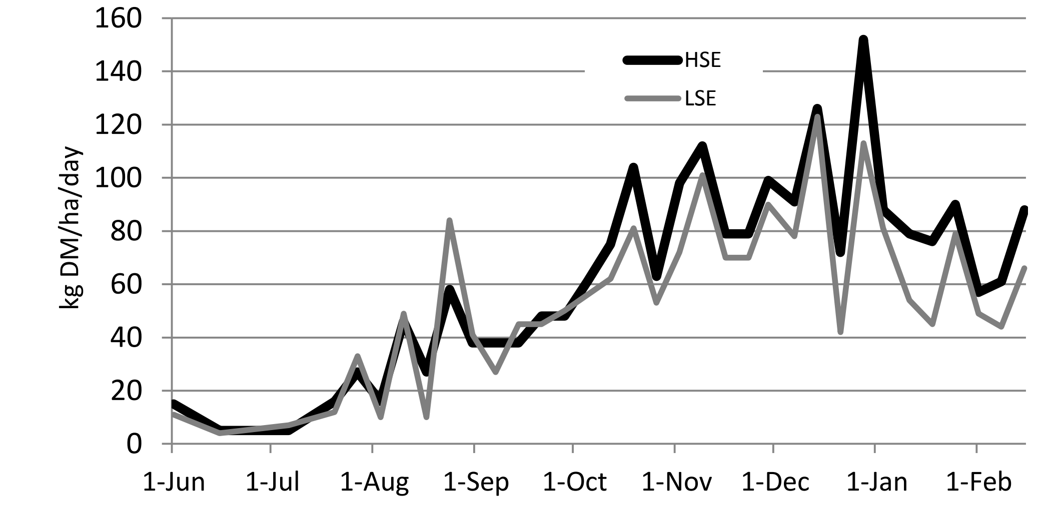
Summary of the results of the first year:

- Both systems exceeded milk production targets, per cow and per hectare.
- Both systems returned good operating profit: close to target, and similar to LUDF.
- Total pasture harvest was similar to model projections (model projections are based on average of 10 years climate data).
- The LSE herd achieved 15 more days in milk compared to HSE.
- In the LSE system, N use exceeded expected usage by 21 kg. Pastures were visibly N-deficient in late summer/autumn, and an 'extra' round of fertiliser was used to ensure pasture cover targets at drying off were met. (Note: neither system received any effluent in 2011/12, and both systems include new pastures on ex-cropping soils, which have lower soil organic N levels compared to soils that have been under pasture for many years).
- Supplementary feeding levels were lower than expected, mainly due to good pasture supply. Grain feeding facilities were not available in-shed until late in the season, restricting grain use.

Second year results to-date: Milking platform, 2012/13

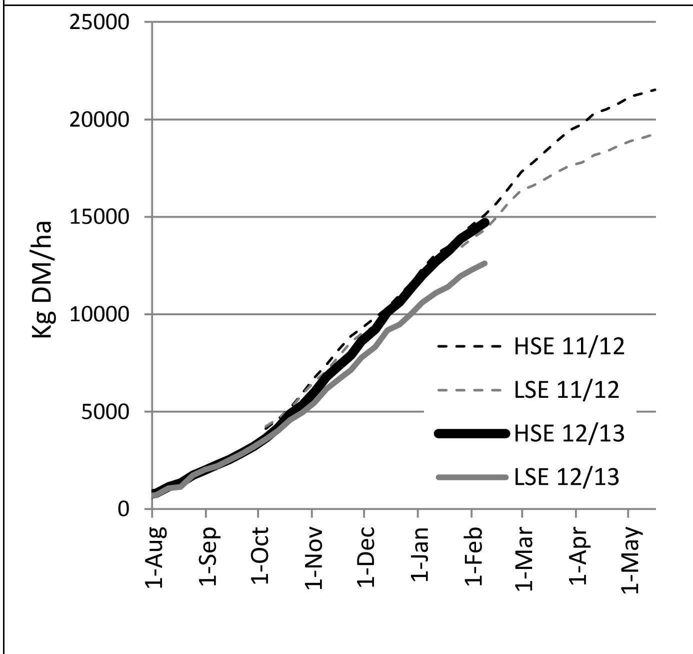
1. Pasture growth

Pasture growth rate, P21 farmlets, 2012/13

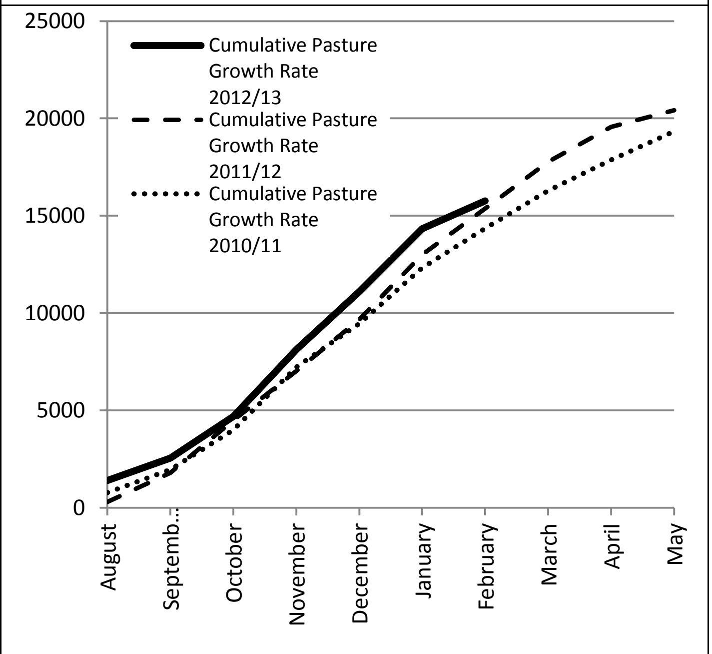


- Growth rate in HSE has generally been higher than LSE since mid-spring. This is related to N fertiliser use (see #2, below).

Cumulative pasture growth
P21 farmlets 2011/12 and 2012/13



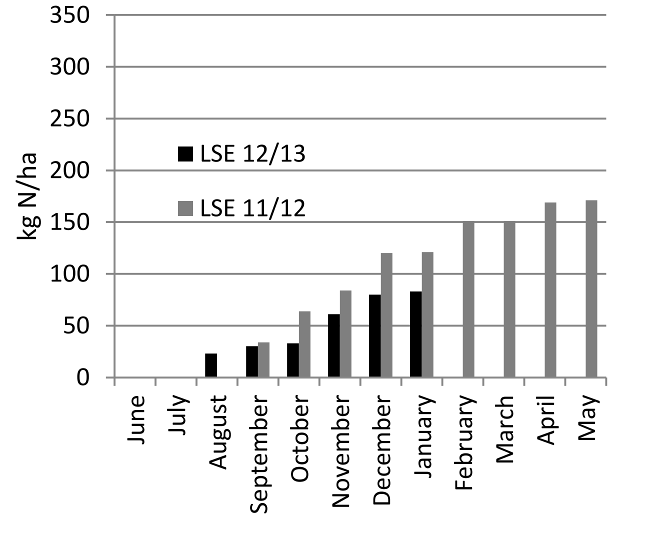
Cumulative pasture growth
LUDF



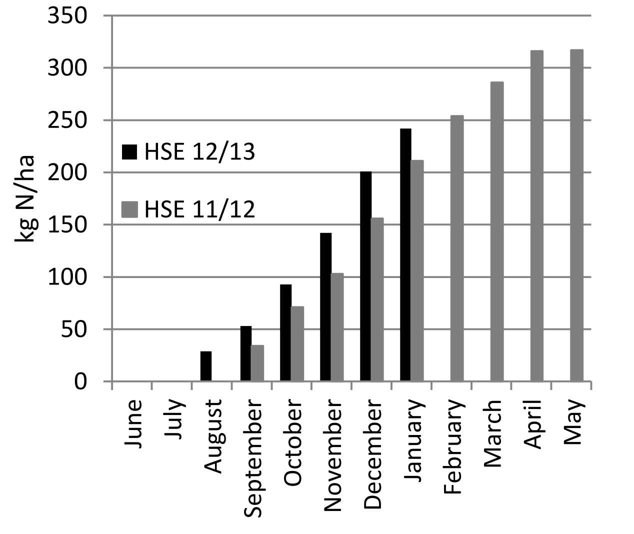
- Cumulative growth in P21 to 1st February has been 12,305 kg DM/ha for LSE and 14,702 for HSE. The difference is probably due to an extra 159 kg N fertiliser/ha in HSE compared to LSE: an average N fertiliser response of 15 kg DM/kg N applied.
- Cumulative growth in LUDF has been 15,372 kg DM/ha. LUDF has used an extra 43 kg N fertiliser / ha compared to P21 HSE: an average response of 15.5 kg DM/kg N applied.

