DAIRY INDUSTRY CASE STUDY

Property Location: Yarram, Victoria

Region: South Gippsland

Owners: Available on application

Property Address: Available on application

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DAIRY INDUSTRY CASE STUDY

Introduction

The purpose of this case study was to evaluate the impact of the Bactivate biological farming protocols on a working dairy farm, with a view to understanding the impact on:

- Value-added cropping;
- Herd health;
- Soil structure;
- Milk production;
- Milk quality; and
- Use of artificial food sources.

Some aspects of this case study are clearly and objectively measureable; others (such as herd health) slightly less so.

Property

This property is located in Kees road, Yarram, in South Gippsland, approximately 230 kms south east of Melbourne. It is approximately 240 Ha in size. The milking herd consists of 300 Friesian cross dairy cows plus 80 replacements, including 35 heifers less than 12 months of age. The property's carrying capacity is 350 dairy cows.

The property in slightly undulating to flat pastures, and is a dry farm (no irrigation). The pasture development consists of rye grasses to sub clover, and natural grasses.

Crop development and rotation is carried out over a full lactation period. Summer crops are Mitchell rape and sorghum, sown in September/ October. Winter crops consist of oats and lucerne, sown during the last week of March.

The soil structure is sandy loam to medium clay, with heavy traces of clay in certain areas. The growing of dry matter is currently at 3 to 4 ton per hectare, with a retention ratio of 1.2 ton per hectare per volume output.

Trial Sites

Two trial sites were used (Paddock 1: approx 3.2Ha and Paddock 2: approx 2.4Ha).

Paddock 1 had not been used to produce lucerne in the past. In fact, the grower had been told to apply 2.5 ton of lime per hectare for the next 10 years if he wanted to grow Lucerne on this site.

Paddock 2 had a heavier soil but had grown the same crop in the previous year.

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Paddock 1 Treatment

Paddock 1 was firstly sprayed with herbicide (Trillion). Then using mechanical disks the soil was turned to a depth of 4 inches (approximately 100mm), and then power harrowed to allow for leveling of the site. Once this was achieved the Lucerne seed was planted by a mechanical power seeder unit (2kg of seed/Ha).

The full biology program was introduced, using the following application rate:

1) 125 kg/Ha of Bactivate.
2) 1 litre of Monty's MLC/Ha, applied at a rate of 1 litre x 100 litres of water.
3) 1 litre of Monty's 8-16-8/Ha was applied at week 3 after seed planting to increase the growth rate and to substitute for the use of Urea. This was unsatisfactory, to the point that the plants at week 12 were showing a need for nitrogen to be applied, so 30kg/Ha of urea with a content of 46% nitrogen was applied.


Figure 1: Paddock 1 being prepared

Paddock 2 Treatment

Paddock 2 was also treated with Trillion. Then, to help break up the heavier clay structure, the 1 litre of MLC (x 100 litres of water)/Ha was applied. The soil was turned (with disks) to a depth of 4 inches (approx. 100 mm) to produce a structure that was loose and workable.

The type of seed used in this case study was rye grass and veg; this type of seed mixture being normal for this area, particularly where grasses are to be used for silage, which was the case here.

Again, because of the heavier soil structure, a higher level of Monty's MLC was applied to address the concern that the soil aggregate and structure was still binding and locking up essential minerals.

The full biological program was introduced at this point.

1) 125 kg/Ha of Bactivate, applied through direct seeding (Duncan Mark 3 seed drill – depth of placement 15cm).
2) 2 litres of Monty's MLC x 100 litres of water, sprayed using a Gold air spray unit.
3) 1 litre of Monty's 8-16-8/Ha was applied at week 3 after seed planting. Again, urea was used as the final application which finished the crop cycle, it was found that the 8.16.8 compound just did not supply the nitrogen levels required for this type of situation.

Crop Production Results: Paddock 1

This crop was planted in September 2010 , and 4 cuts have been taken in the period up to March 2011. The test reports on this crop are reproduced below.

