Northland Research Project Investment Performance

A report prepared for:
Northland Dairy Development Trust, Northland Agricultural Research Farm and DairyNZ

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Nimmo-Bell & Company Ltd

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This report has been prepared by Nimmo-Bell Director Dr Brian Bell

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1 Introduction

This report prepared by Nimmo-Bell & Company Ltd (Nimmo-Bell) is an analysis of the investment performance of six selected projects facilitated by the Northland Dairy Development Trust (NDDT) and Northland Agricultural Research Farm (NARF) between the years of 1998 and 2015. Four of the projects took place at NARF Dargaville, the other two at the Fonterra owned farm at Jordon Valley Hikurangi. The analysis is designed to provide information to NDDT, the NARF and Dairy NZ for use in communicating the benefits achieved on investments in industry good science and research programmes for Northland dairy farmers. It did not look at the potentially significant impact of the research on the wider Dairying Industry.

2 Background

From its inception in 2007 NDDT has set about to facilitate the vision and strategy for dairy farm science and research in Northland. An autonomous body the NARF relies on funding and support from NDDT for its on-farm dairy science and research programmes. Prior to 2007 the NARF funded research from its own resources and determined its own research programmes. The desire to broaden science and research in the Northland region and the increasing burden on volunteer committee member's time and expertise in administering and managing research on the NARF farm were key factors which led to the setting up of NDDT.

3 Objectives

The key objectives of the analysis are:

i. To demonstrate the value proposition of NDDT and NARF to current and potential funders, and sponsors, Northland dairy farmers and the Dairy industry.
ii. To provide tangible examples of how dairy farmers have actually benefited from the research completed over the period 1998 to 2015.
iii. To provide key communication messages for the NDDT, NARF and DairyNZ to assist in the future funding of dairy farm science and research in Northland.
iv. To assist in securing the long term viability of NDDT and NARF.

4 Methodology

4.1 Projects for analysis

NDDT and NARF provided the information for analysis of the six selected research projects undertaken and completed over the period 1998 (the start of the earliest project to be analysed) to 2015. These projects are shown in Table 1.

Table 1. Selected projects with dates undertaken

Split calving	1998-2000
Endophytes	2001-2005
Mastitis	2006
Nitrogen	2008
Kikuyu	2010-2016
Standoff pads	2011

We use the analysis of these projects to demonstrate actual returns from the overall programmes. Given the selection is not random we are not able to make assertions about the actual returns from the total research spend however the difference between the sum of benefits from the six projects and the total cost of all programmes does indicate the lower band of total net benefits.

4.2 Analysis

Our approach to the evaluation of individual projects is consistent with that used in previous analyses undertaken by Nimmo-Bell of DairyNZ research programmes. We provide a standard analysis across projects, and ensure that an objective and independent approach is adopted. Using a consistent approach across a range of projects allows comparison to be made of the results between projects and from one year to the next.

4.2.1 Cost Benefit Analysis

We utilise standard investment analysis that is consistent with The Treasury's Cost Benefit Analysis guidelines (The Treasury 2015)[1]. Results for individual projects will include expected Net Present Value (NPV) and benefit to cost ratio.

Cashflows have been generated based on information provided by NDDT and NARF plus face to face and phone interviews with a range of informed and independent people. As a proportion of benefits is likely to occur in the future we extend the analysis to 2030 and cut off the cashflows at this point. All cashflows are couched in 2015 money values, which means indexing past values into today's dollars. NPVs are provided by discounting the future cashflows at 8%. This is Treasury expected rate of return on research projects in the public sector.

In addition, for each project analysed we provide an estimate of the pre-tax net return per hectare per annum for farmers in the region. This is derived by taking the project NPV, converting this to an annuity and dividing by the total number of hectares expected to benefit.

4.2.2 Project specific analysis

The project specific analysis involved review of file material and project reports, interviews with the project manager and other key people. Rural professionals and farmers have been interviewed to cross check information. Actual costs and benefits for the period 1998 to 2015 are quantified and assessed with estimates for future benefits to 2030. A summary of findings is provided with quantitative and qualitative analysis. This summary contains the key communication messages.

We have relied on the following information made available by NDDT and NARF:

1. NARF Financial statements for all years 1999 (the earliest records available) to 2015
2. NDDT financial statements 2007 to 2015
3. Project reports for the six projects covering:
    a. Objectives
    b. Method
    c. Breakdown of costs on an annual basis
    d. Research outcomes
    e. Actual and expected uptake of the research
    f. Communications strategies including
        i. Field day attendances
        ii. Survey results
        iii. Media reports
        iv. Web site hits.

[1] The Treasury 2015. Guide to Social Cost Benefit Analysis, July 2015. http://www.treasury.govt.nz/publications/guidance/planning/costbenefitanalysis/guide/cba-guide-jul15.pdf

4.2.3 Project Profiles

Profiles of the six selected projects follow the main report. Each profile is set out under the following sub-heads (see Table 2).

Table 2. Project Profile Sub-headings

Project name
Objectives
Funding
Description
Research outcomes
Evaluation methodology
Benefits of research
    Quantitative
    Non-quantitative
Links to other projects
Net Benefit to farmers
    Main drivers
    Costs
    Direct benefit
    Indirect benefit
Net Present Value (8% discount rate)
Benefit Cost Ratio
Return $/ha/yr Direct
    Indirect
    Region
Conclusion

5 Research Funding

The total income on the NARF has over the period of the review been dominated by the ups and down of annual payout for milk solids (MS). Expenditure has also risen with less year to year variation. Net research funding identified in the annual accounts makes up only a small proportion of the budget and has been generally positive with only one period of negative net funding over the period 2005-2007 (see Figure 1).

Figure 1. NARF Farm Income, Expenditure and Net Research Funding

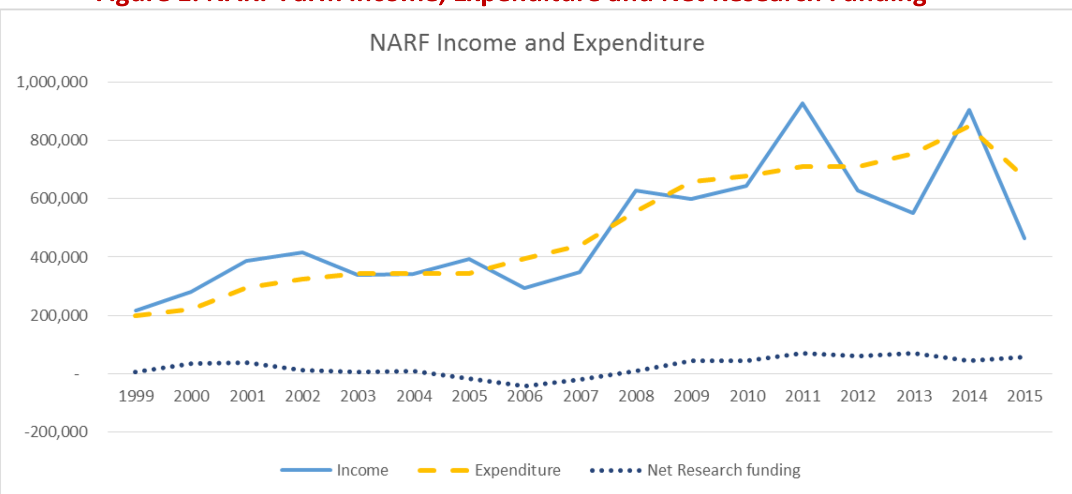
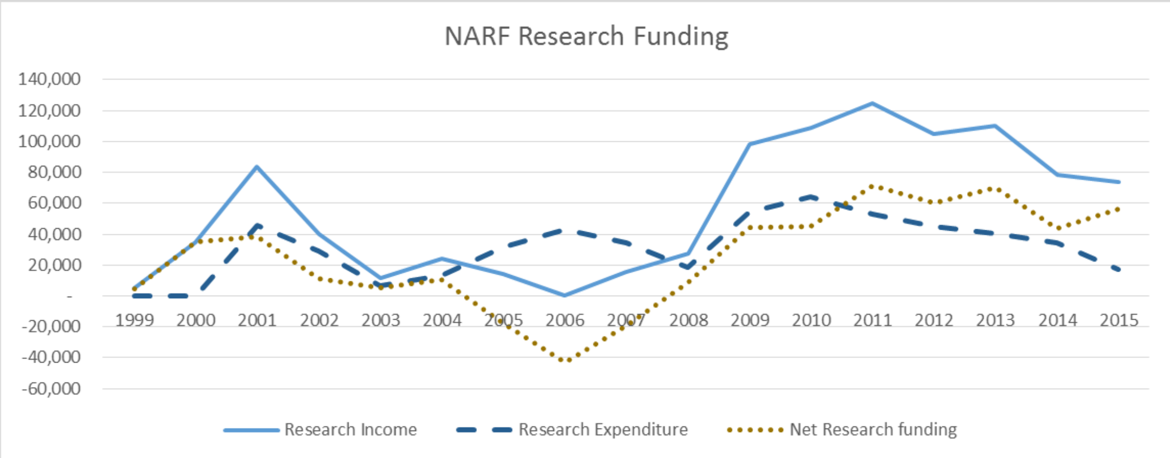


Figure 2 shows research funding in more detail separating out research income and expenditure. The period of negative net research funding (2005 to 2007) coincided with high research expenditure and low research income. As the time and effort required to obtain funding increased volunteers found it too onerous and this led to the establishment of NDDT. With the formation of NDDT the NARF began payment an annual contribution to NDDT amounting to $30,000, which has been maintained at that level in five of the last ten years, decreasing when the farm showed a net deficit on overall operations.

