



Final Report Template

Project Title:	The effects of a probiotic supplement on growth, feed conversion and general health of dairy calves
Project Number:	L12-083
Date of Report:	24 May 2013

Note: The Final Report is due to your Project Adviser within two months after the project completion date.

If any material supplied in, or attached to, this report contains confidential information, or is otherwise unsuitable for wider dissemination, please clearly mark accordingly and highlight directly with your Project Adviser (including the reason for wishing to treat the material in this manner).

This information from Sections 2 – 5 and Section 11 will be published on the Ministry for Primary Industries (MPI) website unless you advise us otherwise.

1. Milestone Summary Table

Milestone Number	Milestone [As per SFF contract schedule]	Completion Date		Percent Complete
		Original	Actual	
1	Select two trial sites; agree protocol with farms & DairyNZ; arrange trial procedures with calf rearers; set up physical features at trial farms (pens, weighing scales, feed & probiotic stores); establish record-keeping; make arrangements with probiotic provider – all as per project application design.	1 Aug 12	15 Aug 12	100%
2	Calf 'collection' by farmer and penning; birth dates and first weights recorded. Initial feed supplement intervention confirmed. Then three further weighings at each trial site; observations noted by calf rearer; farmer & media invitations to watch weighing, and/or a feeding opportunity to observe behaviours. Data finalised after initial and three other weighings. Preliminary report to MPI.	31 Oct 12	31 Oct 12	100%

3	Final Report written for MPI; scientific paper prepared to peer-reviewable standard and submitted to an agricultural journal. Results made available on at least three on-line sources and at least one press release circulated; all extension activities in concert with DairyNZ – and distribution as per extension plan.	15 April 13; variation from 28 Feb 13	10 May 13	100% of what is possible
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Summary of Key Performance Indicators

(NB: This section only applies to projects from 2010 onwards. Outline progress against the KPIs listed in your original project plan, by using direct measures (e.g. percentages, cumulative totals, etc). If a KPI can only be measured in the longer-term, then please note when and how this could be recorded.)

KPI Description	Overall Progress
Selection of two appropriate farms as trial sites by 1 August.	Yes – and 50% more done here; as three farms were required after consultation with DairyNZ scientists.
40 farmers to have an on-site look at the trial, either at a 'weigh in' event or at other opportunities.	At DairyNZ's insistence the work became more of a science trial and sharing/ observations were then not so relevant. We completed weekly weighings instead of the 4 weighing events that we envisaged with this KPI. Even so, approx. 25 farmers saw directly what was happening on farms.
Scientific paper to be prepared to a peer-reviewable standard and submitted to an agricultural journal (by 1 July 2013).	A early version of a paper was drafted (attached); but further statistical work on the data means that this draft will have to be changed a lot. The statistical report itself was a paper, peer-reviewed and was extra work not envisaged. We will continue with the scientific paper preparation – the 1 July date indicates it was intended to be completed after this final report; this date may still be met. MPI will be kept informed of progress.

2. Project Objectives

(Why did you do this project? What were your key objectives at the start of the project? Outline if any of these objectives changed during the course of the project.)

In general terms, we were keen test the anecdotal evidence amongst South Otago dairy farmers that probiotics fed in calving systems improved the calf rearing operation. Observations had included: improved weight gain & growth rates, reduced scouring, improved temperament and improved resilience of calves.

We realised that although the use of probiotics in humans and in cattle on overseas feedlot systems has been well described, there had been little independent field work or demonstrations undertaken to describe how well probiotics perform in New Zealand's pastoral production systems. We understood that probiotics are greatly

affected by the diet of the farming system and results may differ from overseas studies.

We hoped to at least do better than the Queen of Calves trial (Margerison 2007) which showed improved weight gain in calves, but used small numbers (15-20) of animals and did not control for birth weight, a major determinant of future growth. (Trial data on www.donaghys.com on 12 January 2011).