Figure 2: Lucerne crop that has been cut three times since planting, showing very good health and regrowth

Protein Levels

It is important to note that protein levels achieved reached 23.4 %. Because this is a dry farm and the soils were very acidic, comments from local experts had been that this growth should not have been achieved. As detailed above, local expertise suggested that it would take 10 years to produce a Lucerne crop; with the introduction of the biological program the grower has achieved this goal in a 12 month period.

Soil pH

Figure 3: Lucerne crop at six weeks showing good growth for a dry land farm

During the growing cycle of the lucerne regular pH testing was carried out. During the first stage of growth the pH reading was 5.5. This was seen to be too acidic for a successful crop. After the application of the above biological program (at week 2) the soil pH level had increased to 5.8; at the 8 week point the pH level was 6.4, after the 4 cut of Lucerne the pH level was 6.8!

In summary, by the introduction of the biological program the soils have changed from a pH of 5.5 in September 2010 to 6.8 in March 2011, without the use of lime.

Crop Yield

Crop yield was as follows:

Year	Yield	Notes
2009	N/A	
2010	N/A	
2011	40 x 1 tonne bales/Ha x 4 cuts x 2.4Ha = 80 bales	

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Crop Tests

Please find below the results of crop testing.

FEED ANALYSIS REPORT

Southern StockFeeds
PO BOX 293
FOSTER VIC 3960

ATTENTION Jess May
FAX NUMBER 03 56821955
PURCHASE ORDER None
PROJECT NUMBER J1103-0574

DATE RECEIVED 15 March 2011
OUR SAMPLE NUMBER S2011-07780
YOUR REFERENCE
SAMPLE TYPE Silage
DESCRIPTION Lucerne
DATE SAMPLE COLLECTED

TEST	Result
NIR Package	
Dry Matter (%)	49.3
Moisture (%)	50.7
Crude Protein (% of dry matter)	23.4
Neutral Detergent Fibre (% of dry matter)	41.5
Digestibility (DMD) (% of dry matter)	63.2
Digestibility (DOMD) (Calculated) (% of dry matter)	60.4
Est. Metabolisable Energy (Calculated) (MJ/kg DM)	9.7

Note: **This report is not to be reproduced except in full.**

Final Report

Report Number: 48209

Comments:

Metabolisable Energy has been calculated using the following equation:
ME = 0.16 x DOMD%

AFIA Grade for legume and pasture hay + silage : A1

Please note: Dry Matter (DM%), Crude Protein (CP%) and Digestibility (DMD%) have been corrected in accordance with AFIA approved methods.

C Showler

Candida Showler

Team Leader, Feed and Fodder Laboratory

17 March 2011

Report Number: 48209
Issued: 17 Mar 2011

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Crop Production Results: Paddock 2

Protein Levels

Protein levels for this site were 18.8%. There is no information available as to historical protein levels for crop from this site.

Crop Yield

Crop yield was as follows:

Year	Yield	Notes
2009	35 x 1 ton bales x 1 cut x 3.2 hectares = 35 silage rolls	Drought period – before biological program
2010	60 x 1 ton bales x 1 cut x 3.2 hectares = 60 silage rolls	First year biological program
2011	70 x 1 ton bales x 1 cut x 3.2 hectares = 70 silage rolls	Second year biological program

Unfortunately there were no pictures taken of this crop – the farmer indicated that he simply forgot – being silage, the most important issue for the farmer was the question of bales/Ha, as shown above.

Anecdotally, in addition, the farmer claims that dry matter % and protein levels have also improved, but there are no figures to support this. In addition, it must be stressed that this crop was planted towards the end of the drought, yet the growth and increase in production were very evident.

Crop Tests

Please find below the results of crop testing.