Figure 2. NARF Research Funding



In discussions with NARF it has been pointed out that the expenditure on research identified in the accounts has not been a true indication of the cost to provide, develop, maintain and ensure compliance, the additional staff requirement for providing these facilities and hosting the trials, however this has occurred under NDDT involvement with a substantial increase in expenditure from 2009 as shown in the NDDT accounts (see Figure 3).

It should be noted that substantial development of the dairy infrastructure on the farm took place in 2008 and 2009, which raised interest payments from $71,606 in 2007 to a maximum of $169,616 in 2009 and then falling to $103,888 by 2014. Much of this would be necessary for the running of a high profit dairy unit and the only assets that would be research items were an extra vat and a meeting room, both relatively small items.

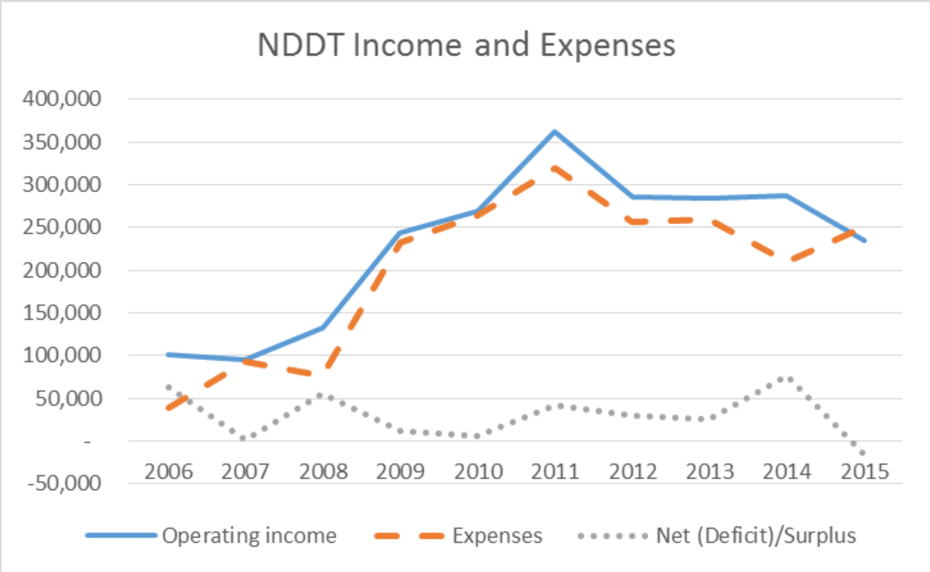
NDDT came into being when it became apparent that the management of the Northland agricultural research programme was getting beyond the resources of the NARF. The NDDT's annual income has exceeded expenses in all but the 2015 year (see Figure 3).

The research expenditure identified in the accounts does not count the untold hours of volunteers, which has been absolutely critical to the success of the programmes. No attempt has been made to quantify this input in dollar terms.

In future it would be helpful if the income and expenses related to the research aspect of the farm could be separated out under separate sub-heads. It would mean extending the chart of accounts to itemise research more clearly

The above analysis shows that NARF and NDDT management have been able to maintain the research programme within available resources in most years. The current period is particularly challenging and hence the need to demonstrate that the programme returns justify the investment needed to continue the research programme. The analysis below addresses this question.

Figure 3. NDDT annual income and expenses



6 Results of analysis

Based on the total costs of research expenditure on NARF ($604,000) in 2015 dollar terms over the period 1999 to 2015 plus the total costs of NDDT ($2.1 million) over the period 2007 to 2015 the net benefit to the region from increased productivity ($319.3 million) is a NPV of $315.1 million. The estimated NB/C ratio is 76:1 and net return per hectare per year $162. The key results by project are summarised in Table 3. The analysis for individual projects is set out in detail in the project profiles.

Table 3: Results

Season ending	PV 8% discount rate
Trial costs	
Split calving	326,018
Endophytes	441,129
Mastitis	116,500
Nitrogen	23,932
Kikuyu	612,475
Standoff pads	49,674
Total	1,569,728
On-farm net benefits	
Split calving	163,498,467
Endophytes	9,279,665
Mastitis	-
Nitrogen	-
Kikuyu	141,490,152
Standoff pads	5,059,156
Total	319,327,441
Total Research costs (2015$)	
Trial costs	1,569,728
NARF	603,573
NDDT	2,110,878
Total	4,205,475
NPV	315,121,965
NB/C ratio	76
Annual Net Return $/ha	162

7 Discussion

During the period of the review there has been a major consolidation of dairying in the region. The number of herds in Northland (including Rodney) has declined by 40% (see Figure 5) while the total area in dairy has declined by 14% and cow numbers down by 4% (see figure 4). Total milk production has soared, up 29% (80.9 m kg in 1999 to 104.2 m kg 2015), making significant productivity gains in the region with a compound average growth rate of +1.6% pa in MS/ha over 16 years (see Figure 6).

Figure 4. Macro Regional statistics

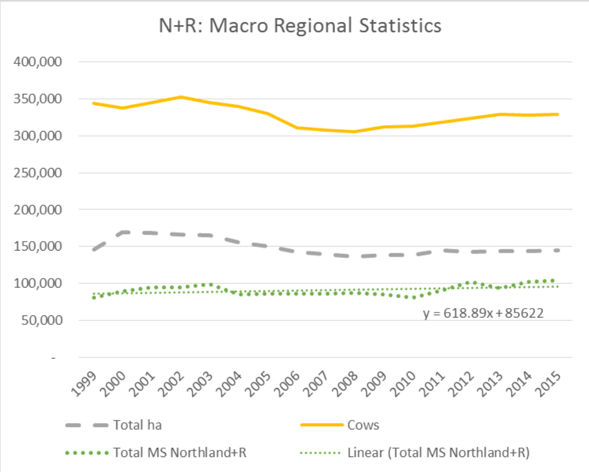


Figure 5. Micro Regional Statistics

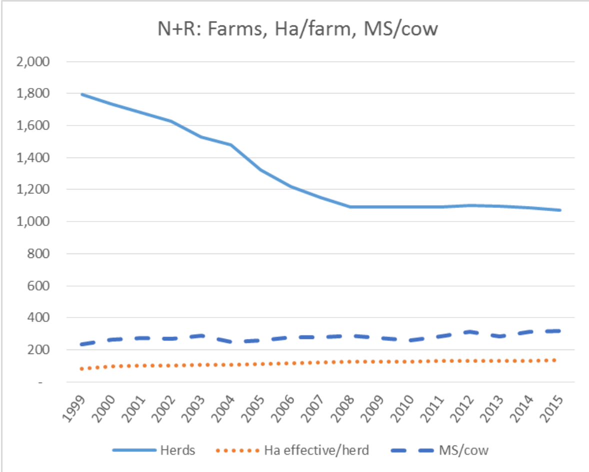
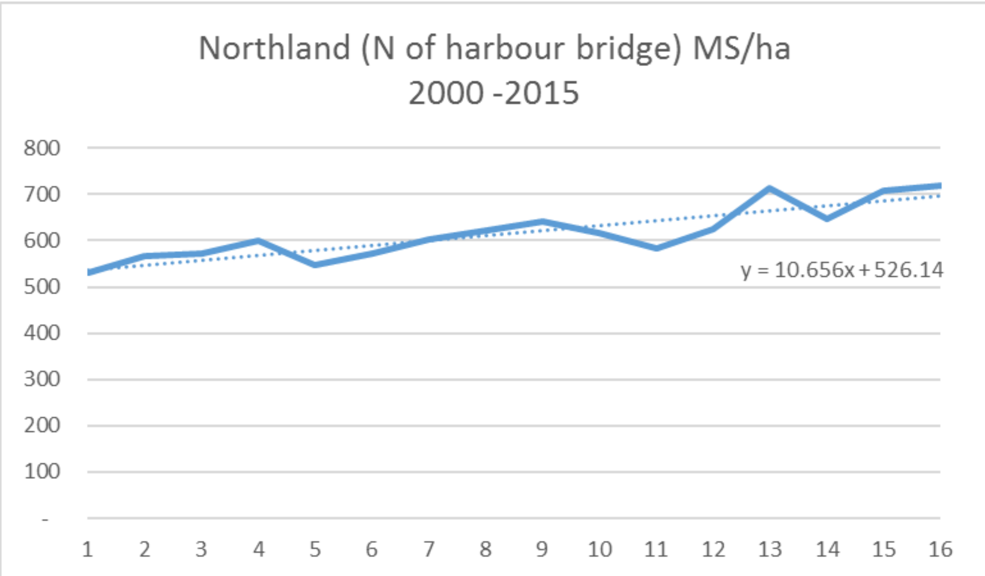


Figure 6. Northland: change in MS/ha 2000 - 2015



Based on the analysis conducted here a significant contribution to these productivity gains has come about through the adoption of technology and management practice demonstrated on the region's research farms and in particular the NARF. Without these gains the milk flow in Northland would have been static or fallen.

