Cost Effective Minerals

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Introduction

I will outline the trace mineral supplementation used on the Lincoln University dairy farm, the cost of the programme and the results achieved. I am not advising that this system is suitable for all other farms, as every farming situation is unique, and must develop a programme suitable for their own operation.

Description of the Dairy Farm

The Lincoln University dairy farm is a new conversion just completing the second season of milking. The pastures are 95% new, having been established in the autumn of 2001.

During the 2001-2002 season 500 cows were milked on 142 ha of the milking platform, with the young stock run on the remainder. During the 2002-2003 season, 600 cows have been milked on the whole milking platform of 161.5 ha. The 2003-2004 season will see 650 cows milked on the milking platform of 161.5 ha, giving a stocking rate of 4 cows/ha.

The dairy farm water supply has a Dosatron™ dispenser installed. During the first season this was used to administer magnesium chloride ($MgCl_2.6H_2O$) and bloat remedies as required through the water supply. For the second season we installed a water meter into the supply line from the dispenser enabling us to record and monitor the water consumed by the herd through the water trough system, and therefore the amount of supplementation that the animals are receiving.

Monitor Programme

The Lincoln dairy farm works with our fertiliser supplier, and we monitor the soil fertility and the mineral status of the pastures. We also monitor the mineral status for the herd, with regular blood testing of the same representative group of cows each time. Together these provide a monitor process for pasture and animal health.

Pasture Samples

Pasture samples have been taken during winter and spring to assess the trace element treatment programme. Establishing the base point at the start of the 2002-2003 season. Table 1 shows the averaged analysis for the samples collected.

Table 1: Pasture samples—mineral status.

Date and Sample	Winter 2002 – Clover		Spring 2002 – Mixed Pasture	
Trace Element	Average Result	Optimum Range	Average Result	Optimum Range
total nitrogen %	4.6	4.8 - 5.5	3.85	4.5 - 5.0
phosphorus % w/w	0.33	0.34 - 0.40	0.42	0.35 - 0.40
potassium % w/w	1.5	2.5 - 3.0	2.0	2.5 - 3.0
sulphur % w/w	0.23	0.27 - 0.32	0.49	0.27 - 0.32
calcium % w/w	1.46	0.40 - 0.50	0.59	0.25 - 0.50
magnesium % w/w	0.21	0.18 - 0.20	0.22	0.16 - 0.22
sodium % w/w	0.3	0.02 - 0.20	0.31	0.10 - 0.25
Px100/N	7.08	-	11.0	6.9 – 7.4
Sx100/N	4.97	-	12.9	4.8 – 5.0
iron mg/kg	168	50 - 65	136	50 – 60
manganese mg/kg	81.5	25 - 30	169	25 –30
copper mg/kg	6	6 - 8	8.25	6 – 8
zinc mg/kg	49	16 - 19	35	14 – 20
boron mg/kg	19.5	14 - 16	8.8	8 – 15
cobalt mg/kg			0.13	-
selenium mg/kg			0.038	-
molybdenum	0.74	0.15 - 0.20	0.49	0.3 - 0.4

Water meter measurements

During the early spring, a water meter was installed on the downstream side of the dispenser, in a position to give accurate water measurement. The water used was recorded, and this information used to assess the dose rates for each trace element administered. Advice was obtained about the target dose rates for each trace element, and a calculation made to supply these trace elements using low cost sulphates where possible. The daily averages of treated water consumed ranged from 60 plus litres/cow/day to low levels of 3 to 4 litres/cow/day during heavy rainfall.