2. N fertiliser use

Cumulative N fertiliser
LSE 2011/12 and 2012/13

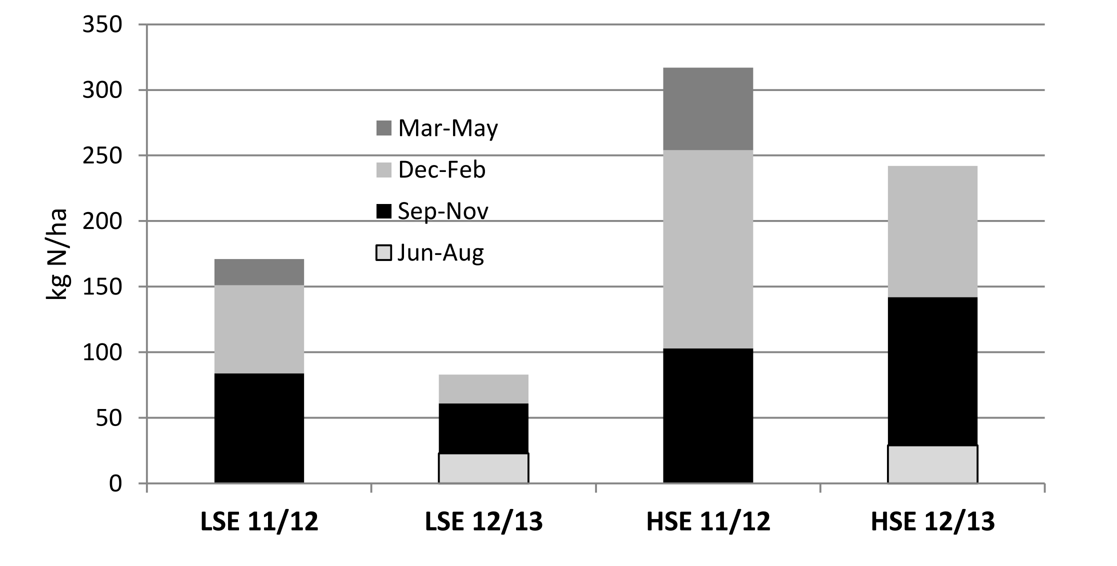


Cumulative N fertiliser
HSE 2011/12 and 2012/13



- N use to-date in LSE and HSE has been 83 and 242 kg N/ha respectively, compared to 121 and 211 this time last year
- In LSE, where the aim is to use just 150 kg N/ha total for the year, more N has been conserved for use in late summer/autumn in 2012/13 compared to 2011/12
- In 2011/12, only 20 kg N/ha was used in autumn (see graph below), which restricted pasture supply, days in milk and total milk production
- In 2012/13, we aim to get some of that production back by changing our N policy

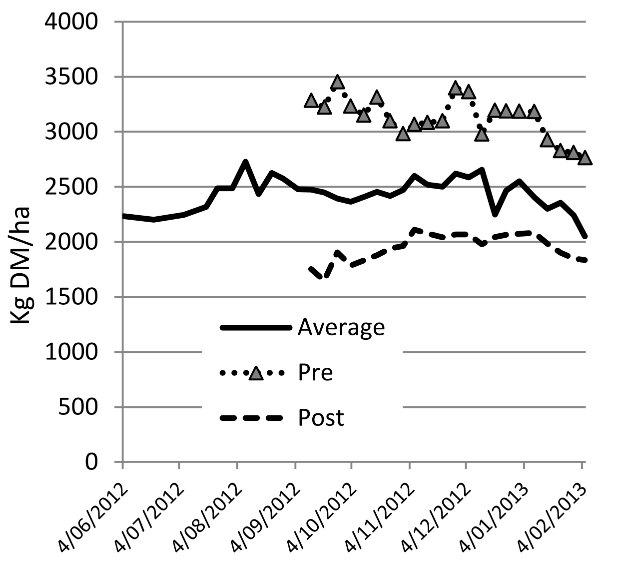
N application in each season of the year, LSE and HSE, 2011/12 and 2012/13



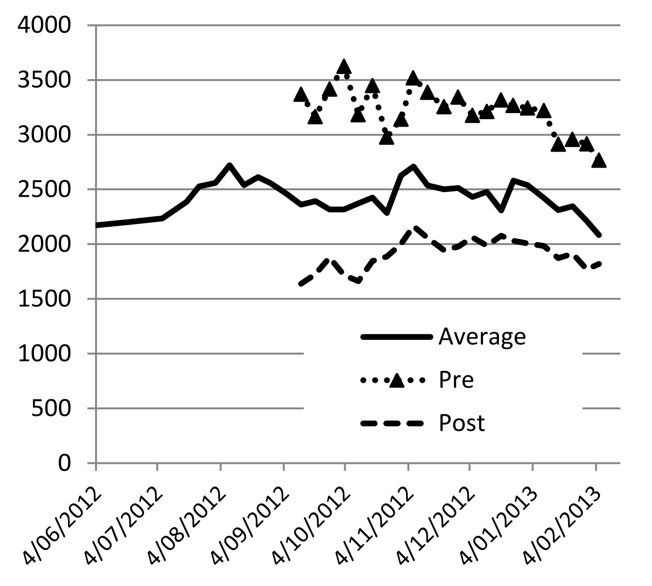
3. Pasture cover

- Pasture cover data are from the rising plate meter with the winter calibration equation
- Average farm cover, pre-graze pasture cover and post-graze pasture cover have all been similar in LSE and HSE during spring/summer 2012/13

Pasture cover, LSE 2012/13



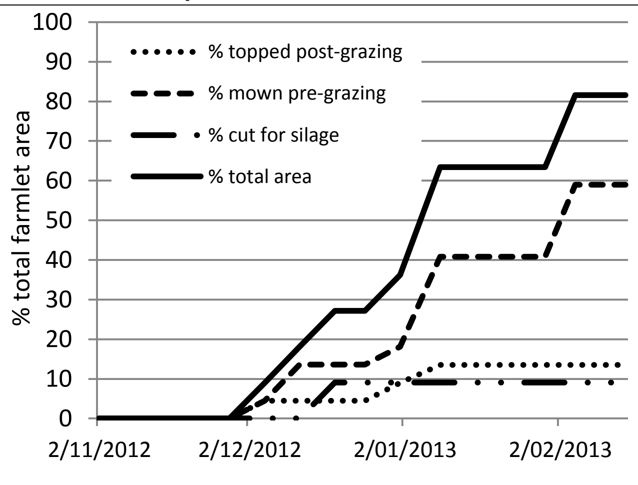
Pasture cover, HSE 2012/13



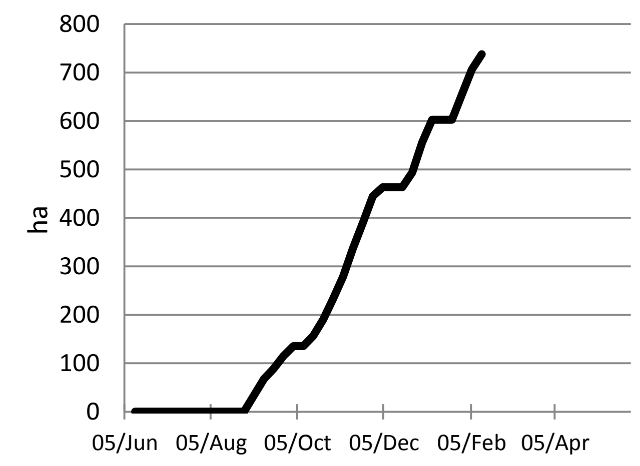
4. Mowing and silage-making

- In total, in LSE, just over 80% of total farm area has been mown in 2012/13, most of which was mown ahead of the cows between early December and late January
- All pre-graze mowing was carried out to help control pasture quality. Paddocks were ear-marked for mowing at the next grazing if patches were left ungrazed, and were judged likely to be rejected at the next grazing due to accumulation of rank/dead material
- Only 11% of the area in HSE has been mown, and no silage has been conserved.
- At LUDF, the entire farm has been mown about 4.6 times (460% of farm area), from September onwards.