We also sought to assemble some data around the potential animal health benefits in young calves – which may have included less diarrhoea, less stress at feeding (for calves and calf rearers), and less use of antibiotics. We also wanted to look at whether there were improved handling characteristics of probiotic-fed calves which would have significance in the area of injury prevention for farmers and staff.

Yes, the emphasis of the project did change considerably during the project. DairyNZ came on board early and they changed the project design intending to assemble reliable and robust data largely to test the ‘improved weight gain’ issue. The project team appreciated the support of DairyNZ but it did mean that we were attempting to run a strictly-controlled trial rather than gathering broad, indicative data on the range of objectives as above.

On reflection, some of our data was compromised because we were working within the three particular farming systems on-farm (however, some views are that this actually adds to the value of the work). We were not able to strictly control conditions: we needed to work in with what real farmers do.

3. Approach

(What did you do – how did you go about it?)

Core Project Design:

- 3 Farms (one more than in SFF application design)
- Approx 20 pens (10 control; 10 treatment) over the three farms at penning
- Approx 10-15 calves in each pen

Treated calves had a multi-strain probiotic (lacto-bacillus & yeasts) added to the milk replacement probiotic supplement from approx. Day Three (after initial colostrum period) when appropriate numbers of calves were available to be assembled and penned.

The probiotic added was a fresh ‘brew’ supplied by a local Clutha firm. The amount of added probiotic was:

- i 20ml/ calf drenched twice a day for two days after penning,
- ii then, 10ml/ calf added to the milk in the calf feeder twice a day for the remainder of the trial.

Even numbers of pens were brought into the trial as appropriate numbers were collected on each farm. Selection into each pen was done by weight; the two lightest calves into different mobs, the next two in different mobs, and so on, i.e. the two mobs will be balanced for weight.

We aimed to have all other feeding, housing and management conditions for each set of two pens (control/ treatment) the same, so that the probiotic intervention is the only variable.

Data Collection Design:

All calves in both mobs were numbered and weighed when they were put into the rearing pens (birth date noted) and then weighed again weekly for the life of the trial. Progressive individual weights for each calf were kept.

The weighing was undertaken under the calf rearer's supervision at the same time of day and under the same conditions on each occasion. Weights and other observations (scouring or anti-biotic use) were made in recording books supplied by the project's manager.

Other calf meal was weighed at entry into each pen, and was aggregated over the life of the trial.

4. What were the main findings from this project?

We believe that we have made huge progress in developing an understanding of the effects of a probiotic supplement on the weight gain of neo-natal calves.

Our key objective was to collect a credible set of data from real, on-farm situations so that New Zealand farmers had that reliable and transparent data to set against previous anecdotes and observations.

We certainly wanted to give farmers reliable and transparent data beyond the two small-scale trials¹ that have been the benchmark in New Zealand research with probiotics until now. We collected hugely more reliable and significant information than any previous trials with approx 300 calves, ten replications and under a variety of on-farm conditions. If any other work has been done for MPI that gets anywhere near the achievement here, we certainly would like to know about it.

The Statistics Report attached with this Final Report shows that there is a positive effect of the probiotic supplement, and that, on the trial farms, it appeared to improve the weight gain of neo-natal calves by up to 57 grams per day. This effect was not seen on every farm. This result appears to align with previous scientific knowledge that the particular farming system is a hugely important determinant of the effectiveness of probiotic supplementation.

The farm which showed no gain from the use of the probiotic supplement was the farm with the most experienced calf rearer, with established systems and, most significantly, where the calves stayed in their pens for the 7 weeks of the trial. On the other two farms, calves experienced more stress in terms of their transition to grass within the 7 weeks, and also more challenging wet and cold conditions in their sheds and on pasture. These two farms showed average weight gains of 39 grams and 57 grams respectively.