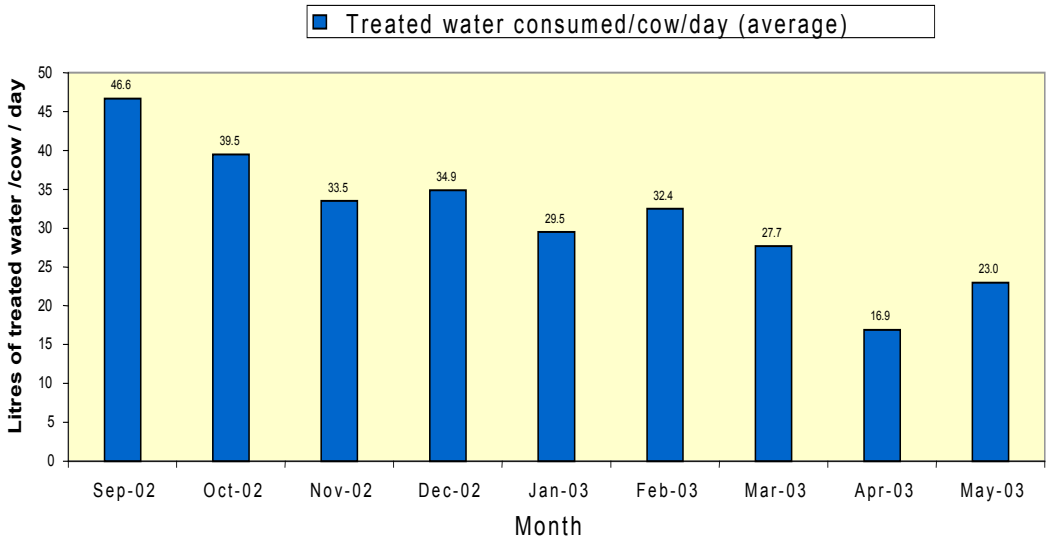

Figure 1: Treated water consumed/cow/day (average valves for period)

Method of supplementation

The trace minerals were administered via the dispenser with the rates and treatment procedure below. The rate was linked to the water consumed as measured by the water meter.

- Dispenser rate set at 1.2% (i.e. 1.2 litre of concentrate mix per 100 litre of treated stock water consumed). In prolonged periods of high water consumption (constantly exceeding 30-35 litre/cow/day), as recorded by the water meter, this was adjusted. During these periods we did run for periods at 0.8% to achieve approximately one drum of concentrate used per day on average.
- 200 litre concentrate drum mixed and supplied to the dispenser on demand, sometimes using more than 200 ℓ per day, and sometimes less.
- Changes in mix made during the season, but not increased from the spring rates. The main changes were adjusting the selenium concentration, reducing the magnesium concentration and a change in iodine supplementation.

Magnesium

The planned dispensed mineral programme adopted for the 2002-2003 season included the use of $MgCl_2$ administered via the water supply, but also included the use of MgO during the late winter and early spring to ensure that the correct levels could be reached. The maximum recommended rate for $MgCl_2$ in the water supply would not meet demand during these high requirement periods. I do not intend looking at the Mg part of the supplementation programme, but have listed the dose rates that we applied with $MgCl_2$ in Table 2.

Table 2: Dose rates of Mg ($MgCl_2.6H_2O$) supplied from the water supply.

Month	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Mg mg/cow/day	11.2	11.9	12.1	9.4	5.3	5.8	5.0	3.0

Extra Magnesium supplied in the spring by:

- MgO dusted on pasture for all dry cows, approx. 50-60g/cow/day.
- MgO dusted on pasture or silage for colostrum cows (+ lime flour 150-200 g/cow/day).
- MgO dusted on all silage feed during this period.

Mineral supplementation programme

The suggested treatment levels of trace elements for the dairy farm for the 2002-2003 season are as listed in Table 3.

Table 3: Dose rates used for 2002-2003 season for trace elements.

Element	Selenium	Copper	Zinc	Cobalt	Iodine
Product Used	Sodium Selenate	Copper Sulphate	Zinc Sulphate	Cobalt Sulphate	Potassium Iodide
Concentration of element	5 mg/ml	22%	21%	21%	76%
mg element/cow/day	4	200	400	10	4.1

Selenium

Treatment

A liquid selenium product (5mg of elemental selenium/ml of concentrate) was added to the concentrate drum (200 litre) at a varying rate through the season. This started at 500 ml per drum and changed to 300 ml and 400 ml during the season. The dosing levels were higher at the start of the season because of the relatively low blood levels. Once the second blood test showed adequate levels, we reduced the dose rate. Selenium (Selcote Ultra) was applied to the farm at the rate of approximately 1kg/ha in the spring of 2001.

Figure 2 shows the treatment rate of elemental selenium and the measured blood serum levels over this period.