Cumulative area mown
P21 - LSE 2012/13

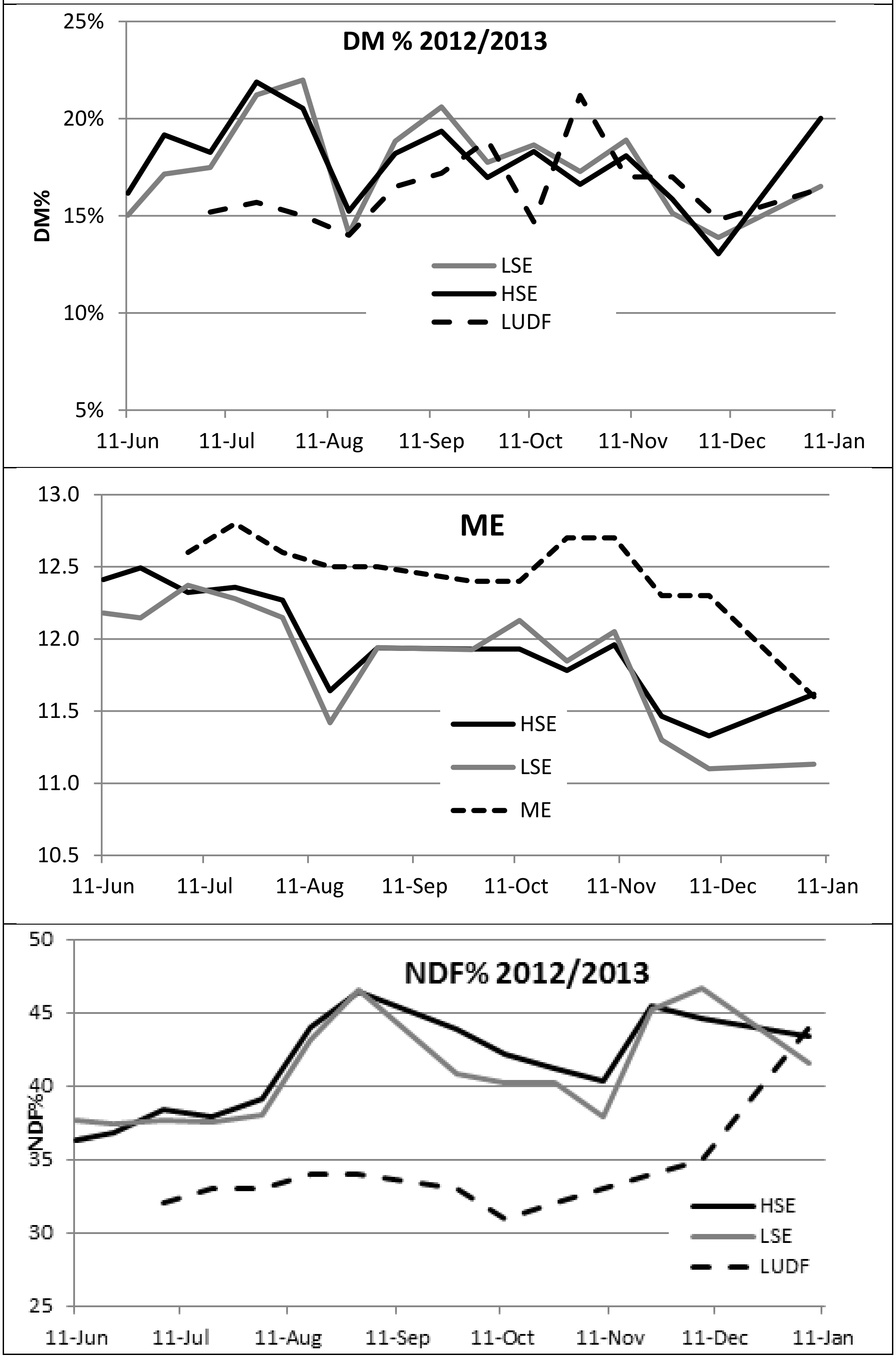


Cumulative total area mown
LUDF 2012/13



5. Pasture quality

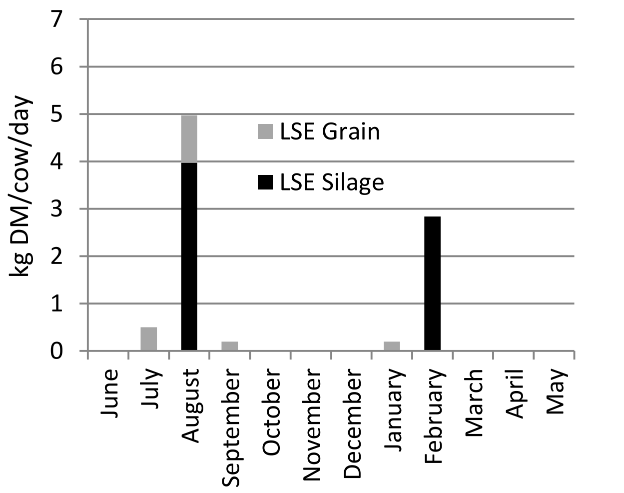
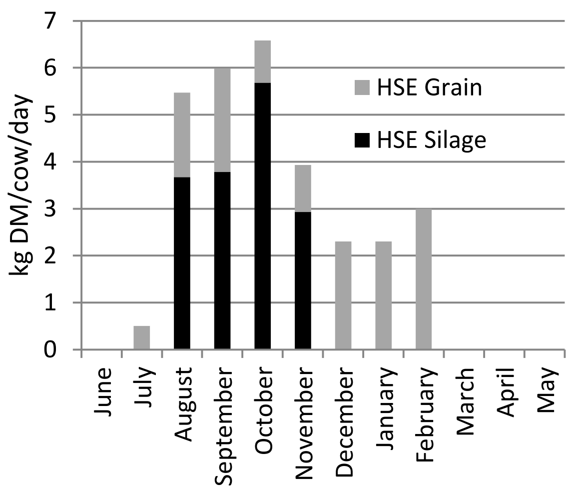
Pasture quality, LSE and HSE 2012/13



- ME in pasture declined about 0.7 units between 9th November and 23rd November in both LSE and HSE
- A decline in ME was also seen in pasture samples from LUDF
- The drop in ME in the P21 farmlets was accompanied by a sharp rise in fibre content
- Pre-graze mowing of the LSE pastures, which started in early December, stopped the fall in pasture quality in this farmlet, but not before ME had dropped to just over 11 MJ/kg DM.
- In retrospect, we probably needed to start pre-graze mowing 2 weeks earlier in LSE

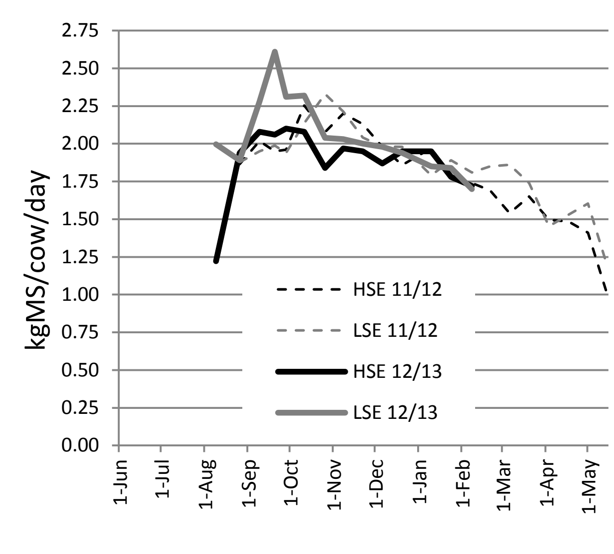
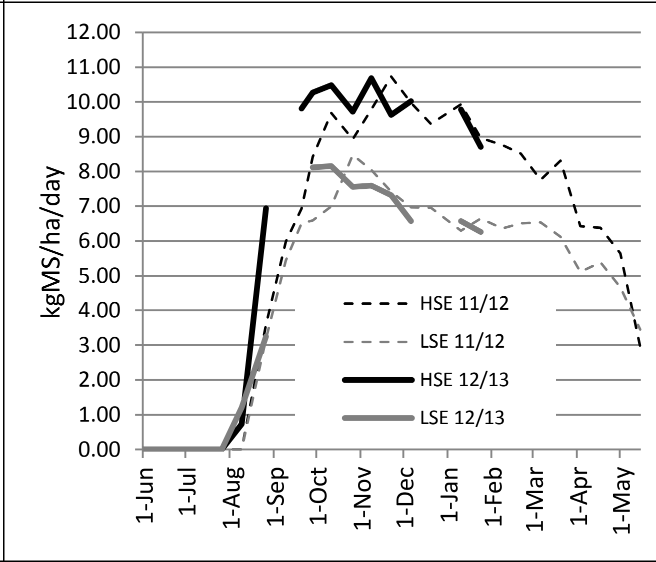
6. Supplementary feeding