The trials that have contributed most to these gains are split calving and kikuyu contributing 51% and 44% of the benefit respectively. Gains from the endophyte trial at 2% of the benefit reflect the assumption that gains are due to a halving of the adoption rate from 10 years to five. The relatively small contribution from the standoff pad trial stems from the assumptions that only 5% of herds in the region will benefit and of those 50% of the cows per herd. We found no quantifiable benefits from the mastitis and nitrogen trials. The mastitis trial confirmed other trial results and the nitrogen trial showed, in the situation the trial was carried out, there was no benefit from SustaiN compared to urea.

8 Conclusions

It is not surprising that there is a wide variation in the return on investment from the six trials that have been analysed. This is the nature of research.

It is notable that the two trials with the majority of the contribution to estimated return (split calving and kikuyu) one started at the beginning of the period under review while the other is one of the more recent to commence.

The major part of the benefits from the kikuyu trial are yet to be realised in Northland. In addition, there will be spin-off benefits (not quantified here) to farmers south of the Harbour Bridge as kikuyu creeps down the North Island.

The main conclusion that can be drawn from this analysis is that overall returns from investment undertaken on NARF and latterly managed by the NDDT are excellent.

9 Appendices: Project Profiles

9.1 Split calving

Project name: Split calving

Comparing 100% autumn calving to 100% spring calving.

Objectives

Compare the physical and economic performance of each system
To measure the production and profitability of each system
To measure the economic return (economic farm surplus) from the winter premium of the time
To determine the breakeven point, with spring calving, of the winter premium

Funding

Northland Dairy Company provided two staff equivalents, one at one day per fortnight (24/240) and one at one day per week (48/240) at $150,000 per person year including overheads, equals $45,000 per year for three years.

Added to this was an extra $15,000 for on-farm labour and $16,000 increase in farm working expenses per year of the trail.

Total cost $228,000 in 1998$.

Description

Project Management: Kerry Chestnut and John Bryant
Farm Manager, Mark Tiller
Location: NARF
Trial Dates: April 1997 - 2000

In 1992/93 there were 25 town supply Autumn calving farms in Northland. Interest in autumn calving was increasing promoted by the Northland Dairy Company with 68 farms by 1994 and 450 by 1997.

From March 1993 to 1997 the NARF operated as a commercial split calving unit, calving 40% of the herd in the autumn and 60% in the spring.

With three years data on split calving the committee decided to investigate the concept of total autumn calving in a system trial with spring calving in a common environment to provide more information on production and profitability for the two systems. The 64 ha farm was split into two 32 ha farmlets, equal in soil types, fertility and pasture species.

Each farmlet was managed to optimise its performance, production and profitability with 2.47 cows per ha for autumn caving and 3.1 for spring and monitoring of all physical and financial information.

Research outcomes

The trial showed that the premium for May to July needed to be 90 cents/kg milksolids for autumn calving to be as profitable as spring calving.

Overall pasture utilisation was 10–15% lower for autumn calving than spring calving.

NARF with clay soils and being a very wet winter farm, was a real test for the autumn calving system.

The economic farm surplus (EFS) for split calving farms was found to be $188/ha higher than spring calving farms (Tafadzwa Manjala) with:

- $90/ha advantage to split at same MS/ha at a premium of $1.65/ kg MS
- Stock sales $348 autumn, $270 spring
- 68 kg MS/ha advantage to split
- Days in milk advantage to split (310 vs 270).
- Shortfalls of split calving – higher animal health costs (breeding and lameness).

Not all farms were found to be suitable for split calving. The attributes required for a farm to be suitable were:

- Good management of mating
- High feed utilisation in winter
- Good races
- Access to cheap supplements/off-farm grazing
- Permanent feed pad and machinery
- Good management
- On/off grazing
- High winter pasture growth relative to summer growth.

Evaluation methodology

Review NARF records; interview NARF committee, project managers, independent farmers and rural professionals.

Construct cashflows from regional LIC data and specific project data based on the outcomes of the research extrapolated to farmers adopting split calving and those who remain with the traditional spring calving.

Professional judgement applied to subjective estimates of adoption and returns.

Benefits of research

Quantitative

The estimated direct benefits of the trial were an additional 400 farms converting to split calving over five years, holding for three years then declining to 260 farms over the following five years. At 136 ha per farm and an increase in EFS of $188/ha, this equals $6.6 million per annum.

Before the trial at the peak in 2000–2003 one million litres per day were produced in the winter up from 30,000. This dropped off to 650,000 to 700,000 litres per day due to farm attrition with a higher payout. The increase from $4-5/kg MS to $6-8/kg MS from the 2008 season had the effect of reducing the premium as a percentage of total payout.

Every other dairy farmer in Northland benefitted indirectly by 3.5% increase in revenue from autumn calvers due to the benefits to dairy processing of flattening out the yield curve and improvements in management that have been translated to spring calving from the winter calving experience.

Without the trail uptake would have been very low. Farmers saw it worked on a winter wet clay farm, however Northland Dairy Company was already promoting winter milk

The dairy company used the results to set the winter milk premium.

Non-quantitative

Winter pasture management improved by changing from two dry cows to one cow in milk. It was a revelation to farmers how much easier it was over winter by taking one cow away. The reduction in pasture damage over winter was remarkable. With split calving 100% of the farm came out of winter in good condition, while with spring calving one third of the pasture on the farm was damaged to the point that 4-5 weeks of growth was lost.

Milk production in the shoulder season went up and the peak stayed the same, raising and flattening the regional milk profile. Farm management skills went up by a quantum amount. An evening out of cashflow to pay the bills and employ labour all year round with upskilling in management acted as a springboard to growing the business

Those who dropped out tended to be smaller units with no extra labour and poorer races and other infrastructure.

Links to other projects

One to two bus loads of Waikato farmers came up to see how split calving worked and Kerry Chestnut went down to the Waikato and gave a seminar. This had a ripple effect on uptake south of Auckland with 50% of winter milk conversions attributed to the NARF trial. While Northland had more winter growth than Waikato, the latter had more autumn growth with a 10-20% increase gained in both situations.

There are significant benefits of this trail for dairy farmers south of Auckland that have not been quantified.

Net Benefit to farmers

Main drivers

Costs

The total costs of the trial were $228,000 in nominal terms, which converts to $326,000 in 2015$ (see Table 1).

Table 1. Split calving trial costs

Season ending		Total	PV	1998	1999	2000
				1	2	3
Cost estimates						
Funding		135,000	135,000	45,000	45,000	45,000
Additional on-farm wages		45,000	45,000	15,000	15,000	15,000
Additional Farm W Exp		48,000	48,000	16,000	16,000	16,000
Total costs		228,000	228,000	76,000	76,000	76,000
Total cost 2015$		326,018	326,018	109,111	109,542	107,365

Direct benefit:

Number of farms converting to winter milk due to the trial peaks at 400 over 2000-2003 with a lead-in and a fall off to 260 by 2008, profile as in Table 2.

Table 2. Assumed winter milk conversion profile

Season ending	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
	2	3	4	5	6	7	8	9	10	11
Farms - direct	100	200	400	400	400	370	340	310	275	260

EFS advantage to winter milk $188/ha in 2000$

Attribution to the trial 100%, with any additional conversions due to promotion by Northland Dairy Company including the winter milk premium not included in the analysis.

Indirect benefit

All dairy farms in Northland benefited indirectly by +3.5% change in EFS.

Net Present Value (8% discount rate)		$163.2 million
Benefit Cost Ratio		502:1
Return $/ha/yr	Direct	$344
	Region	$115
	Indirect	$27

Conclusion

This project has a NPV of $163.2 million (at a discount rate of 8%) and a benefit/cost ratio of 502:1.

Based on 260 farmers adopting and retaining split calving the benefit is a net $329/ha/yr over the 20 year projection of cashflows. The indirect benefit to other farmers through a flattening of the yield curve and improve spring management is estimated at $35/ha/yr and projected over the entire region of Northland including Rodney the benefit is $115/ha/yr.

All three criteria show high returns on investment. The trial was very successful in raising productivity and incomes in the region with a positive non-quantified impact to the south in Waikato as well.

9.2 Endophytes

Project name: NARF Endophyte Project

Objectives

To measure the effects of pasture toxins on milk production, cow health, pasture composition and persistence

Funding

Over the five years of the trail from 2000/01 to 2004/05 total funding amounted to an estimated $341,260 with a diverse group of nine sponsors (see Table 1).