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FEED ANALYSIS REPORT

Southern StockFeeds
PO BOX 293
FOSTER VIC 3960

ATTENTION	Jess May
FAX NUMBER	03 56821955
PURCHASE ORDER	None
PROJECT NUMBER	J1103-0574

DATE RECEIVED	15 March 2011
OUR SAMPLE NUMBER	S2011-07779
YOUR REFERENCE	
SAMPLE TYPE	Silage
DESCRIPTION	Rye
DATE SAMPLE COLLECTED	

TEST	Result
NIR Package	
Dry Matter (%)	62.2
Moisture (%)	37.8
Crude Protein (% of dry matter)	18.8
Neutral Detergent Fibre (% of dry matter)	52.4
Digestibility (DMD) (% of dry matter)	69.2
Digestibility (DOMD) (Calculated) (% of dry matter)	65.5
Est. Metabolisable Energy (Calculated) (MJ/kg DM)	10.5

Note: **This report is not to be reproduced except in full.**

Final Report

Report Number: 48209

Comments:

Metabolisable Energy has been calculated using the following equation:
ME = 0.16 x DOMD%

AFIA Grade for legume and pasture hay + silage : A2

Please note: Dry Matter (DM%), Crude Protein (CP%) and Digestibility (DMD%) have been corrected in accordance with AFIA approved methods.

CShowler

Candida Showler

Team Leader, Feed and Fodder Laboratory

17 March 2011

Report Number: 48209
Issued: 17 Mar 2011

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Cow Production

The crops grown were grown as fodder for the dairy herd, and the most critical part of this evaluation was always the impact on the herd: the areas of herd health, production levels, calving improvement, and overall disposition of the milking cow herd.

The makeup of the milking herd that taken part in this case study was as follows: 50% of milking cows have already been in production for more than 6 months (stale milking cows), and 50% are fresh calved cows.

Each aspect of herd health was closely monitored by the farmer and his staff, 30 day cycle reporting was introduced and records were kept of each period. Evaluation of cow health was by manual inspection, but in addition, photos of 6 animals were taken at the start of the case study, and updated photos of each cow were taken at each 30 day period.

Scouring of the herd was of particular interest. Scouring is a normal reaction of dairy cows once allowed to graze a crop or a fresh source of fodder. However, this reaction can have a negative impact on milk production.

Observations

According to the farmer (and this information coincides with independent observations made during the case study), less than 1% of the herd showed some form of scouring.

Over the entire trailing process it was very evident that the cows were digesting the food source very well, and rumen function was indicting that the grasses and grains added were having an impact on milk production.

The farmer also commented that after morning milking, the cows settled down in the designated paddock and were seen to move into the chewing of the cud phase approximately 1 hour earlier than normal; this meant that what was being provided to the herd was being digested more easily (and therefore more quickly).

Each animal received 22kg of food per day, consisting of 6kg of concentrated formula that is provided in the dairy shed during milking and 16kg of silage and grasses.

Uptake of the food source by the milking herd , particularly the silage that was placed into the paddock was seen to improve. The farmer reported that the uptake percentage was around 95%, a substantial improvement on previous years, in which the farmer indicated the figure was always around 70 - 80% depending what was available in the grazing paddock. The farmer believed that his silage was sweeter and therefore the animals would tend to clean up better (the

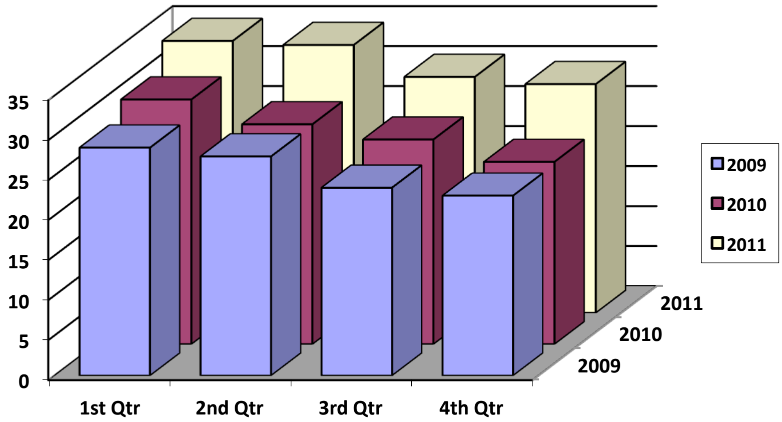
Figure 4: Typical cow from the herd

farmer's terminology) and the grasses in the paddock had more bulk content in them.

While the rainfall that had been received had certainly had a influence on the result, when the information the farmer had collected on rainfall received during the full lactation period was examined, it was shown to be just above average for this area. The farmer commented that he believes that the results being seen in the silage and grasses were because of the use of the biological program.