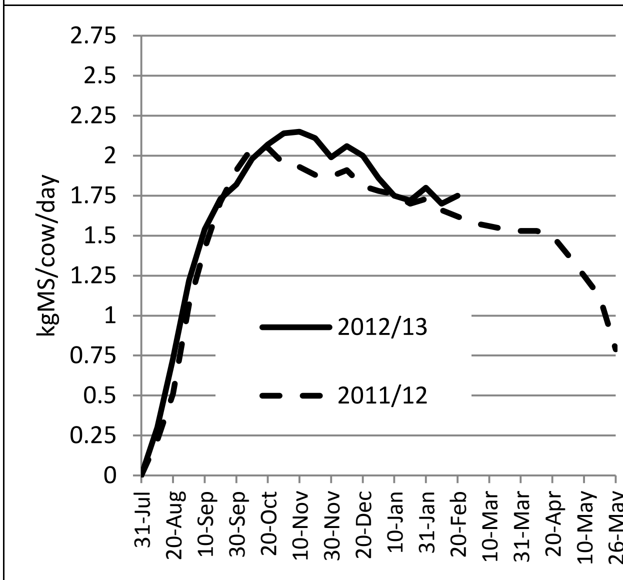
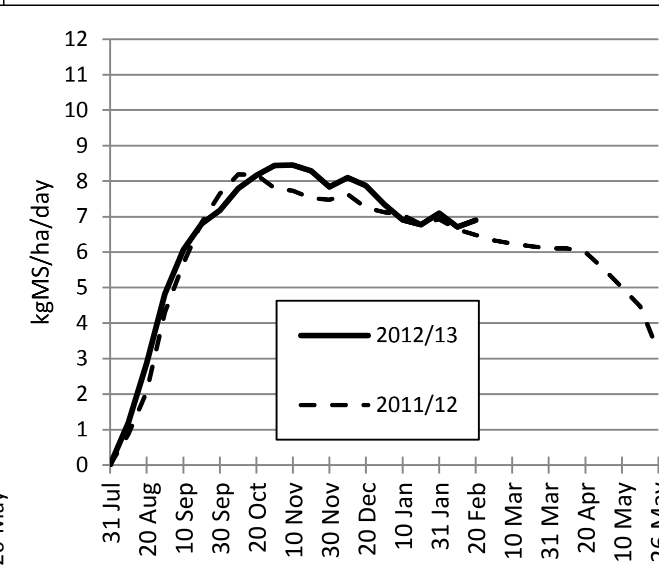
- Supplements fed to-date total 97 kg silage DM/cow and 42 kg grain per cow (total 139 per cow, grain + silage) in LSE; and 219 kg silage DM/cow and 358 kg grain per cow (total 577 per cow, grain + silage) in HSE.
- To-date, LUDF has fed 251 kg silage DM/cow

Supplements fed to-date **LSE 2012/13**	**Supplements fed to-date** **HSE 2012/13**
	

7. Milk production

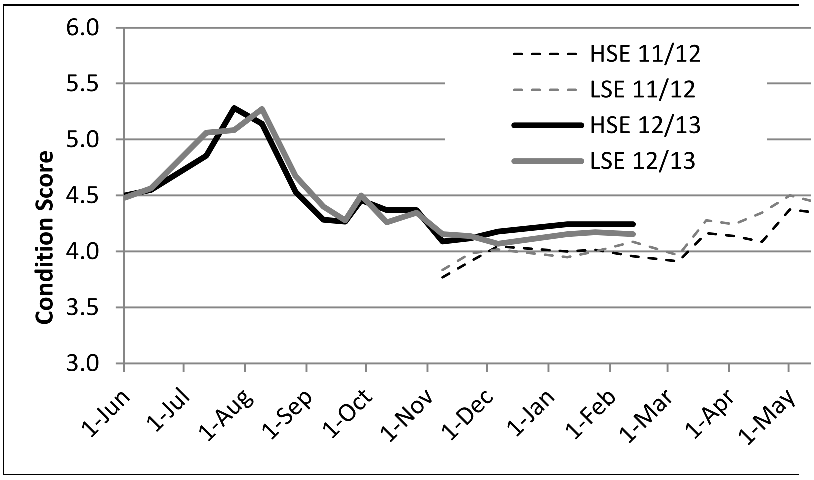
- In 2012/13, cows in the LSE herd produced more milk per head than cows in the HSE herd for the first 1/3rd of lactation
- Milk production per cow has been similar for LSE and HSE in mid lactation
- Milk production per hectare per day in 2012/13 was ahead of production in 2011/12 in both herds in early lactation, but is similar to 2011/12 in mid lactation
- Cumulative milksolids production per cow up to 15th February is 366 kg in LSE and 351 kg in HSE (compared to 349 and 347 in 2011/12)
- Cumulative milksolids production per hectare to 15th February is 1282 kg in LSE and 1753 kg in HSE (compared to 1156 and 1496 in 2011/12)
- Cumulative milksolids production per cow and per hectare to mid-February at LUDF is 331 kg and 1307 kg respectively.

Milksolids production per cow LSE and HSE 2011/12 and 2012/13	Milksolids production per hectare LSE and HSE 2011/12 and 2012/13
	

Milksolids production per cow LUDF 2011/12 and 2012/13	Milksolids production per hectare LUDF 2011/12 and 2012/13
	

8. Body condition score

- Condition score of the LSE and HSE herds has been similar through winter and into mid lactation
- Both herds are in better condition in 2012/13 than at the same stage of the 2011/12 season



9. Production summary

	LSE	HSE	LUDF
Farm Area (ha)	8.25	6.75	160
No. of Cows	29	34	632
BW (actual)	140	133	113
Stocking Rate (cows/ha)	3.5	5	3.95
Production as at 15th February			
Milk Yield	19.5	20.0	18.7
Milksolids (kg/cow/day)	1.61	1.7	1.74
Milk Fat %	4.52	4.84	5.41
Milk Protein %	3.74	3.63	4.24
Body Condition Score	4.2	4.2	4.6
Liveweight (kg)	512	491	488
Growth Rate (kg DM/ha/day) (ave. for week)	66	88	101
Ave. Pasture Cover (kg DM/ha)	2166	2235	2644
Pre Grazing Average (kg DM/ha)	2535	2665	3432
Post Grazing Average (kgDM/ha)	1802	1821	1700
Highest Pre Grazing Cover (kg DM/ha)	2740	2852	3550
Rotation Length (d)	22	21.5	22
Estimated Pasture Intake (kg DM/cow/day)	13	11.8	17.7
Silage Offered (kg DM/cow/day)	2.8	0	0
Grain Offered (kg DM/cow/day)	1.0	3.0	0
Pasture ME	11.1	11.6	11.7
Pasture Protein %	18.5	21	27
Pasture DM %	17	20	15.5
Pasture NDF %	41.5	43.4	42.7
Irrigation and rainfall (mm, for week)	26.6		27.8
Season to-date			
Milksolids (kg/cow)	366	351	331
Milksolids (kg/ha)	1282	1753	1307
Silage Fed (kg DM/cow)	97	219	251
Grain Fed (kg/cow)	42	358	0
Supplement Made (kg DM/ha)	182	0	308
N Applied (kg/ha)	83	254	285

Milksolids production and nitrogen excretion from dairy cows grazing diverse pastures

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Summary

- Diverse pastures containing herbs (chicory and plantain) and legumes (lucerne and red clover) in addition to perennial ryegrass and white clover have been compared with standard perennial rygrass-clover pastures.
- Dry matter production from diverse pastures was comparable to that from perennial ryegrass-white clover pastures under full irrigation; diverse pastures were less affected by temporary restrictions of water supply in summer.
- Milksolids production from cows grazing diverse and perennial ryegrass-white clover pastures was similar when the same herbage allowance was offered.
- The concentration of nitrogen in urine, and the quantity of nitrogen excreted in urine, were lower when grazing diverse pastures.
- Italian type ryegrass were more effective at capturing nitrogen in the soil and reducing nitrate leaching than perennial ryegrass and tall fescue.
- Diverse pastures may be a useful tool for reducing nitrate-N leaching while maintaining or increasing milksolids production.

Background

The production focus of dairy farming has led to a limited range of plants being used; predominantly perennial ryegrass-white clover pastures with some brassicas and maize. There has been a relatively low use of pure swards or mixtures of alternative legumes such as red clover and lucerne, or forage herbs such as chicory and plantain. With concerns around the poor persistence of perennial ryegrass, and growing awareness of the role that plant species may play in reducing the environmental impacts of dairy farming, there has been increased interest in alternative plant species. This article reports on dry matter (DM) production, milksolids production (MS), urinary nitrogen (N) excretion and nitrate-N leaching from diverse pastures containing a mixture of legumes, herbs and grasses compared with standard perennial ryegrass-white clover pastures.

DM production and nutritive value

In studies at the Lincoln University Research Dairy Farm, DM production and botanical composition of pastures has been measured over 2 years for perennial ryegrass-white clover and diverse pastures containing additional clover and herbs (Table 1). All pasture mixtures were irrigated, fertilised with 150 kg N/ha/year and grazed by dairy cows under typical perennial ryegrass-white clover pasture grazing management.