Table 1. Funding

Source	2000/01	2001/02	2002/03	2003/04	2004/05	Total
KDCN	15,000					15,000
Fonterra		15,000	15,000	15,000	15,000	60,000
Monsanto	3,500					3,500
Agricom/Agriseeds	5,760					5,760
Dairy Vets	1,000					1,000
Ellett Ag Res Trust		10,000				10,000
SFF			45,000	45,000	55,000	145,000
NARF			20,000	20,000	20,000	60,000
Balance Fert.	5,500	5,500	10,000	10,000	10,000	41,000
Total	**30,760**	**30,500**	**90,000**	**90,000**	**100,000**	**341,260**

Source: Gavin Ussher FRST final report NDFP9901 2002, Kathryn De Bruin SFF Grant application 2002/03

The 2002/03 to 2004/05 funding estimates come from a proposal to the SFF. As there is no record of actual expenditure we use these figures as the cost of the trial.

Description

Project Management: Farm Managers Malcolm and Kylie Welsh, Farm Consultant Colin Page, NARF Trust Chair Mark Croucher
Location: NARF
Dates: 2000/01 – 2003/04

Three farmlets were established each with split calving herds consisting of 40% autumn calving cows and 60% calving in the spring.

The control herd on 31 ha grazes the existing pasture mix of 45% kikuyu and 55% ryegrass/poa/clover mix.

AR1 Herd on 15 ha of new pasture that has maintained levels of Peramine (which gives ryegrass tolerance to Argentine stem weevil) low levels of Ergovaline (a toxin that increases body temperature with decreased feed intake and possibly lower milk production, but also acts as a feeding deterrent on Black Beetle) and Lolitrem B (which causes grass staggers, but gives established pastures protection against ASW).

Wild high endophyte herd grazing 15 ha of new pasture that has high levels of endophyte.

Research outputs and outcomes

Oct0-May1	AR1 produces 35kg MS more than the S Endo herd
Oct1-May2	AR1 produces 30kg MS more than the S Endo herd
Jun2-Sep2	AR1 produces 15kg MS less than the S Endo herd
Oct2-May3	AR1 produces 70kg MS more than the S Endo herd
Oct3-Feb4	AR1 produces 33kg MS more than the S Endo herd

Over the first two years of the trial the milk production response from AR1 pastures has been 10-15% higher in the autumn translating into a 5% milk production advantage over the whole season. Over the last two seasons the amount of kikuyu on the NARF farm increased and in the 2001/02 season production from the control farmlet was intermediate between the high and novel endophyte herds. This suggested that as kikuyu becomes more dominant there may be a benefit in terms of a lower level of endophyte (Colin Page, April 2002).

Gavin Ussher (2002) concluded that the commercial prospects for the use of novel endophyte ryegrass may be limited for Northland dairy pastures based on the very small milk production advantage, but higher per cow production indicates that in some situations overall production may improve particularly in normal seasons (the trial was conducted under favourable summer conditions). Discussions with farmers indicates that this view did not take into account the intangible benefits of improved animal behaviour. For example, young stock with grass staggers tipping over when moved. Farmers knew there was a problem, but didn't know the solution. The trial provided the solution.

AR1 was the precursor to a new generation of pasture seeds that combine high production and reduced insect damage with animal health benefits. This combination was so successful that there is virtually no seed with wild endophyte sold in Northland. AR1 has subsequently been displaced by new higher performing strains such as AR37, which arrived on the scene about 2008.

Pasture renewal prior to AR1 was around 5-10% and now 10% has become normal as farmers have recognised the benefits of introducing new grass strains into their pastures.

Evaluation methodology

Review NARF records; interviews with NARF committee, project managers, independent farmers and rural professionals.

Construction of cashflows from regional LIC data and specific project data based on the outcomes of the research extrapolated to farmers adopting novel endophytes.

Professional judgement has been applied to derive subjective estimates of adoption and returns.

See Table 2 for research outputs.

10 Table 2. Research outputs

Season 200-	Oct0-May1	Jun1-Feb2	Oct1-May2	Jun1-May2	Oct2-May3	Jun2-May3	Oct3-Feb4	Oct4-May5
Production MS/ha								
AR1	782	956	786	1144	943	1299	577	
S Endo	747	959	756	1129	873	1229	544	
Rye/Kikuyu	741	904	755	1107	854	1192	522	
Pasture growth rates t DM/ha								
Control rye	14.9		14.9		15.8		8.2	
Control rye/kik	18.7		18.7		15.8		9.0	
AR1	16.8		14.4		14.4		8.7	
H Endo	17.1		15.9		15.9		9.0	
Stocking rate cow/ha								
Control	2.9		3.3		3.2		3.35	
AR1	3.06		3.3		3.2		3.33	
H Endo	3.06		3.3		3.2		3.33	
Cow condition CS	Jan1	May1	Jan2	May2	Jan3	May3	Jan4	
Control	4.31	4.30	3.86	4.15	4.40	4.38		
AR1	4.40	4.30	4.14	4.29	4.20	4.25		
H Endo	4.58	4.15	3.93	4.07	4.30	4.35		
Cow LW kg								
Control	460	456	455	465	No funding for research monitoring so no monthly weighing		462	
AR1	465	441	434	437			466	
H Endo	482	454	429	454			458	

11 Source: NARF

Benefits of research

Quantitative

The 2000/01 Dairy Statistics produced by LIC indicate 168,600 ha of dairy land in the Northland statistical area (including Rodney). The average benefit in the trails over 2000/01 and 2001/02 for the novel endophyte (AR1) was 25kg MS per ha. About 65% of dairy land consisted of ryegrass/clover pastures. So the immediate potential was for 50% of dairy land that could be established in novel endophyte ryegrass. This provides a potential benefit of 2 million kg MS which at $4.50/kg MS is $9 million in increased income. About 5-10% of Northland dairy land is regressed each year which represents about 12,000 ha that could be sown with novel endophyte (Kathryn De Bruin 2002/03 grant application).

The three years of research confirmed perennial ryegrass with AR1 endophyte gives more milk and makes the cows on the NARF farm happier and healthier. They produced 4% more milk solids yearly with the biggest gain in the autumn of11% on average with a range of 8-14%. Cows produced an extra 122kg MS/ha, which as $3.60/kg MS provides extra income of $440/ha from a $25/ha investment is seed (M and K Welsh, Straight Furrow, 24 September 2003).

The key benefit of the trail was to speed up the adoption of novel endophytes. Farmers needed the confidence to make the change based on independent testing, which the trail provided. Without the trial adoption was likely to take 10 years and with the trial actual adoption was estimated at five years.

Non-quantitative

The work showed the effect ryegrass with AR1 had in a commercial setting and in a climate and environment where heat stress, ryegrass staggers and other animal health issues related to high levels of fungal toxins can have a major effect on production. The research helped resolve long running animal health issues in Northland (Mark Croucher, Straight Furrow, 24 September 2003).

When put on novel endophyte (AR1) paddocks cows behaved themselves, grazed the paddock evenly, then lay down contentedly while cows on standard (wild high) endophytes were the ones that broke out of their paddock, wouldn't graze, stood around at the gate complaining, walked slowly and generally misbehaved. Production benefits vary throughout the year, in the end though the cows on AR1 produced more milk (M and K Welsh, Straight Furrow, 24 September 2003).

Links to other projects

A similar endophyte trial was conducted at Ruakura funded by Dexcel in 2000/01 to 2003/04 with similar results.

Net Benefit to farmers

Main drivers

Dairy effective ha	168,600
Area to benefit ha	84,000
Benefit kg MS/ha	25
Attribution of benefit to the trail	50%
With trial Regrass ha/year	16,800 for 5 years
Without trial Regrass ha/yr	8,400 for 10 years
Less extra seed cost $/ha	25

Net Present Value (8% discount rate)	$8.8 million
Benefit Cost Ratio	20:1
Return $/ha/yr Direct	$11
Region	$5

Conclusion

This project has a NPV of $8.8 million (at a discount rate of 8%) and a benefit/cost ratio of 20:1.

The benefit of this trial is to speed up adoption rate of novel endophytes. Based on the difference between sowing 16,800 ha/yr for five years novel endophytes with the trial compared with 8,400 ha/yr for ten years without the trial the direct benefit is a net $11/ha/yr over the 20 year projection of cashflows. The benefit to the region as a whole is estimated at $5/ha/yr.

The benefit to cost ratio shows a high return on investment, while the NPV and $/ha/yr are more modest. The trial was successful in raising productivity and incomes in the region with a positive non-quantified impact of lower stress levels to both animals and farmers due to the lowering of metabolic related issues such as grass staggers.

9.3 Mastitis

Project name: Mastitis Trial

Mastitis Productivity Trial

Objectives

The aim was to examine the impacts of 2 key mastitis prevention treatments, Teat spraying and Blanket (whole herd) dry cow therapy on herd production and mastitis incidence, for cows managed within the same herd over a period of two years.