Milk Production

The following graph shows the milk production before and during the period of the .



As can be seen, during 2010, as the biological program developed, so did the milk production improve. It needs to be borne in mind that the program began during the drought conditions which were regarded as the worst on record.

In 2009 each cow produced average 25 litres/day, in 2010 the figure was 27 litres/day, and in 2011, 30 litres/day (this information was gathered from the manufacturer reports each month on production). It is interesting to note that as of 2011 the stale milking cows are still maintaining 28 litres/day of production.

Butter fact percentage improved from 4.43% to 4.53% and protein percentage from 3.28% to 3.34%.

Animal Health

During this trial a number of areas relating to animal health and the effects that this biological program may have on the overall performance of the milking herd were examined. Areas believed important included ease of calving, cow attitude, digestion of fodder and overall health of the animals. Each of these categories will be discussed below.

During the lactation period there were many factors that had to be taken into consideration, including weather patterns, as these can and do have a influence on the results. However, it is clear that the biggest influence on the overall health of the cows concerned was the biological program and the fodders that it developed. It is the farmer's belief that the change in weather conditions only had a very small influence on the results, because in previous years (before the drought), weather and other conditions were very similar to those during the trial, and yet the cows did not respond in the same way as now.

Digestion of Fodder

The cow's digestive tract consists of the mouth, esophagus, a complex four compartment stomach, small intestine and large intestine, as can be seen in figure 1. The stomach includes the rumen or paunch, reticulum or " honeycomb," the omasum or "manyplies" and the abomasums or "true stomach."

The beneficial bacteria found in Bactivate will form Colony Forming Units (CFUs) in these areas.

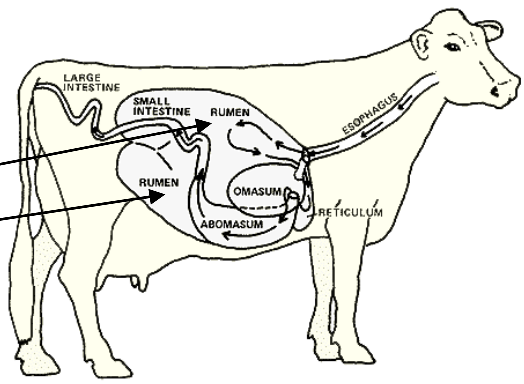
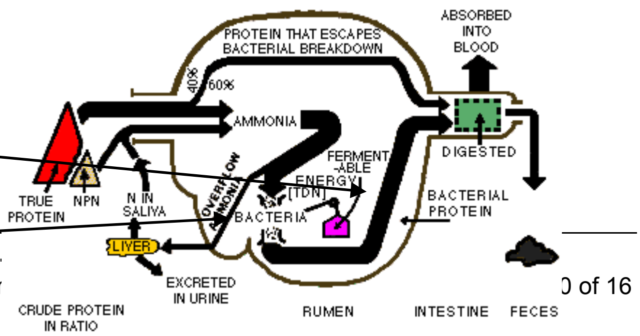


Figure 5: The bovine digestive system

The rumen. The rumen (on the left side of the animal) is the largest of the four compartments and is divided into several sacs. It can hold 95 litres or more of material, depending on the size of the cow. Because of its size, the rumen acts as a storage or holding vat for feed. It is also a fermentation vat. A microbial population in the rumen digests or ferments feed eaten by the animal. Conditions within the rumen favor the growth of vital microbes; the rumen absorbs most of the volatile fatty acids produced from fermentation of the feedstuffs by the rumen microbes. Absorption of volatile fatty acids and some other products of digestion are enhanced by good blood supply to walls of the rumen. Tiny projections called papillae increase the surface area and the absorption capacity of the rumen.

Bacillus subtilus, bacillus mucilaginous, and bacillus licheniformis are found in these areas of the rumen.



Currently in most pasture situations the beneficial bacteria that are needed by the rumen for fermentation come partly from the soil and its grasses. However, because of many different issues that surround grass production and fodder crop production, these bacteria are in many cases not available. This biological program has certainly improved this area; soil tests taken show a very substantial improvement in biological activity.