Averaged across 2 years, diverse pastures:

- Had 8% higher annual DM production than perennial ryegrass-white clover pastures (12.9% higher in summer).
- Retained a high proportion of herbs after two years, with chicory and plantain making up approximately 40% of the total herbage in the second year.
- Similar ME to perennial ryegrass-white clover pastures (ME > 11.7 MJ ME/kg DM across all mixtures).
- Extracted water from deeper (0 to 1.5 m) in the soil profile than perennial ryegrass-white clover pastures (0 to 0.85 m) and were less affected by temporary irrigation restrictions in summer; when pasture mixtures were subjected to a treatment of no irrigation for 2.5 months in mid-summer, total annual DM production was reduced by 32% in a standard perennial ryegrass-white clover pasture but only by 20% in a diverse pasture.

Combined, these data highlight that the diverse pastures grew at least to comparable levels as standard perennial ryegrass-white clover pastures, and that they may offer benefits for DM production in dryland pastures or in irrigated situations where temporary water restrictions occur.

Table 1. *Seasonal and annual DM production (t DM/ha) and metabolisable energy content (MJ ME/ kg DM) (in parenthesis) from May 2010 to May 2012 from perennial ryegrass-white clover (high sugar or standard perennial ryegrass) and diverse pastures with chicory, plantain and red clover. Study carried out on a Paparua sandy loam soil on the Lincoln University Research Dairy Farm, Canterbury (Nobilly et al. 2013, PhD thesis). Sowing rates (kg/ha): Ryegrass and high sugar (ryegrass 20, white clover 5); Diverse (ryegrass 10, white clover 2, red clover 4, chicory 2, plantain 1).*

	High sugar	**High sugar diverse**	**Ryegrass**	**Ryegrass diverse**	**Significance**
Perennial ryegrass	High sugar	High sugar	Standard	Standard	
Clover	White	White Red	White	White Red	
Herbs		Chicory Plantain		Chicory Plantain	
Winter	1.4 (12.6)	1.6 (12.5)	2.1(12.3)	1.9 (12.2)	NS
Spring	5.7 (12.3)	6.1 (12.0)	5.4 (12.0)	5.5 (11.7)	NS
Summer	5.9 (12.2)	7.1 (12.0)	6.0 (12.0	6.8 (11.7)	*
Autumn	2.5 (12.5)	2.5 (12.7)	2.5 (12.3)	2.9 (12.4)	NS
Annual	15.5 (12.5)	17.2 (12.3)	16.0 (12.1)	17.1 (12.0)	*

* P value of diversity effect for DM production; no significant effect of diversity for ME

Milk production and nitrogen excretion

The effect of feeding dairy cows pastures mixtures containing additional herbs and legumes has been considered over a series of grazing and indoor studies. In an autumn study (Totty et al. 2013, J. Dairy Sci 2013, 141-149), milksolids production and N excretion in urine were compared for late lactation cows grazing either a standard perennial ryegrass-white clover pasture or a more diverse pasture that also contained chicory and plantain. Diverse pastures had a lower crude protein content than perennial-ryegrass white clover pastures (23.7 vs 26.2% CP), leading to slightly lower N intake from diverse pastures (555 vs 610 g N/cow/day). Milksolids production was similar between diverse and perennial ryegrass white clover pastures (1.47 vs. 1.49 kg MS/cow/day) but the N concentration in urine (3.4 g N/l vs 5.8 g N/l) and estimated total N excretion (354 g N/cow/day vs 426 g N/cow/day) were lower in diverse than perennial ryegrass white clover pastures.

Further studies on Lincoln University Research Dairy Farm, have compared diverse and perennial ryegrass pastures across early, mid and late lactation (Table 2).

Diverse pastures resulted in:

- Similar milksolids production to perennial ryegrass-white clover pastures when the cows were offered the same herbage allowance.
- Lower urinary N concentration in spring and autumn than perennial ryegrass white clover pastures. Averaged across the three trial periods, urinary N concentration was 23% lower from cows grazing the diverse (4 g N/l) compared with the perennial ryegrass-white clover (4.9 g N/l) pastures.

Table 2. *Milksolids production (kg MS/cow/day) and urinary N concentration (g N/l) from perennial ryegrass-white clover (high sugar or standard perennial ryegrass) and diverse pastures with chicory, plantain and red clover.*

	High sugar	**High sugar diverse**	**Ryegrass**	**Ryegrass diverse**	**Significance**
Perennial ryegrass	High sugar	High sugar	Standard	Standard	
Clover	White	White Red	White	White Red	
Herbs		Chicory Plantain		Chicory Plantain	
Milksolids					
Spring	1.80	1.74	1.73	1.72	NS
Summer	1.59	1.51	1.46	1.68	NS
Autumn	1.55	1.43	1.42	1.45	NS
Urine N concentration					
Spring	4.6	3.3	4.2	2.9	**
Summer	4.4	3.1	3.8	4.1	NS
Autumn	6.8	5.3	5.7	5.3	*

* P value of diversity effect

In related indoor work, milk yield and N partitioning to milk, urine and faeces, were compared in dairy cows fed either a perennial ryegrass - white clover pasture or a diverse pasture which also contained chicory, plantain and lucerne (Woodward et al. 2012, Proc of 5th Australian Dairy Science Symposium, 463-464). Diverse pastures resulted in a lower dietary CP content than perennial ryegrass white clover pasture (15.0 vs 18.6% DM) but higher milksolids (1.16 vs 1.03 kg MS/cow/day) and a greater percentage of daily N dietary intake allocated to milk (23 vs. 15%). Urine N concentration was lower in diverse pastures (2.6 vs. 6.9) and because urine volume did not change, the urinary N excretion from cows fed the diverse pasture was half that of cows fed the standard pasture (100 vs. 200g N/cow/day).

As the urinary N concentration and total urine excretion are important factors leading to nitrogen loading in the urine patch, and subsequent nitrate-N leaching, the results demonstrate a role for diverse pastures in reducing nitrogen losses without negative impacts on milk production

Capturing soil nitrate

Plants species may also play a significant role in reducing nitrate leaching by capturing N in the soil before being lost as nitrate in drainage water. A lysimeter study at Lincoln University has compared nitrate leaching losses following urine application from perennial ryegrass-white clover pastures and tall fescue-white clover pastures with those from a diverse pasture containing perennial ryegrass, white clover, red clover, chicory and plantain, and from an Italian ryegrass-white clover pasture (*Malcolm et al. 2013, PhD study; Moir et al. Grass and Forage Sci, 2012*).

Over two years, the study showed:

- Nitrate-N leaching losses beneath Italian ryegrass-white clover pastures were 24-33% less than beneath the diverse and perennial ryegrass-white clover pastures and 50% less than beneath tall fescue pastures. Nitrate-N leaching losses beneath Italian ryegrass-white clover pastures with no DCD applied were similar to those measured with perennial ryegrass-white clover pastures when DCD was applied to reduce nitrate leaching.

- Negative linear relationships between nitrate-N leached and plant N uptake; plants with greater growth during the cool season had greater N uptake and lower N leaching losses. This indicates that reductions in the quantity of N leached are strongly related to the cool season growth activity of the forage (e.g. that exhibited by Italian ryegrass) and that plants such as chicory which have deeper roots but low cool season growth may give less benefit in terms of capturing nitrogen in the soil prior to it being leached in winter drainage.

Management considerations in use of diverse pastures

- Relationships between pasture height and pasture mass may vary between diverse and perennial ryegrass-white clover pastures, leading to over- and under-prediction of available herbage if using rising plate meter of sward height stick. Recalibration of rising plate meter and monitoring of milk production needed to ensure appropriate allocation.
- Chicory, red clover and lucerne are slower to establish than ryegrass, requiring greater thermal time for emergence. Spring to early autumn sowing desirable.
- Some herbicides used for broadleaved weed control (e.g. thistles) also harm chicory and plantain. Chicory and plantain may not be option where thistles are an expected problem or alteratively use non-herbicide control methods (mowing/grubbing).

Future work

Research work on the diverse pastures is ongoing including experiments to help understand the mechanisms (forage composition, rumen physiology) leading to a lower N concentration in urine and less N excretion when cows graze diverse pastures containing herbs, and the quantity of herbs in the diet needed to achieve a reduction in N excretion. As the potential for a higher intake of diverse pastures containing herbs and legumes has been identified, some of the work will address how modification of feed allowance and grazing management of diverse pastures may be used to promote greater daily DM intake. This may well lead to greater animal productvity, so allowing stock numbers to be reduced with subsequent reductions in environmental footprint.

