Supplements –

Getting the Biggest Bang for your Buck!

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Take Home Messages:

- **The key to dairying success is good quality forages!**
- Ensure forage is harvested at the ideal maturity and dry matter
- Pack, pack, pack the silage
- Effectively sealing the exposed surface of the silage pit is one of the most important management decisions for silage supplement
- Effective sealing reduces aerobic spoilage to avoid shrinkage and nutrient losses
- Ensure tires are touching on the silage stack
- Do not feed moldy silages – it depresses DMI, reduces nutrient digestibility, negatively affects rumen health and in the worst case can cause abortion or death
- The more your cow eats, the more she milks!
- Regular pasture and silage testing is critical to optimizing nutritional management.
- Work with your nutritionist! Inclusions of any supplement (forage, concentrate or by-products) needs to be nutritionally balanced to meet the requirements of the cow at different stages of the lactation cycle.
- Adding supplements to "fill the gaps" is very cost effective.

As a dairy nutritionist I have had the great fortune of working in many countries around the world and have learned to operate within a diverse range of production systems. I am familiar with very extensive, low input systems in poverty stricken Central America, to high-tech operations in Japan and Korea where they import very expensive forages. Being Canadian I am familiar with the intensive North American systems but I have also worked in drought stricken Australia. Now I have the luxury of living and working within the New Zealand pasture based system.

By luxury, I mean that NZ is one of the few places in the world that we can grow pastures and have cows harvest that pasture for us. In Canada our ground is frozen and under 1 m of snow for 5 months of the year, forages must be preserved or cows starve. In China, the population density demands that three to four crops be harvested from one piece of ground. One of the most important things I have learned in my career is that **REGARDLESS OF GEOGRAPHY or PRODUCTION SYSTEM, THE KEY TO SUCCESS IS QUALITY FORAGE!!!**

Supplements mean different things to different people. So to make sure we are all on the same wave-length, let's go through a few definitions. A **supplement is anything that is used to balance the nutrient profile of grass in order to meet the cow's nutritional requirements**. Forage supplements include grass silage, maize silage, hay, straw, etc. Concentrate supplements include grains (barley, wheat, maize grain, etc.), molasses and pellets manufactured by feed companies. By-product supplements include soy bean meal (SBM), palm kernel extract (PKE), copra, tapioca, bakery waste, vegetable waste, etc. Micro nutrient supplements include salt, macro-minerals (Ca, Mg, P, K, Na, Cl, S), trace elements (Se, Cu, Co, I , Zn, Mn), and vitamins.

I classify inputs such as ionophores, anionic salts, glycol, yeast, biotin and sodium bicarbonate as ADDITIVES. Additives are a group of ingredients that can cause a desired response such as shift rumen acidity, enhance growth, or modify metabolism. Most are not nutrients, although some also contain nutrients such as the sodium in sodium bicarbonate. Inclusion of additives into dairy diets is a subject for a seminar on its own. For now we will focus on supplements.

Forage Supplements

To begin with, let's look at **silage utilisation**. As I drive around the countryside, I get the impression that it is not important to cover silage. Or at least, there are not very many silage stacks which are well covered.

Sights like Figure 1 are common place around the lower south island.

I would argue that **effective sealing is CRUITIAL**!! The whole point behind making silage is to preserve the forage by squeezing the air out and keeping it out. You go to all the expense and effort of making silage; it really pays to finish the job properly.

Figure 1 – Poorly sealed silage stack

Poor sealing, and / or damage to the plastic layer, allows air into the stack causing aerobic spoilage. Covering a stack with plastic but no tires acts like billows – every time the plastic flaps, there is an injection of air into the silage. The result is growth of aerobic bacteria, yeasts and molds. These little beasties consume the dry matter and nutrients that should be "preserved" for our cows. For example, research by Jarrige (1982), calculates that aerobic spoilage can account for dry matter losses greater than 20%. This kind of loss can be critical, especially in seasons like this year when feed is tight. To compound the problem, Zimmer (1980) found that spoilage can reduce the energy content of feed by as much as 10%.