Beneficial bacteria and fungi have been found in large quantities in grasses and fodder crops that have been produced under this biological program.

Digestion of Energy Feeds in the Rumen

What has been found on examination of the faeces dropped by the cow, is that full digestion had taken place, in previous years this herd had a problem in fermentation of the nature wheat and barley crops that were being feed in the milking extraction areas (milking shed).

Simple and complex carbohydrates (fibre) are digested by the rumen microbes then converted into volatile fatty acids. The volatile fatty acids, which consist mainly of acetic, propionic, and butyric acids, are the primary energy source for the ruminants.

When large amounts of forage are dry feed, which was the case here, the formation of acetic acids predominates (60 to 70 percent of total) with lesser amounts of propionic (15 to 20) and butyric (5 to 15 percent) acids occurring. However, when grain feeding is increased or when finely ground forages are fed, the proportion of acetic acid may decrease to 40 percent, while the amount of propionic acid may increase to 40 percent. Such a change in volatile fatty acid production is generally associated with a reduction in milk production.

When certain microbial populations are active in the soils and grasses and fodder being supplied to the cow, approximately 30 to 50 percent of the cellulose and hemicelluloses are digested in the rumen by the microbial population. Sixty percent or more of starch is degraded, depending on the amount fed and how fast ingested materials move through the rumen. Most sugars are 100 percent digested within the rumen.

The volatile fatty acids are absorbed from the rumen into the blood stream and transported to body tissues, where they are used as sources of energy for maintenance, growth, reproduction, and milk production. The cow derives 50 to 70 percent of its energy from volatile fatty acids produced by the rumen (see diagrams below).

Microbial digestion of feed

Carbohydrate in the cow rumen.

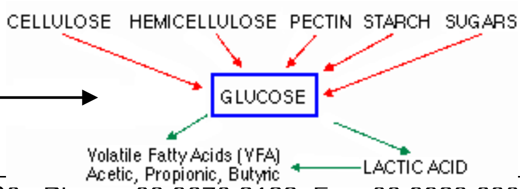


Figure 6: Microbial digestion of feed carbohydrate

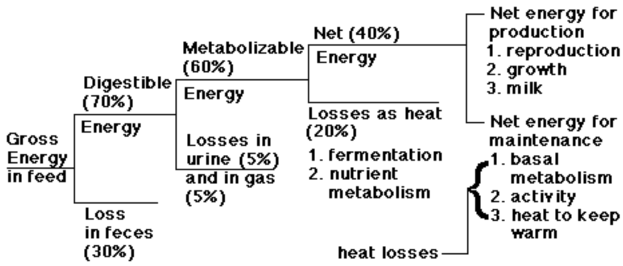


Figure 7: Energy losses in a lactating cow

The importance of biological activity (and therefore of soil biological activity) can be seen; this is a very important area in managing production.

The results that have been achieve in these areas of digestion during the trial have been excellent, information was gathered from the excretion from the cows as well as monitoring feed intake as well as milk production. All areas improved over the trial period.

Feed uptake improved 20%, holding and conversion of those feeds by the rumen seemed to have improved (indicators were feces piles), and cow temperament as well as production of milk improved.

There has been very little sign of scouring throughout the herd; this indicated that the rumen is converting all nutrients that are being supplied, the impact of this conversion can certainly be seen in the production tank.

The behavior of cows after milking (chewing their cud earlier than before the trial) shows that the feeds that have been supplied from the trial sites were being converted more easily (and therefore faster) and the cows were more at ease.

Figure 8: Cows in the day paddock 1.5 hours after milking

Ease of Calving

20 replacement heifers and cows were monitored through to calving, the cows had been in the paddock for 30 days , and had been grazing in the biological paddocks during their lactation period for approximately 8 months. The first year heifers had been fed silage and grasses as part of the program.

One of the biggest problems in the dairy industry is ease of calving issues, genetic adjustment in some cases has worked, but in many it has not.

This farm has been using Artificial Insemination (or "AI" as it is commonly known among farmers). In the previous years leading up to the program being introduced, calving of the herd was not a real problem, but the farmer indication that he would still like to see some improvement, as 10% of all his first year heifers had experienced some sort of calving problems, and did the mature cows, and milk fever was always threatening.