Acknowledgements

This research was funded by MBIE contract DRCX0802 Dairy Systems for Environmental Protection and by New Zealand dairy farmers through DairyNZ Inc.

N excretion and milksolids production from diverse and ryegrass-white clover pastures

	Perennial ryegrass	High sugar	Diverse
CP (%) diet	26.2	26.3	23.7
Milksolids (kg/d)	1.55	1.49	1.47
Milk N excretion (g/d)	104	101	112
Urine N (g N/l)	5.7	5.8	3.4
Urine N excretion (g/d)	438	426	353

Milksolids production (kg MS/cow/day) from perennial ryegrass-white clover and diverse pastures

	High sugar	High sugar diverse	Ryegrass	Ryegrass diverse
Spring	1.80	1.74	1.73	1.72
Summer	1.59	1.51	1.46	1.68
Autumn	1.55	1.43	1.42	1.45

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Urine N concentration (g N/L) from perennial ryegrass-white clover and diverse pastures

	High sugar	High sugar diverse	Ryegrass	Ryegrass diverse
Spring	4.6	3.3	4.2	2.9
Summer	4.4	3.1	3.8	4.1
Autumn	6.8	5.3	5.7	5.3

New Zealand's specialist land-based university

N partitioning in cow from diverse and perennial ryegrass-white clover pastures

	Ryegrass	Diverse
CP (%) diet	18.6	15.0
Milksolids (kg/day)	1.03	1.16
Urine N (g N/L)	6.2	2.6
Urine N excretion (g/day)	200	100
% N in urine/N intake	43	29

Woodward et al. 2012

New Zealand's specialist land-based university

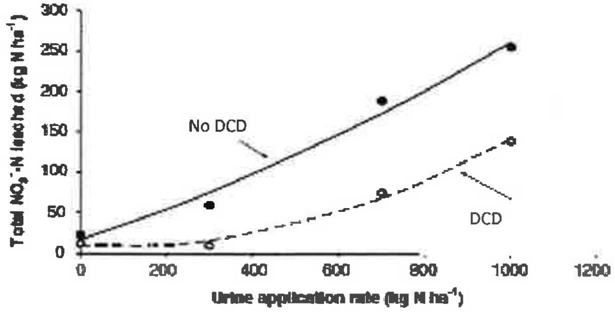
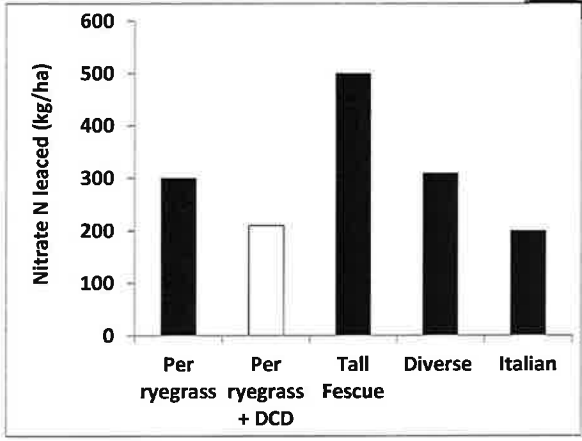


Fig. 3 Relationships between urine application rate and total NO_3^--N leaching loss with and without DCD applied

Nitrate leaching from standard and diverse pastures



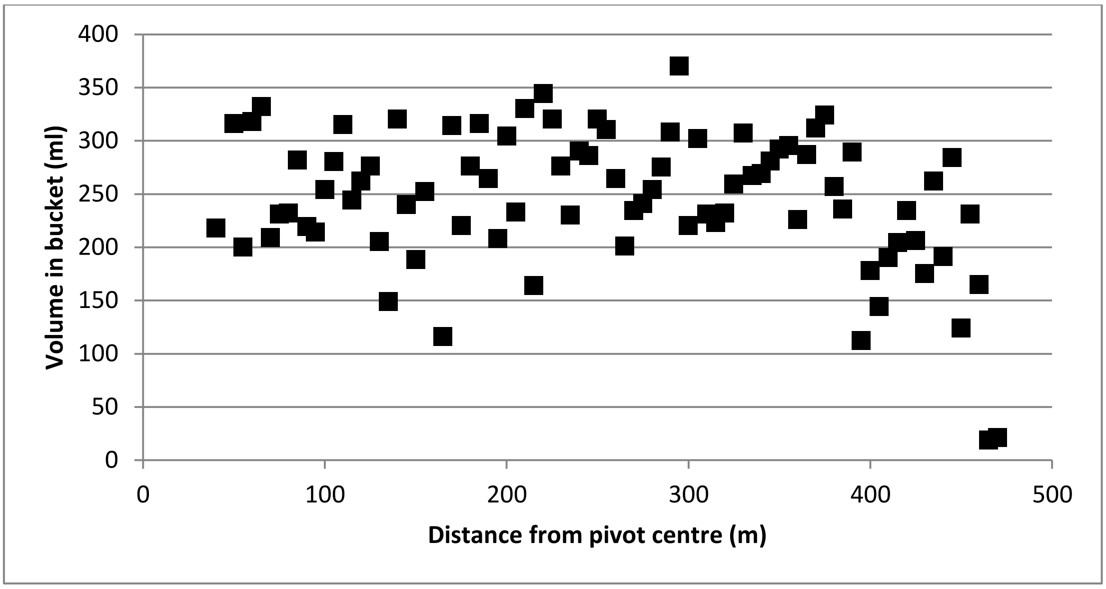
Irrigation uniformity, North block pivot

S Dennis, T Knight, E Cranston (AgResearch), S Lee (DairyNZ)

The water distribution under the North block pivot was measured in December, using 80, 10L buckets at 5m spacings, following the method in the New Zealand Code of Practice for Irrigation Evaluation (Page Bloomer Associates). The volume of water collected in each bucket is presented in

Table 1.

Table 1: North block pivot, volume in each bucket



This data was used to measure irrigation uniformity in two different ways, DU and CU.

- DU refers to the "lower quartile distribution uniformity". A DU of 0.5 means that the poorest quarter of the paddock is only receiving 50% of the water it should be receiving, a DU of 0.75 means the poorest quarter is receiving 75%.
- CU refers to Christensen's uniformity coefficient, which is a more complicated way of doing the same sort of thing.

This pivot has a DU of 0.59, and a CU of 78%. The NZ Code of Practice and Irrigation Design Standards state that a centre pivot should have a DU of 0.76-0.82, and a CU of 85-90%. According to the code of practice, this pivot has a similar uniformity to a good border dyke or travelling gun.

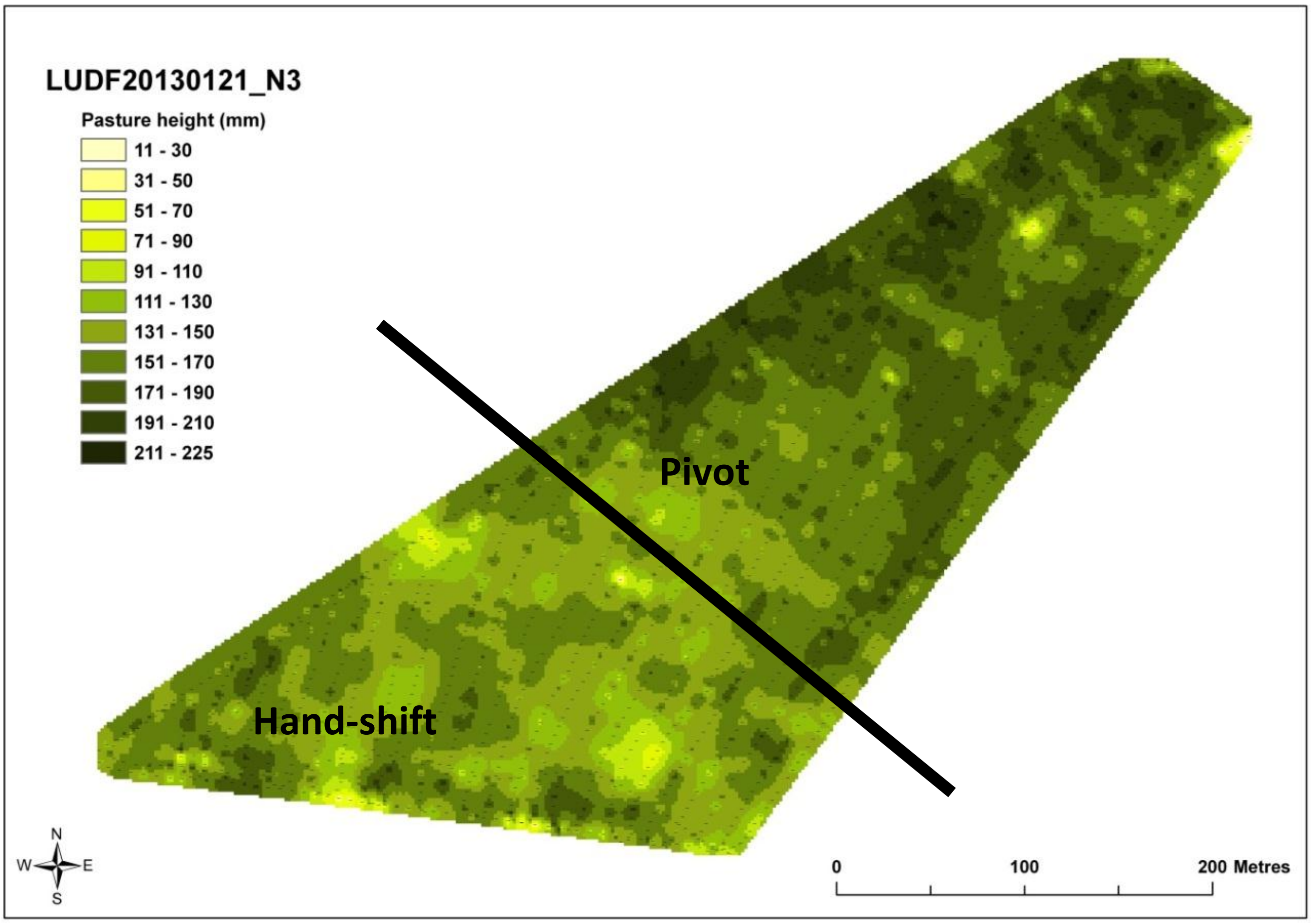
So what needs to be fixed?