When we pay the contractor, we pay them for what goes into the silo, not what comes out. So in order to get the biggest BANG for your forage supplement dollar, it pays to seal the stack effectively.

Effect of surface spoiled silage

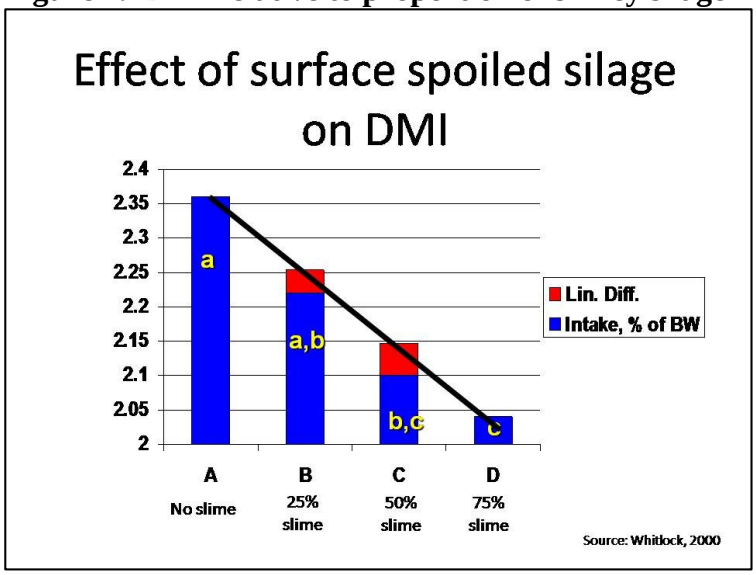
A study done by Whitlock et al. (2000) evaluated surface spoilage in silage. The original depth of the packed silage in the bunker was about 91 cm; however the final depth of the spoiled (i.e. poorly sealed) silage was only about 56 cm. This demonstrates the huge loss in the quantity of feed. Not only that, the quality of the feed was significantly affected as well. Of the 56 cm left, there was a 15 cm layer of black, slimey, "mud like", foul smelling waste. The remaining 38 cm layer had a very strong acetic acid smell, an indicator of poor quality.

Four rations containing 100% normal silage (A), 25% silmey silage (b), 50% slimey silage (C), and 75% slimey silage were fed to twelve ruminally cannulated crossbred steers to

determine the effect of the surface spoiled silage on dry matter intake and nutrient digestiblities.

As demonstrated in Figure 2, dry matter intake decreased in a linear manner as the proportion of spoiled silage increased from 0 to 75%. Remember, **the more a cow eats the more she will produce**. If we are limiting her dry matter intake (DMI) by giving her poor quality silages we are not getting the biggest bang for the buck we spent on making those silages.

Figure 2. DMI relative to proportion of slimey silage



To compound the DMI issue, addition of surface-spoiled silage had negative associative effects on nutrient digestibilities (DM, OM, CP, ADF, NDF) and the integrity of the forage mat in the rumen was partially destroyed by even the lowest level of spoiled silage.

Problems with quantity and nutrient quality of spoiled silage are made worse by the fact that if you feed moldy silage you run the risk of causing abortions or even death.

Cost of DM and Nutrient Losses due to Surface Spoiled Silage

What are dry matter and energy losses due to aerobic spoilage actually costing? Does it really matter? **YES IT MATTERS!!! Feeding poor quality silages is costing you milk solids.** To demonstrate how to get the biggest bang for our supplement buck three scenarios are presented.

Table 1 outlines the differences between feeding good quality forage (11 MJ ME / kg DM); poor quality forage (10 MJ ME / kg DM); and poor quality forage supplemented to fill the energy gap.