Funding

2006 Teat spray unit	$1,500
Dairy Insight	$105,000
NARF	$10,000
Total	$116,500

Description

Project Management: Sally-Ann Turner, John Williamson, Kate Wynn (Dexcel Regional Science Manager) and Jane Lacy-Hulbert
Location: NARF, Dargaville
Dates: July 2006 to May 2008

The trial was conducted at NARF (240-250 cows) and TARS (120 cows, including 80 heifers) in Taranaki.

While both teat-spraying and dry cow treatment (DCT) are regarded as effective mastitis control solutions independently there was not published information for grazing dairy cows on the effect of combining both strategies. It was reasoned that a combination of teat-spraying and DCT would decrease clinical mastitis (CM) and somatic cell count (SCC) and result in higher milk production. This was tested using four different combinations of mastitis control programs operating across similar cows within the same farm management environment.

The study was conducted across 2 lactations using approximately 250 cows/season and was based at the Northland Agricultural Research Farm (Dargaville, New Zealand). Treatments were applied as a 2x2 contrast of the following (see Table 1):

- A. post-milking teat sanitation with an iodine teat spray for the whole lactation (TS)
- B. no teat spraying for the whole lactation (NoTS)
- C. blanket (whole herd) treatment with dry cow antibiotic at dry off at the end of the 1st season (BKT)
- D. selective treatment with dry cow antibiotics at dry off at the end of the 1st season (SEL).

Teat spraying was done manually, using a central pressurised spray system, containing an iodine based spray. Selective DCT involved treating with dry cow antibiotics only those cows that were treated for clinical mastitis during the preceding lactation plus those cows that showed one or more high SCC across 4 herd tests. The threshold SCC was 150,000/ml for cows and 120,000/ml for heifers. Milk samples were collected from all 4 individual quarters of each cow for bacteriological analysis at the first milking (M1), mid lactation (R1), late lactation (R2) and before dry off (DO). Both collection and analysis of samples were conducted according to National Mastitis Council (NMC) guidelines. Milk yields were estimated from the bulk milk vat for each herd (teat spray and no teat spray herds) and measured at each milking using in-line milk meters, and milk samples were collected approximately fortnightly in the first three months of lactation and monthly thereafter, for milk composition and SCC analysis.

Table 1. Treatments, 1 July 2006 – 31 December 2008

	Teat spraying applied through both seasons		*2 Dry Cow Therapy 3 applied at end of 1st season*	
Treatments:	Teat spray after each milking	No Teat spraying	Blanket (All cows)	Selective (SCC >150k cows SCC >120k hfrs at any of 4 HT)
A "Super SAMM"	✓		✓	
B "SAMM no TS"		✓	✓	
C "SAMM sel. DCT	✓			✓
D "Basic SAMM"		✓		✓

Note: SAMM - Seasonal Approach to Managing Mastitis

Research outcomes

TS significantly reduced the proportion of cows with CM by the end of the 1st season. In addition, the proportion of quarters per cow that were bacteriologically negative was higher following teat spraying. SCC was also influenced by teat spraying, with a significant reduction in SCC in those cows that were teat sprayed in the 2nd half of the lactation.

No consistent effect was apparent on milk fat, protein or yield. In contrast to the 1st season results, there was no effect of TS on the proportion of cows with CM, nor was there a difference in CM incidence between those cows receiving blanket or selective DCT.

There was a significant interaction between TS and DCT for S. uberis prevalence, with significantly fewer intra-mammary infections (IMI) in those cows in the TS-BKT treatment group at the sampling immediately post-calving. In addition, coagulase-negative staphylococci (CNS) prevalence was also affected, with significantly fewer IMI in those cows in the TS-BKT treatment at the R1 and R2 samplings. S. aureus prevalence was also significantly lower in those cows that were teat sprayed.

There was no effect of DCT and no consistent effect of TS on SCC in the 2nd season. However, the concentration of fat in the milk of cows that received the SEL-DCT was higher throughout most of the season, and protein concentrations higher for part of the season, compared to those cows that received the BLK-DCT.

While the trial showed a positive teat spraying effect on CM incidence in the first season, this was not apparent in the 2nd season. Flooding in season 2 resulted in a 2-3 day period in which cows were not milked. This could have been a contributing factor in the lack of repeatability of the result between seasons.

The combination therapy of TS and BLK DCT resulted in a significant reduction in S. uberis IMI at calving, supporting the use of these two treatments together. However, while the combination of TS and BLK DCT was effective at controlling S. uberis there was no effect of combination therapy, nor either treatment in controlling the incidence if CM. CM incidence was low in season two for all treatment groups (between 10.6 and 6.2 % of cows infected) and this could have led to the lack of detection of a treatment effect. In addition, the lack of an effect of selective and blanket DCT on CM could be due to the high number of cows in the selective group.

Due to decision rules adopted at the beginning of the trail very high levels of cows in the selective group receiving DCT (75%) reduced the likelihood of showing a difference compared with blanket treatment.

The trial set out to test the effect of combining two reliable mastitis reduction strategies, teat-spraying and dry-cow therapy, on reducing the incidence of mastitis and SCC and improving milk production. Benefits of teat-spraying and dry cow therapy were apparent when used individually. However, the trial did not show statistically that combining both treatments was of additional benefit because there were several confounding factors that affected the results.

Further field-scale work was considered to be required to test the interaction between DCT and TS under more controlled conditions than were able to be used or to use more replicates to account for variability.

Evaluation methodology

Review NARF records; interviews with NARF committee, project managers, independent farmers and rural professionals.

Limited and inconclusive data meant that cashflows could not be constructed. Specific project data based on the outcomes of the research were utilised to make general comments only.

Professional judgement has been applied in assessing of the trail outcomes.

Benefits of research

Quantitative

In the situation of the trial and taking into account all costs except labour there was a significant advantage to teat spraying (54% lower costs) compared with no teat spraying (see Table 2). This result confirmed other trial work.

Table 2. Comparative costs of mastitis treatment 2007

	Teat spray	No teat spray
Loss of milk production	?	?
Antibiotics	348	652
Discarded milk		
- Ist 5 days	0	0
- After 5 days	611	990
Cows culled for mastitis	0	500
Cost of teat spray	428	0
Total costs	1,387	2,142

Note: Labour costs not included

Non-quantitative

DCT has been controversial to many farmers because of the perception that the veterinarians exploit their position as monopoly suppliers of the antibiotics when recommending treatments for mastitis. This link may now be weakened however as there is now a DCT option (teat sealant) that is effective and does not require antibiotics.

The trial provided similar results to other similar trials i.e. the net benefits of teat spraying are conclusive and almost all farmers practice it with a significant uptake of all season teat spraying since the trial 85% in 2008 to 94% in 2015 (see Table 3).

Table 3. Northland Teat spray change from 2008 to 2015

	2008	2015
TS	92%	95%
TS all season	85%	94%

While selected DCT has economic advantages over BKT DCT national survey results indicate a swing to BKT CDT and a reduction of farmers applying selected DCT (see Table 4).

Table 4. Comparison of national mastitis survey results 2008 and 2015

	2008	2015
BKT DCT (protective)	56%	71%
Selective DCT	36%	19%
None	4%	-
Something	77%	85%

In 2015 55% of herds nationally used antibiotics as part of DCT, 20% used a combination of DCT and TS and 10-20% used either TS or DCT.

Links to other projects

This trial confirmed the results of other trials.

Net Benefit to farmers

None quantified.

Conclusion

This trial while providing results that were not expected by the NARF Committee did provide more TS/DCT options which is seen as quite important. The trial did not result in any change to national SAMM recommendations, but it helped in the background.

While teat spraying was shown to provide significant advantages in lowering the cost of mastitis there have been a number of previous trials that showed similar results and therefore no additional benefit has been attributed to this trial.

9.4 Nitrogen

Project name: Nitrogen Trials

Comparison of Urea and SustaiN on Pasture Dry Matter Yields in a Northland Spring

Objectives

In 2007 an experiment to examine the differences in pasture response between standard urea, SustaiN Green (ground spread) and FPA SustaiN (Fine Particle Application, spread by helicopter).

In 2008 the trial examined differences in dry matter (DM) yield differences from pastures fertilised with urea or urea treated with Agrotain.

Funding

Estimates of the direct costs of this trial have been taken from the NDDT accounts for the years ending 2008 and 2009 which amount to $6,611 and $14,808 respectively.

Description

Project Management: Kate Wynn
Location: Jordon Valley Farm, Hikurangi
Dates: August – November 2007 and August to December 2008

The urea-based product SustaiN Green (herein referred to as SustaiN) has been reported to increase the response to nitrogen by up to 75% when compared with urea alone. This increase in efficiency has been achieved by treating urea fertiliser with the urease inhibitor N-(n-butyl) thiophosphoric triamide (NBPT), commercially known as Agrotain®. Agrotain has also been shown to be effective in reducing ammonia volatilisation from urea and to reduce nitrate leaching, as an indirect result of the reduction in the rate of availability of ammonium-N for conversion into nitrate.