Our three trial farms all had different calving procedures, meal intakes and practices, so the variable results are not surprising. We tried very hard to follow the project design, and there should not be an expectation of laboratory quality data from this project. We were obliged to fit in with the farming systems of our supporting farmers – like complicating the design by having calves move out of pens and on to grass pasture at various stages. We believe that this, in fact, adds strength to the data. We

¹ While NZ companies such as Donaghys or Queen of Calves presented trial data (Margerison 2007) showing improved weight gain in calves, these trials are limited since they use small numbers (15-20) of animals. Also, the Queen of Calves trial was not under field conditions while Donaghys's (trial data on www.donaghys.com on 12 January 2011), failed to control for birth weight, a major determinant of future growth.

have collected reliable weight-gain data from real-world farming situations. We believe this will mean more to farmers than artificial, laboratory situations.

We believe that we have successfully followed the co-operative model that is espoused by government for research and development programmes. We have farmers involved considering the aims and managing the project, we have consulted and followed the advice of the levy supported body DairyNZ, we have co-operative links with the commercial developer of fresh probiotic product, we have sought independent advice on the statistical variation observed, and we have interested a variety of scientists in the subject and its opportunities.

We had what we now understand were unrealistic ambitions to make health and behavioural observations to add to the weight data. The increased work involved in collecting weight data (as advised by DairyNZ) largely swamped out these considerations. No reliable data was collected on scouring and anti-biotic use for supplement and control groups and there was no clear observation on any of the three farms that either group showed more or fewer signs of overt health situations.

Having said that, 10 calves from control pens died during the trial and 2 died from the supplement pens. This is likely to be statistically not significant, but it is interesting and worth further study.

Behavioural observations were also inconclusive. On two of the farms there was no observed difference in the behaviours of control and supplement groups and on the other farm the main calf rearer noted that the supplement calves were easier to handle. This would be very difficult to support scientifically.

The meal-eaten data collected from the three farms was not analysed by the statisticians but we believe there was an interesting situation on one of the farms. We believe that here calf meal data was reliably collected. This farm has three different weight classes in three replications. In the larger weight class (birth weight over 40kgs) the supplement calves appeared to eat 21% less calf meal than the control calves but still put on weight at the same rate. In the middle weight class (35-40kgs) the supplement calves ate just 7% less for equivalent weight gain. But in the smaller weight class (under 35kgs) the supplement calves actually ate 19% more calf meal.

No one trial can ever be conclusive about any new technology, but we believe that there is considerable positive indications in this project for the industry to consider further work with probiotic supplements. This work is suggested in the “Next Steps” section of this report.

5. What difference has this project made to your group / community of interest / industry?

(Include intangible benefits where significant — e.g. “enabled us to develop a strong on-going working relationship with the scientists”).

Our community of interest in this project was mostly dairy farmers. We believe that we have been able to develop a considerable amount of hard data to set against the anecdotal evidence for probiotic supplementation in some circumstances. We have found a trend towards significance for treatment in the raw data and on two of the three farms in the trial. We think this is a huge step forward from previous evidence.

We have clearly shown that probiotic supplementation does not work in all situations. We could not be sure of this before our trial.

The consistent trend towards significance for treatment in the calves that were under some stress should interest many farmers and be the focus of the next phase of science work in this field.

We have made links with DairyNZ during this project and also with other scientists at Lincoln and Massey Universities. This has been valuable for us.

6. If you did the project again what would you do differently?

(i.e. what worked and what didn't?).

There were probably aspects of the project design and data collection that we could have done differently. We took the available advice from DairyNZ but in hindsight probably should have taken more trouble to explain to them our intentions and likely difficulties. The escalation of the project from the originally approved SFF project took us by surprise and some time to manage. We had clearly brought DairyNZ into the process too late.

7. Is there anything the SFF could have done differently?

We have been well encouraged by MPI SFF. We received good feedback on how to proceed after our successful application. We have had some difficulty completing the final reports as the statistical interpretation of the raw data proved a huge exercise. We took the time necessary, we believe, to get this as accurate a representation of the various views on the data as we could. We appreciate the patience of SFF in this process. So we don't think SFF could have helped more.