Table 1. Economic analysis of good vs. poor quality forage vs. poor quality forage + concentrate supplement

	Good Quality Forage	Poor Quality Forage	Poor Quality Forage + concentrate
Forage Energy (MJ ME/kg DM)	11	10[1]	10[1]
DMI (kg)	18	16.2[2]	19
Total Energy Intake (MJ ME/c/d)	198	162	198
Energy Cost of maintenance, body condition gain, walking[3] (MJ ME/c/d)	75	75	75
Energy available for production (MJ ME/c/d)	123	87	123
Energy conversion to milk solids (kg MS/c/d) [4]	1.89	1.34	1.56 1.34 kg from forage 0.22 kg from conc.
Pay Out ($/kg MS)	$7.00 / $6.50	$7.00 / $6.50	$7.00 / $6.50
Per Cow Income ($/d)	$13.23 / $12.29	$9.38 / $8.71	$10.92/ $10.14
Extra Feed Cost ($/c/d)	0	0	$1.22[5]
Lost Income	0	$3.85 / $3.58	$2.73 / $ 2.15
Return on concentrate investment			26% / 17%

[1] Energy loss due to aerobic spoilage assumed to be 9% (i.e. 11 to 10 MJ ME /kg DM). This assumption is well within the responses of up to 10% energy loss found by Zimmer, 1980

[2] DMI reduced by 20% due to dry matter loss of poor quality forages (Jarriage et al., 1992)

[3] Dexcel Farm Facts 5-22

[4]Assuming 1 kg MS costs 65 MJ ME from forage (Dexcel Farm Facts 5-22) and 1 kg of 13 MJ ME/kg DM concentrate yields 0.08 kg MS (Roche and Holmes, SIDE 2007). These are very conservative assumptions.

[5] 2.77 kg of 13 MJ ME/kg DM concentrate is required to balance energy intake to 198 MJ ME/c/d + 10% concentrate wastage = 3.05 kg/c/d @ $400/T

Good Quality Forage Scenario

In this scenario the cow is eating 18 kg of good quality forage, (e.g. a combination of 11 MJ ME/ kg pasture and grass silage). In this case her total energy intake is 198 MJ ME / day (11 MJ ME / kg DM * 18 kg DMI). Some of that energy is needed for maintenance, body condition gain and walking to and from the shed. Using the DairyNZ guidelines (Dexcel Farm Fact 5-22), this leaves the cow with 123 MJ ME for production. If 1 kg of MS requires 65 MJ ME from forage, then this cow has the ability to produce 1.89 kg MS/ day. At a $7.00 payout she will earn $13.23 per day. At a more conservative $6.50 payout she will earn $12.29 per day.