Another factor which may affect N uptake is the method of application. Traditionally, urea is spread in granular form by land application; however, an alternative is fine particle application (FPA) whereby the SustaiN is combined with water to form slurry and then sprayed on by helicopter to deliver tiny particles in place of a single granule. SustaiN FPA is said by the promoters to work principally via the immediate uptake of SustaiN through the leaves and latterly through the roots thus improving N availability and efficiency.

2007 Trial

The trail had two applications in two forms (Granular SustaiN from Ballance Agri-nutrients and FPA SustaiN from Summit-Quinphos) and at two application times (August and October 2007). In the first application an untreated control was compared with urea at 43 and 86 kg N/ha, SustaiN at 43 and 86 kg N/ha and FPA SustaiN at 43 and 86 kg N/ha.

In the second application the FPA was again applied but at rates which far exceeded the experimental design (70 and 103 kg N/ha) resulting in pasture damage to the FPA plots. For this reason, the remaining plots had their treatments applied at 30 and 60 kg DM/ha and the FPA plot data was not analysed after the second application.

2008 Trial

An experiment examined differences in dry matter (DM) yield from pastures fertilised with urea or urea treated with Agrotain at 0.5, 1.0, 1.5 or 2.0 l Agrotain per tonne of urea. Each treatment was applied twice (in August and October) at the rate of 40 kg N/ha per application.

Research outcomes

2007 Trial

There were no significant differences (P<0.05) in dry matter (DM) yield between the various products after the first application. At the first harvest in September there was a significant N fertiliser rate effect (P<0.001) on yield but this had disappeared by the second harvest in October. The DM response rate to N was greater at 43 kg N/ha than the higher rate of 86 kg N/ha and this was irrespective of type of N used (Table 1).

Table 1. N response efficiency (kg DM/kg N) for the September and October harvests and the total yield to the first N fertiliser application.

Treatment	September N Response	October N Response	Total N Response
Control			
Urea @ 43 kg N/ha	16.7	8.6	25.3
SustaiN @ 43 kg N/ha	20.0	8.2	28.2
FPA @ 43 kg N/ha	20.2	6.5	26.7
Urea @ 86 kg N/ha	13.4	5.2	18.6
SustaiN @ 86 kg N/ha	11.8	2.6	14.4
FPA @ 86 kg N/ha	15.3	3.6	18.9

Source: Kate Wynn, 29/04/08

No differences were observed in yield after the second application (FPA results excluded). However the N response efficiency was much higher in urea at the lower rate of application. There was no significant interaction between fertiliser type and rate of application at any of the three harvests or in the overall total.

Plots were harvested three times and no significant differences in dry matter yield between products were measured when compared at similar N application rates. However, there were clear responses to additional N. While no differences were measured in the present experiment, work from other researchers would suggest that benefits from SustaiN can be expected where there is a direct risk of leaching or volatilisation.

2008 Trial

Plots were harvested four times and there were no differences in DM yield between treatments for either the August or October applications. Except for the final harvest, all treatments increased DM yield compared with the nil nitrogen control (see Figures 1 and 2).

Figure 1. Pasture yield responses (kg DM/ha) to N after the first N application (cuts 1 and 2 and cuts 1 and 2 combined).

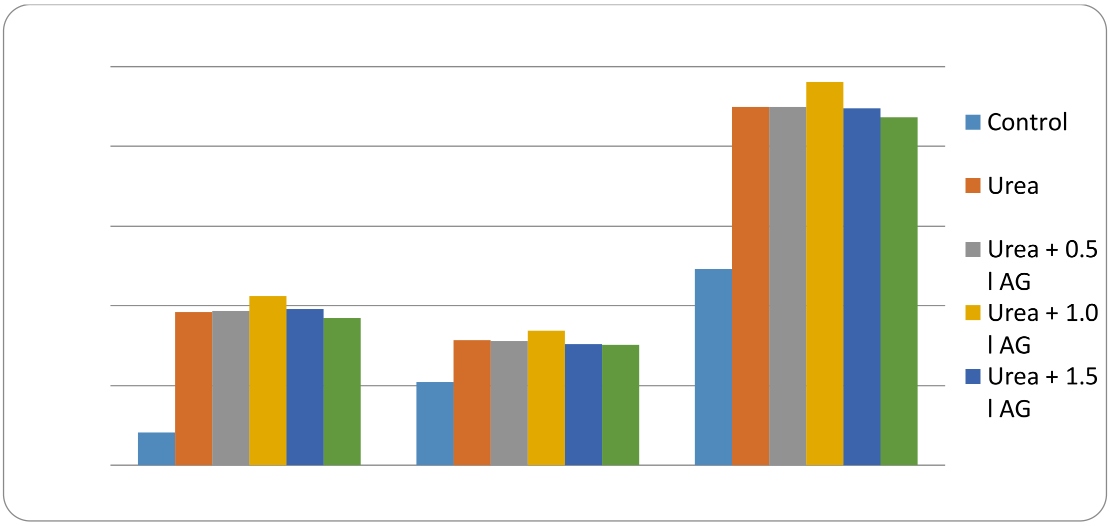
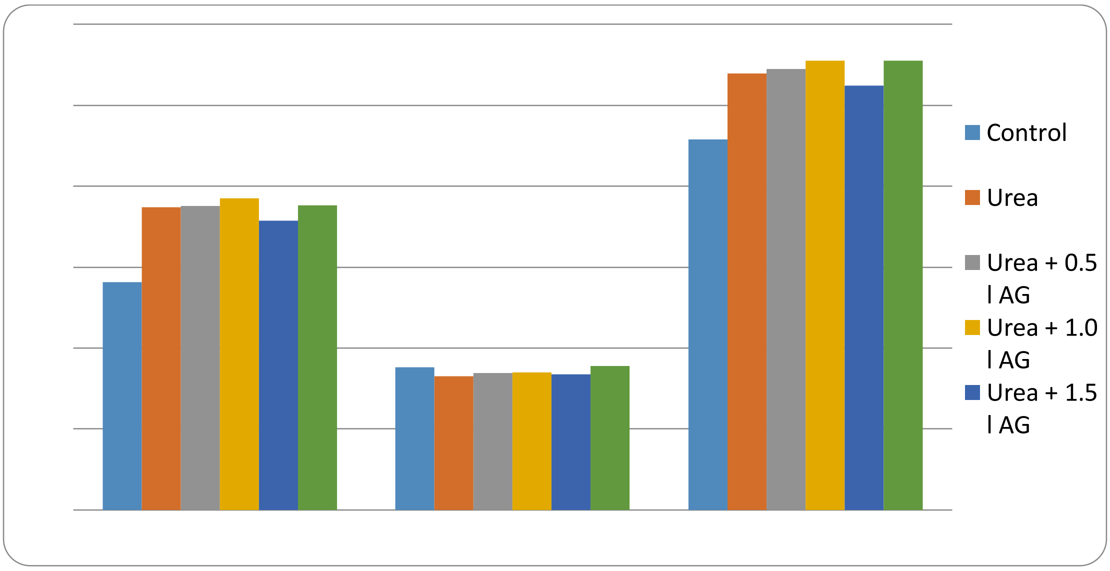


Figure 2. Pasture yield responses (kg DM/ha) to N after the second N application (cuts 3 and 4 and cuts 3 and 4 combined).



There was no indication of any variation in chemical composition of pasture in response to any treatment, although data were not statistically analysed.

The results from this 2008 experiment showed that treating urea with Agrotain at rates of 0.5 to 2.0 l Agrotain per tonne of urea product does not improve pasture DM yields over the use of standard urea in Northland during August to December. The response to nitrogen was similar for all five N treatments throughout the experiment.

Evaluation methodology

Review NDDT records; interviews with NDDT committee, project managers, independent farmers and rural professionals.

Cashflows were not constructed due to faulty product specification negating the trial results.

Professional judgement has been applied to draw conclusions about the trail outcomes.

Benefits of research

Quantitative

The trial found there was no benefit to SustaiN over urea in the situation of the trial.

Non-quantitative

At the time of the trail there was considerable advertising pressure for farmers to use SustaiN and the trial results halted uptake.

The results of the 2007 trial reported in the Dairy Exporter (October 2008, p121-123) were controversial as the manufacturer of FPA SustaiN, Summit Quinphos, contended that the rates of application of SustaiN were one third of the recommended rate and therefore the results should have been discarded as inaccurate and an unfair representation of the product (Dairy Exporter November 2008, p124). However, the SustaiN was applied according to manufacturer specification. When subsequently tested the SustaiN product was found to contain one third of the stated concentration of Agrotain. As a result of the information provided from the trial Summit Quinphos changed the formulation so the correct concentration of Agrotain was provided. It is noteworthy that Ballance, the current owners of SustaiN, now recommend the product should be used when conditions are not quite right rather than all the time.

Links to other projects

None investigated.

Net Benefit to farmers

No quantitative results provided to analyse.

Conclusion

In this case the benefit of the trial was in the industry watchdog role played so that farmers received what they paid for.

In the situation of the trial SustaiN provided no additional productivity benefits over using urea.