8. Is there anything that you have learnt that would be useful for new project teams?

Our advice would be:

- If you attempting any sort of science trial, have really good discussions with a variety of science advisors on the one hand and with the farmer trialists on the other hand.
- I suggest that project teams should consider 'indicative explorations' rather than formal trials in many situations as best use of SFF money. It is difficult to have full, science expectations without considerable financial resources.

9. Where to from here – what are the next steps?

The project team is hugely encouraged by the findings of this project and expects that considerable activity will follow on from this work.

Firstly we need to revisit the academic paper that was prepared in January (before all the statistical work had been completed). This will need to be rewritten and then submitted to an agricultural journal.

We are also keen to present the findings of this trial to farmers and we thought the best way to do this would be via a series of seminars which would explain the concept of a probiotic and present trial data and findings. We had scientists lined up to take part, and an application went to DairyNZ in February to run 3 seminars in each of the Waikato, Taranaki, Canterbury and South Otago/ Southland. Unfortunately Dairy NZ declined the application as the statistical analysis had not been completed. We need to talk to DairyNZ again in the light of the recent statistical conclusions and our farmer group's further requests.

In any event we are keen to run this seminar programme, albeit with fewer opportunities to discuss these results and issues with farmers. We need to do this to explore further farmer needs in this field.

We will also attempt to promote further science work around these issues:

- Under what farming circumstances do probiotics work best (is this when the animals are stressed?).
- Do probiotics decrease feed intake and improve feed efficiency in non-pastoral systems and does this vary by weight class?
- Is the composition of the meal relevant in determining where probiotics do best and where they appear to have no effect?
- Can we identify reliable links between calf scouring, other disease and even death rates and probiotic treatment?
- The mechanics of what probiotic supplements are doing in the gut – do they affect rumen development and rumen activity?
- Do probiotics change the protein metabolism and ammonia transport in the lower gut by acidifying the gut? This would have important consequences for nitrogen partitioning which in turn effects how much nitrogen ends up in the urine.
- Would probiotics be a useful tool to reduce the damage caused by E-coli, esp. *E. coli* 0157:H7 and paraTB which causes Johnes disease?

We believe that these are all important issues for farmers. Even acknowledging that we have found out that probiotic supplementation does not work in all circumstances, there are production gains to be had if we can show robust answers to any of the above issues. These would be production gains without further intensification which is a macro emphasis in the current New Zealand farming situation.

10. Financial summary

Provide a brief comment as to whether the project was completed on budget; whether there is any grant money left unspent. Please provide a financial statement to summarise the incomings/ outgoings over the life of the project – you can either attach a copy of your own financial statement or use the “final financial template” available at our website <http://www.mpi.govt.nz/sff/>

The project was completed on budget with DairyNZ additional support. More in-kind work was achieved than estimated in the original application. Financial statement attached.

11. List and attach any major outputs from the project.

- The Statistical Report
- Raw Data (has been sent in previous report)
- The initial academic article written to be peer-reviewed for an agricultural journal.
- Our “Findings” section of this report will be the major immediate output to our farmers

If appropriate, we would like to publish a copy of the above on our website: please provide an electronic copy for this purpose preferably in Word format.

Report Confirmation

Name:	Confirmation	Date:
Malcolm Deverson	I hereby confirm the above information is true and correct: Yes ✓	24 May 2013

Submission Notes:

1. **Final Reports should be sent electronically** to the MPI SFF Fund Administrator **and** your Project Adviser (in the same e-mail as the final Request for Payment form and invoice). Also attach electronic versions of any resources developed.
Please ensure you put your project number in the e-mail’s subject line:
e.g., 09/999 Final report 2011.
2. **Hardcopies of any project resources** developed should be **posted** to the Fund Administrator **and** your Project Adviser.