There is a large amount of variation in the volume collected in each bucket. However for the majority of the length of the pivot, there is no clear pattern to this variation, one bucket can be low while the one beside it can be high. This makes it difficult to determine how, and if, to fix it. However, the water applied does appear to tail off at the end, under the swing arm and gun.

An inspection of the pivot showed that when the swing arm was fully extended and the end gun operating, 1/3 of the nozzles on the swing arm were not working correctly. The control system for these nozzles (which should operate as the swing arm retracts) is not working properly. The farm has looked at getting this repaired but deferred the work as installation of a VRI system is imminent. Visual observation of the pivot is carried out on a routine basis as part of the farms irrigation process to address items like this.

The swing arm is from around 390m on, and in the graph can be seen to apply considerably less water than the main boom. The main boom when considered alone is performing within the NZ Standards (DU 0.78, CU 86%). Also, the swing arm on its own is not too bad (DU 0.65, CU 80%). It is the difference between the depth applied by the swing arm and the main boom that is the primary cause of the low uniformity for the pivot as a whole. If the swing arm can be brought up to the application depth and uniformity of the main boom, the pivot will perform within the standards.

The importance of a quality irrigation system is illustrated by the pasture yield map below for paddock N3 taken on 21 January (funded by MPI's Sustainable Farming Fund). The pivot centre is to the top right (north-east) of the picture, the pivot ends about half way down the paddock, with the south-west end of the paddock being irrigated using hand-shift sprinklers. Despite the apparently poor performance of the pivot, the pasture height (and therefore mass) is clearly greater under the pivot than the hand-shift sprinklers.



Even an apparently good pivot can have poor uniformity, and this can impact yield particularly in periods of high irrigation demand. We are currently working out what to do about the poor uniformities measured at LUDF.

Project funded by:
Ministry for Primary Industries Manatū Ahu Matua
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DairyNZ Profitability. Sustainability. Competitiveness.

Training for Irrigation Managers

A one day training course for irrigation managers - Improve your irrigation skills and knowledge.

Irrigation NZ has recognised that for training to be successful it has to be achievable. Training modules to fit within industry qualifications or as standalone packages are being made available.
The first step is . . .

The *1-day Irrigation Manager* training programme

The day is a mix of classroom learning and in-the-paddock practical application.

Block 1 *Irrigation Regulation*

What you need to know and how it affects your business. How do the RMA, Consents and Rules fit together?

Block 2 *Irrigation Scheduling*

Builds on your knowledge of soils, water and climate. How should we schedule water application? Some of the tools available to help are explained and demonstrated.

Block 3 *Irrigation Operation and Maintenance*

The safety and efficiency of your equipment and staff depends on regular maintenance and correct procedures being followed. Developing procedures within Farm Plans is explained.

After an 'irrigator walk' you begin building an operations manual specific to your property.

Block 4 Introduction to Irrigator Calibration

Data collected during the 'irrigator walk' is analysed using tools developed to check the performance of irrigators. This is a practical application that you can use immediately on your farm.

Take home resources and support

A full suite of resources is provided to take home for reference and further learning.

NOTE: This training is the first step of a larger programme. Irrigation NZ is working with the Ministry for Primary Industries (MPI) and the Primary Industries Industry Training Organisation (PrITO), to develop and deliver training and qualifications for the management, operation and use of irrigation - a key input into your business.

The training and programme has had wide acceptance and support from industry. Farmers Mutual Group (FMG) has seen the benefits of training and enthusiastically sponsors these courses.

See www.irrigationnz.co.nz for details

Lincoln University Dairy Farm - Farm Walk notes

Tuesday 19th February 2013

CRITICAL ISSUES FOR THE SHORT TERM

1. **Monitor average pasture cover and respond to surplus or deficit.**
2. **Maintain post grazing residuals of 7 - 9 clicks.**
3. **Use back-fences on all herds whenever paddock grazing takes more than 36 hours.**
4. **Continue Mg supplementation via water system.**
5. **Administer bloat oil through dosatron.**

Herd Management

1. 623 cows are milking into the vat. There are now 205 cows in the small herd, 388 in the main herd, and they will be managed separately until the end of the season.
2. There has been 1 new case of mastitis and 22 new cases of lameness, this is a major frustration and we are working hard to resolve this ongoing high incidence.
3. The second/final pregnancy test was 7th February, achieving a 10 week in-calf rate of 87%, the same as last year.

Growing Conditions

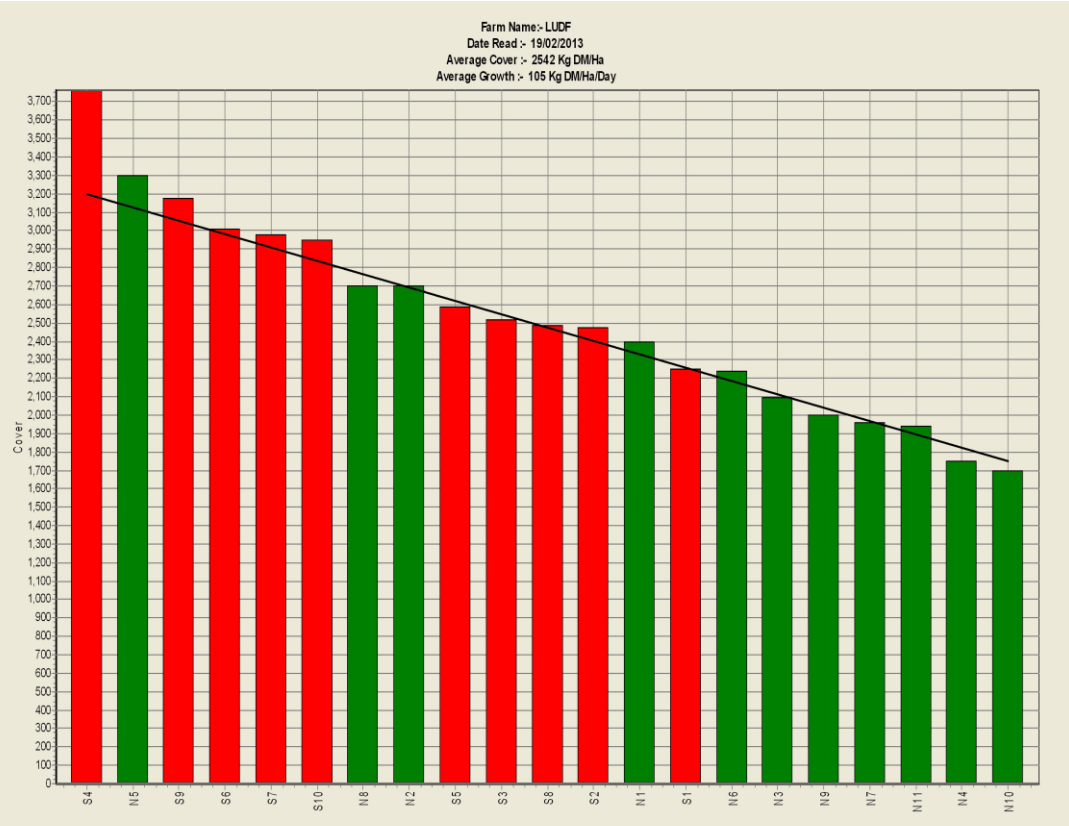
4. Pasture growth has been 105 kg DM/ha day, much the same as last week, and expected to grow a similar amount over the coming week.
5. Soil temperatures at 9 am have averaged 16.7 degrees, last week was 17 degrees.
6. There has been no rain. The Aquaflex soil moisture meters indicate that soil moisture levels are now 20-90% of field capacity, the irrigators have run 5 days on the North block and 5 on the South block. We will continue to irrigate as required to hold soil moisture.