Due to commercial sensitivities in assessing the change to farmer purchasing of SustaiN post the trial we have not attempted to quantify the benefit of saved costs as farmers stopped using the product and reverted to using urea.

9.5 Kikuyu

Project name: Kikuyu

Pasture management systems for Northland: Quantifying the effect of three different pasture management systems on milk production and farm profitability

Objectives

The aim of this project is to compare the productivity and profitability of three different pasture management systems – kikuyu based farmlet using mechanical control of pasture; kikuyu based farmlet using no mechanical control of pasture and an all ryegrass farmlet. The productivity of kikuyu based farms is traditionally fairly low and by providing accurate data on the most cost-effective and efficient way to manage their pasture base it was hoped to ensure that milk solids production in Northland is improving in a sustainable manner.

Funding

Table 1. Proposed Budget for phase 1, 2007

Item	Year 1	Year 2	Year 3
Set up of third vat and chiller unit			
Extra shed running costs - power	2,000	2,000	2,000
Additional bulls x 4	4,000	2,000	2,000
Reels and standards	500		
Mulcher	10,000		
Labour (1 FTE)	35,000	40,000	40,000
Consultant ($500/visit – 26 visits)	13,000	13,000	13,000
Technician	5,000	5,000	5,000
Lab costs	10,000	10,000	10,000
Herd Tests	8,000	8,000	8,000
Extension	5,000	5,000	5,000
Total	92,500	85,000	85,000

Total budget for the first three years was $262,500, with a further four years at a nominal amount of $85,000 per year, total cost $602,500. In 2015 dollar values this amounts to $618,772. As no records are available showing actual expenditure these costa are used in the quantitative analysis.

Description

Project Management: Kim Robinson, Kate Wynn, Dave Clark (DairyNZ),
Location: NARF
Dates: initially 2009/10 – 2011/12 with an plus extension to 2015/16.

Well-managed C4 grasses (the subtropical grasses - kikuyu, and paspalum) can maintain adequate ME values relative to ryegrass for the same period of the year. Milk production from a kikuyu based farm in Northland may be ± 20% that of a ryegrass farm in the same district but at the time of the trial no data existed on comparing the two systems on the same farm . The opportunity existed to measure productivity by building on the existing knowledge of kikuyu pasture management using mechanical control and comparing this to kikuyu that is managed by non-mechanical means. An all ryegrass farmlet was used as a control

NARF had three vats and therefore could collect separate milk data off three farmlets under the different management systems. Data from this study was expected to allow an economic comparison of milk production from three alternative pasture systems.

The project was designed to represent the three pasture based systems that the majority of Northland farmers currently operate. That is:
a) C4 dominant pasture system managed with mechanical control i.e. mulching in Autumn followed by the under-sowing of annuals (Farmlet 1)
b) C4 dominant pasture system managed without mechanical control i.e. using dry cows or other classes of stock to manage kikuyu residuals and broadcasting annuals in Autumn (Farmlet 2) and
c) a predominately ryegrass system (Farmlet 3).

Stocking rates to be consistent across all farmlets. In the first two years this was to provide an overall benchmark for the region and address overall farm productivity – how much DM and milk solids are produced per ha/yr in each farm system and what are the economic implications of each system?

In the third and fourth years, forage crops may be introduced into the system to compare the effects on farm productivity and profitability of growing crops for year-round supplementary feeding of either grazed herbage or conserved feed. The farmlet and crop management is outlined below.

Supplementary feed inputs was to be made available to all herds through to December so that the kikuyu herds were not being disadvantaged by having a lower peak. The amount of supplement fed to be determined by the average pasture cover on each farmlet and the projected feed demand as determined by a weekly farm walk and historical pasture growth data.

Research outcomes

Key Points (Presentation to NDDT Conference 2012)

•Mulching and drilling Italian ryegrass was the most profitable farm system overall

•Non Mulched farmlet marginally more profitable in the final year but ended season with high kikuyu base which would affect Italian ryegrass establishment

•More pasture was harvested on the kikuyu farmlets than the ryegrass

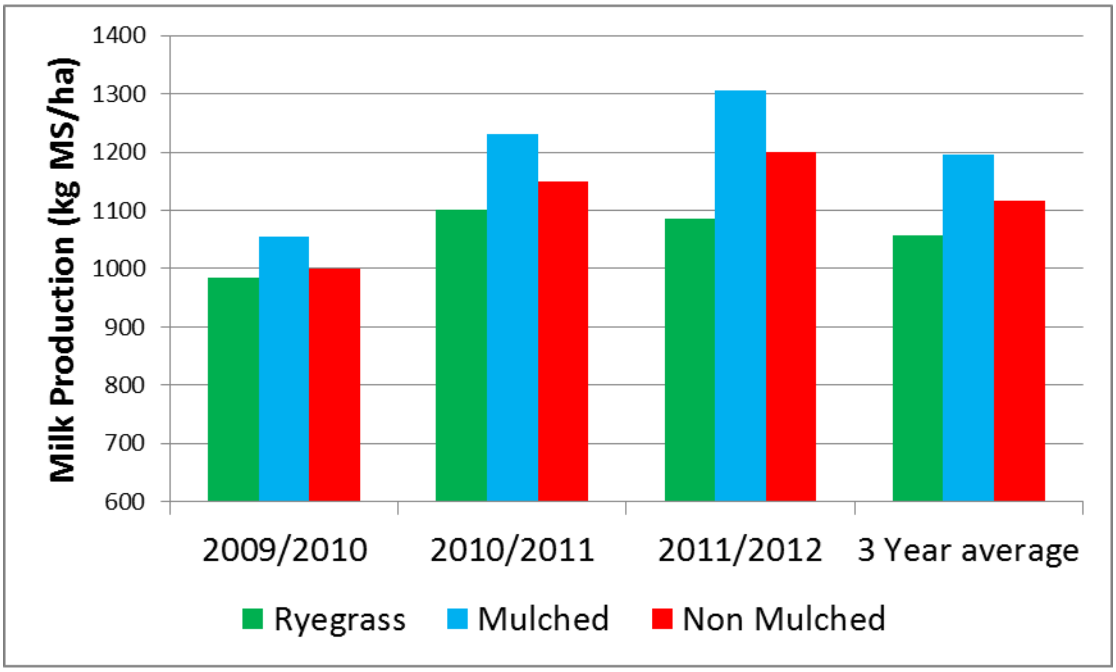
•Milk production was higher than the regional average on all farmlets due to higher stocking rate and supplement use

•Grazing a proportion of cows off during winter reduces pressure on the milking area and allows good ryegrass establishment before calving

•The greatest cost differences between the systems were for regrassing, grazing off and supplement use. While the mulched farmlet generally had the greatest costs in these areas it also produced the most milk.

The subsequent years of the trial confirmed the earlier results.

Chart 1. Milk Production



Source: SY803 results

Table 2. Operating Profit (EFS) comparison

	2009/2010	2010/2011	2011/2012	Average
Northland OP (EFS/ha)	864	2172	NA	1518
Ryegrass OP (EFS/ha)	1653	3223	1739	2205
Mulched OP (EFS/ha)	2695	4802	1945	3147
Non Mulched OP (EFS/ha)	2579	4516	2092	3062

Source: NARF Financials 2008-2012

The trial created a lot of talk amongst farmers with profitability only one facet. Pasture management with kikuyu needs to be the opposite to normal. With ryegrass pastures feed is carried into winter whereas kikuyu pastures need to be grazed down before growth stops (1 June to 1 September) and rely on new growth from September with a peak in November (followed by a rapid fall in production) to get of the hole. Kikuyu carried through into winter rots at the first frost followed by negative pasture cover and negative growth rates. Farmers had to learn to start mulching early so a proportion of kikuyu was under control. The trial showed that done aggressively it was profitable and it had to be done right. An increase of 100 kg MS/ha was achieved by increasing stocking rate to manage kikuyu aggressively.

During the trial there was a big drop in payout and the message was – whichever system used it had to be done properly. It was a surprise to many that mulching was more profitable.

Evaluation methodology

Review NARF records; interviews with NARF committee, project managers, independent farmers and rural professionals.

Construction of cashflows from regional LIC data and specific project data based on the outcomes of the research extrapolated to farmers adopting the recommended kikuyu management programme.

Professional judgement has been applied to derive subjective estimates of adoption and returns.

Benefits of research

Quantitative

From a base of 500 kg MS/ha the expected increase is 150 kg. Adoption is assumed to occur over three years from the start of year four of the trial.

The area to benefit has a low of 20%, most likely 33% and high 40% and an expected value of 31%.

Attribution of uptake to the trail has a low of 30%, most likely 60% and high of 100% with an expected value of 63%.

Apart from the costs of the research farmers incur costs of drilling $30/ha, mulching $90/ha and Italian ryegrass seed $100/ha for a total cost of $220/ha.

Non-quantitative

Prior to this trial the conventional wisdom was that farmers should try and eliminate kikuyu from their pastures. The trial showed that with careful and aggressive management kikuyu based pastures could be high producing. A non-quantified benefit is the saved cost of not spraying out kikuyu.