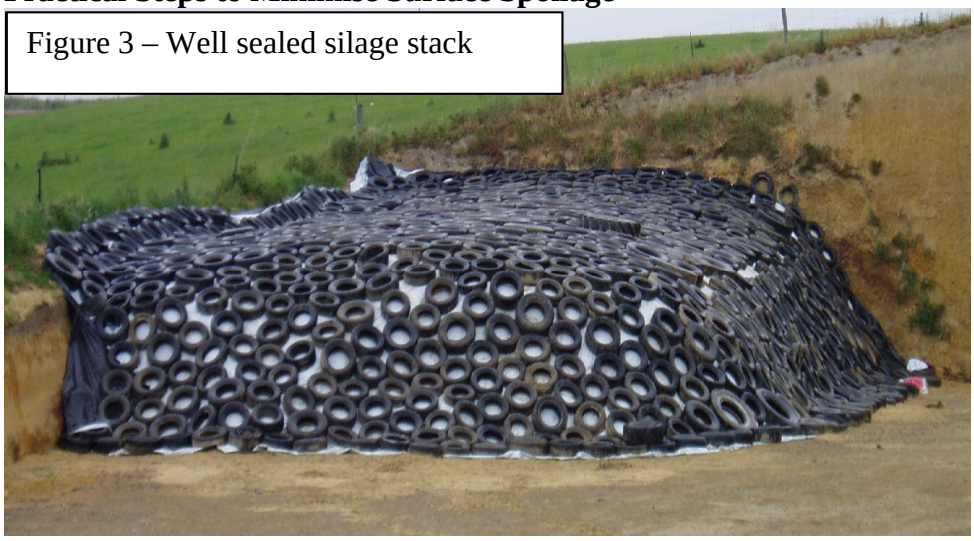
Poor Quality Forage Scenario

In the poor quality forage scenario, I have assumed that the cow is eating 10% less dry matter simply because it is no longer there for her to eat (i.e. it is assumed that 10% of the silage was lost due to poor sealing). The total energy intake for this cow is 162 MJ ME / d (10 MJ ME/ kg DM * 16.2 kg DMI). After we account for maintenance, body condition gain and walking this cow has 87 MJ ME left over for production. This translates to 1.34 kg MS/day. At a $7.00 pay out this cow will be losing $3.85 per day. At a $6.50 pay out she will be losing $3.58 per day.

This example demonstrates that in order to get the biggest bang for your silage buck, effective sealing of the exposed surface is one of the most important management decisions for silage supplements!!!

Practical Steps to Minimise Surface Spoilage

Figure 3 – Well sealed silage stack



Creating an effective seal can be done by the following:

- Achieve a high pack density (minimum of 240 kg/m^3)
- Back, front and sides should not exceed a 3 to 1 slope
- All surfaces should be smooth so water drains off… not in
- Seal as soon as filling and compaction are complete
    - If sealing is not possible on the day, cover with plastic and tires over night
    - Seal the next morning, but do not remove the plastic to re-roll
    - Delayed sealing increases losses
- Use 2 sheets of plastic specifically designed for silage making
- Overlap joins by 1.2 m and seal with plastic adhesive tape designed for silage sheeting
- Use dry, clean plastic
- Sheets should reach at least 1.2 to 1.8 m off the forage surface around the entire perimeter of the stack
- Put uniform weight on the sheets over the entire surface
    - **MAKE SURE TIRES ARE TOUCHING!**
- Double the weight placed on all overlaps

Reducing aerobic spoilage at feed out is also important. This can be achieved by:

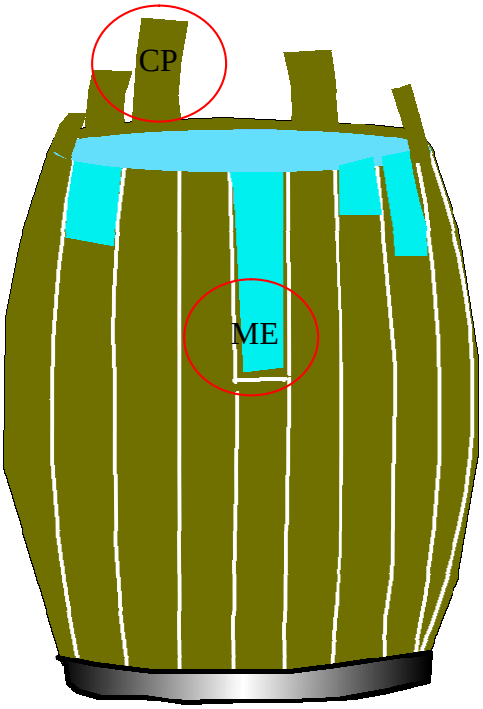
- Rapid filling, good compaction and effective sealing
- Use reputable silage inoculants
- Ensure feed out rates is fast enough to avoid heating the silage face
- Minimise disturbance to the feeding face in order to minimise air penetration.

Filling the Gaps

But what if you are stuck with 10 MJ ME/kg DM forage? If your forage quality is not ideal, you have identified a nutrient gap.

The production capability of a cow can be explained using the barrel analogy. For example, the genetic potential of our cow is the height of the barrel (e.g. 25 l of milk per day or 2 kg MS per day).