In 2010 the herd was introduced to the biological program, and since that time ease of calving has improved, the farmer has indicated that he is now only experiencing around 3% of difficult calving experiences.

It is possible that the intake of beneficial bacteria into the diet could be responsible for this decrease, as well as climate conditions, which always play a very important role.

Foot Disease, Bloat, and Milk Fever

All of these areas have shown improvement, the farmer had indicated that because of the abnormal weather conditions he was expecting the above areas to be a problem, but despite this he has had only a very small amount of his herd with any reaction to the weather conditions, particularly the freshly calved cows, where it has been seen over a normal season and similar weather pattern, the farmer has been very impressed with the results thus far.

Summary and Discussion

What this case study illustrates is the benefits that can be achieved through biological balance. Not only has the production level increased within the milking herd, but many other areas of concern have shown improvement as well.

The growing of fodder and grasses for milk production has many different aspects to it. The results that have been achieved in the area of digestion are amongst the most important parts of any milk production operation; we can see the importance of providing the bacteria that are needed by the animal to breakdown all the nutrients that are being supplied.

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Consider for a moment just the area of crude protein. Approximately 60 percent of the crude protein in the typical dairy cow diet is broken down by microbial digestion to ammonia. The rumen microbes must convert the ammonia to microbial protein if the dairy animal is to receive any benefit.

Fermentable energy must be available for the micro-organisms to grow and synthesize the necessary amino acids, if the rumen ammonia levels are excessively high, the ammonia is absorbed into the blood and recycled or excreted in urine as urea.

This area alone indicated the importance of having good biological balance within the soil structure.

According to the University of Minnesota, this has conducted extensive research info the affects of microbial activity within soil structure, and the impact that it has on dairy cow health:

"The optimal diet fed to a dairy cow will:

1. **Meet the nitrogen requirement of the rumen micro-organisms for maximum synthesis of micro-organism protein and**
2. **Allow for maximum escape or bypass of high quality feed protein for digestion in the small intestine. Protein synthesis by rumen microbes will depend on feed intake, organic matter digestibility, feed type, protein level, and feeding system."**

This trial has certainly shown that microbes do play a very important role, not only in the area of production, but also in the area of animal health. This trial has shown improvements in all health area, including the reduction of methane gases.

Because of the availability of beneficial bacteria that were supplied to the soils during this trial and then through growth of the fodder crops and grasses, we have seen improvement in the not only the digestive system of the dairy cows but also in their attitude in the dairy production area. In addition, ease of milking has improved, this can be seen in the reduction of negative bacteria counts within the milk product (these counts are taken by the collection manufacturer each month, and farmers are instructed to lower these levels on a continuous basis, in the past this farmer has experienced some problem in this area, but since the cows have been grazing on the biological feeds this area has improved).

Pasture growth and development was a key factor in this trial. The farmer was told on many occasions that he could not grow lucerne on this property; if he wanted to try he would have to apply 2.5 ton/Ha of lime for a period of 10 years. As a result of the biological program, this farm has achieve growth of lucerne within 20 weeks after the introduction of the \ program, and as can be seen in the above results, the first year yield was as good as soils that had been growing this species of plant for many years.

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Re-growth was excellent – the farmer has achieved 4 cuts in the first year of production, with energy levels of 23.4 a very good result considering that the property is dry land farming and far from ideal for growing this crop.

The result achieved with rye grass silage were also very good, considering that this was harvested at the end of the drought, and the tonnage that was achieved has certainly indicated that dry land farming can achieve very good results and tonnage.

In summarizing the results of this case study, we have seen cow health improve, increases in production, heifer health improvement was seen, soil structure improved (including the reinstatement of biological balance).

The farmer will continue with the use of the program (and this case study will continue) into the next lactation period.

Note Of Thanks

Trials such as this require not only the consent of the farmer, but considerable time and effort in cooperation. Although in this case the results for the farmer have been outstanding, this is not always the case for a farmer entering into a trial, and agreeing to do so can be a substantial commitment without a guarantee of a good result.

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We would like to thank our host farmers for their cooperation during this trial.