It should be noted that improvement in kikuyu pasture management through adoption of identified best practice is directly applicable to improvement in on farm production for sheep and Beef, which covers a greater area of Northland than dairy. Particularly the value for different stock classes for pasture management. This aspect is outside the terms of reference for the project, which is assessing the benefit to Northland dairy farmers.

Kikuyu is gradually creeping south and is now found in the lower North Island, thus the results have significant benefits south Northland.

Links to other projects

Prior to the trial the Kikuyu Action Group (KAG) had over a number of years refined the management system that the trial showed was superior if well managed.

Net Benefit to farmers

Main drivers

Net Present Value (8% discount rate)		$141.0 million
Benefit Cost Ratio		3:1
Return $/ha/yr	Direct	$275
	Region	$85

Conclusion

This project has a NPV of $141.0 million (at a discount rate of 8%) and a benefit/cost ratio of 3:1.

The benefit of this trial is a significant increase in milk solids achieved over three years. The direct benefit is a net $275/ha/yr over the 20 year projection of cashflows. The benefit to the region as a whole is estimated at $85/ha/yr.

The benefit to cost ratio shows an acceptable return on investment, while the NPV and $/ha/yr are very good. The trial was successful in raising productivity and incomes in the region with a positive non-quantified impact further south as kikuyu creeps down the North Island.

9.6 Standoff pads

Project name: Standoff pad trial

Selection and Maintenance of Uncovered Stand-off Pads.

Objectives

To evaluate the suitability of commercially available surface materials (concrete, post-peelings and limestone) for standing cows off pasture during winter on uncovered stand-off areas in the North Island.

An application to the 2011/12 SFF funding round (11/013) was approved which aimed to improve on-off grazing practices on dairy farms and additionally seeks ways to reduce/limit stand-off pad construction and maintenance costs, test new surface material, reduce nutrient loss to the environment from excreta on pasture, minimise damage to wet pastures and improve animal welfare.

Funding

May 2010 – March 2011

Project Total Value	$126,086
SFF	$17,391
NDDT	$26,087
Dairy NZ	$43,478
In-Kind Contributions	$39,130

(Source: L10-131 R4P)

Total Expenses	$112,400
SFF	$14,400
Other Cash	$53,000
In-Kind Contributions	$45,000

Consultants and Contractors $10,000
Dissemination Costs, $5,000
Other $30,000)
(Source: L10-131 Final Financial report)

Description

Project Management: Kate Wynn
Location: Jordon Valley Farm, Hikurangi
Dates: May 2010 – March 2011
The trial work took place at Fonterra's Jordan Valley farm (concrete and post-peel treatments) and a local commercial farm (limestone treatment) under the supervision of Dairy NZ's Regional Scientist, with assistance from DairyNZ specialist staff and local contractors.

During winter 2010 at the Jordan valley site, measurements were taken from two uncovered stand-off pad surfaces (concrete and post peelings (PP)). Approximately 150 cows per treatment were used to test the surfaces over the winter period. Cows alternated between pasture, fed pad and stand-off pad and on average, spent 15-20 hours per day over a six week period off the grazing platform.

The PP material was subjected to different treatments over the course of the study. The stand-off pad was divided into four even sized areas with 150 cows on each. Management treatments included aeration of the material once (#1 - R1) or twice per week (#2 - R2) using a tractor and mechanical ripping device or no intervention (#3 - NI). The PP material was to have been changed on #4, half way through the monitoring period to determine the effect of renovation on measurements. However, due to the poor condition of the PP material on all areas after three weeks, it was decided to continue without the change and terminate the trial one week earlier than planned.

The fourth group (C) was stood-off pasture on the uncovered concrete dairy yard (n=30) which was hosed down daily after cows had gone to grazing. Cows in all treatment groups were allocated 6 m^2 per cow whilst on the stand-off areas.

At the commercial farm, similar measurements were taken, but cows were only put on the limestone surface at the owner's discretion. As the weather conditions were very mild over the trial period, cows were only stood off at this commercial farm for 5 days over the whole 6 week period. Therefore, the limestone measurements were not included in the analysis as the impacts on animal welfare and pad durability cannot be compared with the post-peel and concrete.

During the course of the trial work it became apparent that environmental impact measurements would not be able to be taken. This was due to the manner in which the stand-off pad had been constructed allowing all effluent to flow into one main sump, making the measurement of individual treatments impossible. This also impacted on the ability to determine the cost effectiveness of different stand-off pad options. Therefore, the main focus shifted to determining the impacts of pad surface on cow activity and welfare.

Animal Welfare measures included Cow lying down time, live weight, locomotion score, cow/udder cleanliness and lameness. ICE tag activity meters were used to record cow lying/standing time and motion index. Bacterial counts on pad surfaces were also measured to determine the bacterial type and loading.

Research outcomes

Animal Welfare

Standing cows off pasture on a **concrete** surface for a prolonged period of time resulted in:

- Reduction in grazing time
- Reduced lying time at night, increased during the day
- Increase in lameness
    - 27% of the concrete cows scored a 3 or higher in locomotion score
    - compared to less than 5% in the PP herds
- Lameness after 5 weeks Concrete: 34% mildly/moderately lame (2 or 3), 16% lame/severely lame (4 or 5), 2 removed from trial (1-5 scale: Sprecher et al., 1997)
- Minimal live weight change indicating that cow condition was actually going backwards (other research has indicated that jersey cows should gain at least 0.5 kg lwt/cow/day in the late-gestation period)

Standing cows off pasture on a **post-peeling** surface for a prolonged period of time resulted in:

- Some reduction in total lying time
- Small increase in lameness - mild to moderate lameness (2-20%)
- Minimal live weight change
- Extremely dirty cows
- Surface bacteria (streptococci and Gram negative bacteria) on the teats was extremely high and remained high throughout the trial but was not significantly different between treatments

Pad Durability

- Post peeling surfaces required replacement after 5 weeks, irrespective of ripping treatment
- The actual cost of ripping (machinery and labour) is negligible but didn't offer any clear benefits
- Bacterial loadings were similar across all treatments

Further research is required to investigate how to improve cow comfort (through improved surface materials or management) when standing cows off pasture in non-housed conditions. An application was made to SFF (with the support of NDDT and local farmers) which was approved (11-013) with further trial work to take place in 2012.

Results from this trial were presented at three events to a total audience of approximately 500 farmers and rural professionals:

- Northland Dairy Development Trust conference (Whangarei, October 2010)
- International Lameness in Ruminants conference (Rotorua, March 2011)

o Wynn KT, SM Adams, JE McGowan, GA Verkerk 2011. Effect of stand-off pad surface material on lying behaviour and lameness

- Northland Agricultural Research Farm open day (Dargaville, February 2011).

Evaluation methodology

Review NDDT records; interviews with NDDT committee, the project manager, independent farmers and rural professionals.

Construction of cashflows from regional LIC data and specific project data based on the outcomes of the research extrapolated to farmers adopting the outputs of the research.

Professional judgement has been applied to derive subjective estimates of adoption and returns.

Benefits of research

Quantitative

Quantitative benefits are based on improvements to Body Condition Scores (BCS) of cows using standoff pads. This is assessed at 0.75 BCS at $90 benefit per cow per BCS.

Adoption of 5% of the regional herd numbers is assumed to occur over two years. Within herd benefit is assumed to be 50% of the cows. Attribution of benefit to the trial is assumed to be 100%.

Capital cost of pad construction is estimated at $45/v=cow and maintenance $5/cow.

Non-quantitative

There has been strong interest in this project within the farming community and it has fuelled much discussion at farmer groups and industry events. It has also left a lot of questions unanswered.

Standing cows off pasture for a prolonged period of time with a concurrent reduction in grazing time, resulted in reduced lying down times, increased lameness and minimal live weight changes pre-partum.

For the cows on post peeling this also resulted in an increased state of dirtiness. The effect of different post peeling surface management techniques was nominal in terms of increasing cow cleanliness, lameness or bacterial loadings but was superior for cow comfort as measured by lying down times.

Links to other projects

The results and features of the trial are included in DairyNZ's publication "Stand-off pads" Version 1, 2014 by Chris Glassey, pp 7 and 34.

Net Benefit to farmers

Main drivers

See quantitative analysis section

Net Present Value (8% discount rate)			$5.0 million
Benefit Cost Ratio		3:1	
Return $/ha/yr	Direct	$61	
	Region	$3	

Conclusion

The quantified benefit of this trial is an improvement in BCS for cows using standoff pads with an NPV of $5.0 million (at a discount rate of 8%) and a benefit/cost ratio of 3:1. The direct benefit at the farm level is a net $61/ha/yr over the 20 year projection of cashflows. The benefit to farms in the region as a whole is estimated at $3/ha/yr, which is low because of the assumed adoption rate of 5% of regional herds.

The benefit to cost ratio and NPV are positive while being comparatively low compared to other projects. The trial generated a lot of interest, but did not achieve the outputs expected at the start of the trial because of deficiencies in design. The limited results generated were however incorporated into national guidelines thus achieving benefits beyond Northland.