The staves in the barrel represent the various nutrients required to reach the production capacity (e.g. energy, crude protein, ADF, NDF, effective fibre, vitamins, minerals, water, etc.). Each of these nutrients can be provided by various feedstuffs. Cows are actually not that picky, they don't care if the energy comes from pasture or another supplement as long as she gets it as part of a balanced ration.



The diagram represents the nutrients which are provided to the cow from pasture. In this scenario there are some staves which are greater than the production potential of the cow. This is similar to the case of spring pasture which is very high in crude protein (CP). The amount of CP provided by the spring pasture is more than the cow requires to reach her production capacity. In this case, addition of extra CP will not elicit a positive production response (i.e. more milk solids). In fact, addition of a nutrient beyond the requirement can be detrimental and cause body condition loss and / or a negative production response. In order to balance the diet, supplements may be needed balance high soluble protein levels with soluble carbohydrate levels (e.g. molasses) and ensure effective fibre is available (e.g. straw).

There are a few staves in the barrel which are below the cow's production capacity; that is to say these nutrients are limiting production. No matter what else you do the bucket will never be able to be full. For example, in the case of poor quality, 10 MJ ME/kg DM, forages the lowest stave represents metabolisable energy (MJ ME). Inclusion of a high energy supplement is warranted to optimise the full potential of this cow (i.e. Fill the bucket!).

The secret of dairy nutrition is to identify what the profile of the staves of the barrel is and supply supplements to fill the gaps.

This strategy is in line with Roche and Holmes who stated "The profitable use of supplements in dairy systems requires an understanding of the factors affecting responses to supplements" (SIDE, 2007).

Going back to our examples in Table 1, the third scenario is filling the energy gap of the poor quality forage with a concentrate supplement. In order to fill the energy deficit of 36 MJ (198 – 162), an additional 2.77 kg DM of 13 MJ ME concentrate could be fed. According to Roche and Holmes (SIDE, 2007) supplementation with concentrate will not elicit the same

production response as forage energy. According to their study, 1 kg of 13 MJ ME concentrate can contribute a minimum of 0.08 kg MS. Therefore 2.77 kg of crushed barley will contribute an additional 0.22 kg MS/c/day. We know that feed out of concentrate incurs some waste. Assuming a 10% waste level it will cost $1.22/c/d to supply the concentrate. Although the production response is still not as great as 100% quality silage, the added milk solids due to inclusion of crushed barley at a $7.00 payout equates to a 26% return on investment. At a more conservative $6.50 payout the return on investment is 17%. That is an investment I am happy to make!

It should be noted that such a production response can be achieved with a cow that is grown out properly and in suitable body condition for phase of lactation. If an animal is in poor body condition, it is very likely that she will use some of the energy for herself. Although there is not an immediate production response in such a case, it will pay dividends over the longer term.

In order to achieve the biggest bang for your supplement buck, you need to identify where the gaps are. This can be achieved through regular forage testing of your pasture and silage. A nutritionist can work with you to interpret the forage analysis (i.e. identify the staves in the barrel) and balance the ration strategically to select supplements which accommodate for the limiting and / or excessive nutrients.

In order to ensure the cost effectiveness of strategic supplementation, tracking performance is strongly recommended. There is no point in including inputs which do not offer a return on your investment.

Summary

In summary, in order to get the biggest bang for your supplement buck, it is important to remember the key criteria to optimising ideal forage preservation. Ensure the forage is harvested at the ideal maturity and DM. As the pit is being filled, pack it, pack it again and when you think you have packed it, pack it one more time. As soon as the packing is complete, cover the stack with plastic weighted down with touching tires.

When considering the inclusion of any type of supplement, from forage to concentrates to by-products, the decision should be based on balancing the ration. Identify the limiting and / or excessive nutrients in the pasture and select supplements accordingly. Work with your nutritionist to monitor the responses and adjust accordingly.

References:

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