Pasture Production and Management

7. 4 ha were pre- mown this week, ½ of N1. A total of 53 ha was grazed for a 21 day round length, we are happy with this round length and would like to remain at 18 -22 days for the time being. Pasture quality appears to be improving with visibly less seed head and stem, we expect that our pasture samples tomorrow will return ME values above 12. If cows continue to gain weight and have a small decline in production while residuals and round length are in the target zone we will not mow.
8. 56 ha received 30 kg N/ha as urea.
9. The farm has an 8 tonne DM feed surplus, and average cover is 2542 kg DM/ha, down on last week's 2644kgDM/ha). We made one paddock of silage which yielded 9.9T DM, and will continue to monitor pre graze and round length to make sure that the farm stays well balanced for supply and demand. Our current plan is to grow and have the cows eat as much pasture as possible while achieving even consistent residuals to ensure good quality through the remainder of the season.

Feeding Management

10. Cows are currently producing 1.77 kg MS/day and the whole herd gained 3kg liveweight over the week. The ME calculator estimates, based on MS production and weight change, that the cows have eaten 19 kg DM /day of 11.7 MJME pasture, making intake around 222 MJME.
11. The focus is on ensuring that cows are well fed and paddocks grazed to even consistent residuals and that cows meet their BCS targets by drying off [as late as practical]. This week's wedge is printed below.



12. Data sheet

LUDF Weekly Report	29-Jan-13	5-Feb-13	12-Feb-13	19-Feb-13
Farm grazing ha (available to milkers)	160	160	160	160
Dry Cows on farm / East blk / other	0/0/0	0/0/0	0/0/0	0/0/0
Culls (Includes culls put down & empties)	0	0	0	0
Culls total to date	15	15	15	15
Deaths (Includes cows put down)	0	0	0	0
Deaths total to date	10	10	10	10
Calved Cows available (Peak Number 632…)	628	628	628	628
Treatment / Sick mob total	2	2	4	4
Mastitis clinical treatment	2	0	2	1
Mastitis clinical YTD (tgt below 64 year end)	71	71	73	74
Bulk milk SCC (tgt Ave below 150)	113	97	121	120
Lame new cases	5	2	13	22
Lame year-to-date	179	181	194	216
Lame days YTD (Tgt below 1000 year end)	2947	3052	3206	3416
Other/Colostrum	2/0	2/0	3/0	2/0
Milking twice a day into vat	607	607	599	593
Milking once a day into vat	17	17	23	30
Small herd	211	211	209	205
Main Herd	396	396	390	388
MS/cow/day (Actual kg / Cows into vat only)	1.84	1.79	1.69	1.77
MS/cow to date (total kgs / Peak Cows 632	307	319	331	343
LUDF Weekly Report continued ..	29-Jan-13	5-Feb-13	12-Feb-13	19-Feb-13

MS/ha/day (total kgs / ha used	7.16	6.97	6.59	6.87
Herd Average Cond'n Score	0.00	4.60	0.00	4.50
Monitor grp LW kg WOW 157 early MA calvers	484	484	483	486
Soil Temp Ave Aquaflex	17.0	18.4	17.0	16.7
Growth Rate (kgDM/ha/day)	93	103	101	105
Plate meter height - ave half-cms	14.9	15.0	15.3	14.6
Ave Pasture Cover (x140 + 500)	2585	2596	2644	2542
Surplus/[deficit] on feed wedge - tonnes	17	19	27	8
Pre Grazing cover (ave for week)	3346	3459	3432	3571
Post Grazing cover (ave for week)	1750	1700	1700	1650
Highest pre-grazing cover	3800	3578	3550	3700
Area grazed / day (ave for week)	8.48	8.68	7.20	7.57
Grazing Interval	19	18	22	21
Milkers Offered/grazed kg DM pasture	20.3	19.2	17.7	20.2
Estimated intake pasture MJME	230	225	209	234
Milkers offered kg DM Grass silage	0	0	0	0
Silage MJME/cow offered	0	0	0	0
Estimated intake Silage MJME	0	0	0	0
Estimated total intake MJME	230	225	209	234
Tgt total MJME Offered/eaten (incls 6% waste)	230	0	0	0
Pasture ME (pre grazing sample)	11.8	11.7	0.0	11.6
Pasture % Protein	26.6	27.1	0.0	23.8
Pasture % DM - Concern below 16%	15.7	15.5	0.0	14.2
Pasture % NDF Concern < 33	38.9	42.7	0.0	41.0
Mowed pre or post grazing YTD	624.8	675.9	707.7	711.7
Total area mowed YTD	654.9	706.0	737.8	749.6
Supplements fed to date kg per cow (632 peak)	251.2	251.2	251.2	251.2
Supplements Made Kg DM / ha cumulative	307.8	307.8	307.8	368.17
Units N applied/ha and % of farm	40units/38%	35units/42%	35units/30%	35units/35%
Kgs N to Date (whole farm)	262	276	285	296
Rainfall (mm)	0.2	15	3.8	0
Aquaflex topsoil relative to fill point tgt 60 - 80%	20-50	30-100	20-90	20-90

The facts around suspension of eco-n

What's the background?

Ravensdown introduced eco-n for dairy farmers in February 2004. Developed in conjunction with Lincoln University, it reduces nitrate leaching from urine patches, lowers emissions of the greenhouse gas, nitrous oxide and increases pasture production. Eco-n contains the nitrification inhibitor dicyandiamide (DCD). DCD's effectiveness has been confirmed in three years of national trials which started in 2009 supported by Ministry for Primary Industries (MPI), Fonterra, DairyNZ and the fertiliser industry.

On Thursday 24 January 2013 Ravensdown announced that eco-n sales were suspended due to the detection in New Zealand of minute traces of DCD in milk products, and to protect and strengthen NZ's excellent international reputation as a food exporter. The last eco-n applications were in September.

Why were sales of all DCD products voluntarily suspended?

- DCD is safe (10 times safer than salt [#]). MPI Director General, Wayne McNee said that based on the highest of the levels detected in some milk powder, a 60kg person would have to drink 130 litres of liquid milk per day to reach the European commission's limit for an acceptable daily intake and considerably more to have any health effects.
- Because DCD contains nitrogen, it has the potential to be seen as a possible milk protein adulterant.
- Last year, the US Food and Drug Administration added DCD to its lists of compounds to scan for with its increasingly sophisticated scanning equipment.
- In early December 2012, we were told that Fonterra had detected occasional presence of minor traces of DCD in milk powder (at decimal points of parts per million) around the time of applications.
- Fonterra and MPI confirmed there are no food safety issues, not just because of the minute levels detected, but also because DCD is such a safe compound.
- However, there is no international standard for DCD residues in food because DCD has not been considered to be a risk to food safety and has been around for over 30 years and therefore has not been included in the World Health Organisation's Codex list.
- This created a technical problem, because with no codex standard, some countries NZ exports to would default to a standard of zero detection.
- This meant that any detection of DCD had the potential to become a trade risk and damage NZ's exceptionally good reputation as a food producer.
- After looking at all the options, there was no way anyone could guarantee zero detection in milk for the coming season, so Ravensdown voluntarily suspended sales of eco-n.
- Because DCD is a totally biodegradable compound and does not accumulate in the soil, MPI confirms the chance of any further detection is minimal.

What will Ravensdown do now?

- Act with transparency and integrity as a long term participant in the NZ agricultural sector.
- Continue to invest in science and evidence-based innovation and look at ways to mitigate any trade risk from DCD.
- Partner with others in the industry, specifically contributing on the MPI's Technical Working Group, seeking an internationally agreed food standard for DCD.
- Using its technical knowledge, the co-operative will push hard for DCD's return for the benefit of farmers facing pressure to reduce nitrate leaching.
- Continue offering services such as whole farm testing, nutrient management planning and precise fertiliser application to help lower environmental footprint whilst lifting production.

Any questions - contact your Account Manager or call 0800 100 123 to speak to one of the eco-n team.

 # For LD50's refer to OECD SIDS – cyanoguanidine 461-58-5 (2004), and MSDS for Sodium Chloride 7647-14-5.