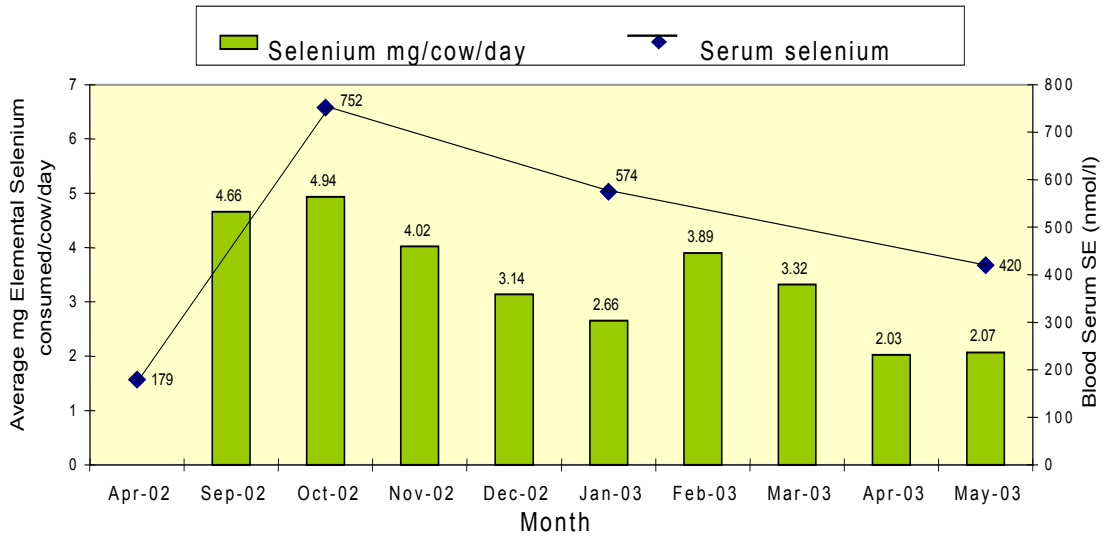

Figure 2: Selenium dose rates and serum blood test results

Marginal Range Blood Serum SE (nmol/l) 85 – 139

Adequate Range Blood Serum SE (nmol/l) 140 - 7000

Liver samples were taken from cull cows for selenium and copper, their analysis is shown in Table 4 and Table 5.

Table 4: Liver Sample May 2003 – Selenium.

Animal	01	02	03
Liver Selenium (nmol/kg)	2600	1560	2700
Mean Selenium (nmol/kg)	**2287**		
Low	0 - 599		
Marginal	600 - 850		
Adequate	851 - 15000		
High	15000 - 100000		

Copper

Treatment

Copper sulphate was added to the concentrate drum at the required rate, and dispensed.

Table 5: Liver Sample May 2003 – Copper.

Animal	01	02	03
Liver Copper (umol/kg)	1660	410	1400
Mean Copper (umol/kg)	**1157**		
Low	0 – 44		
Marginal	45 – 95		
Adequate	96 – 4000		
High	4001 - 100000		

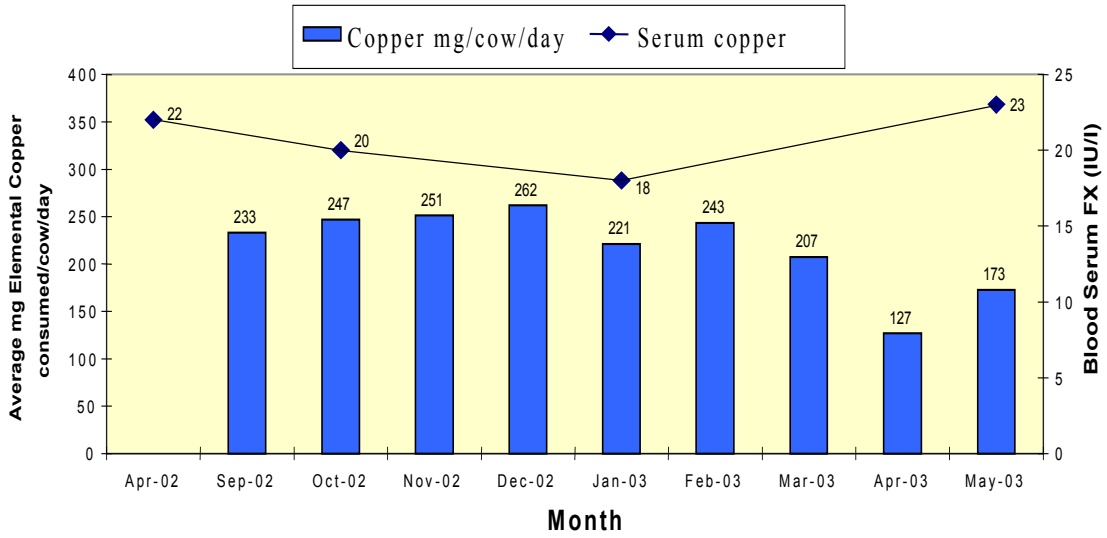

Figure 3: Copper dose rates and serum blood test results.

Adequate Range for Blood Serum FX (IU/l) 15 - 35

Zinc

Treatment

Zinc sulphate was added to the concentrate drum at the required rate, and dispensed. The blood tests for zinc have been low for the herd throughout the 2001-2002 season. The aim this year was to raise the levels to the adequate range. Figure 4 shows that the dose rate of 400-500 mg/cow/day was adequate to raise the levels to the target range.

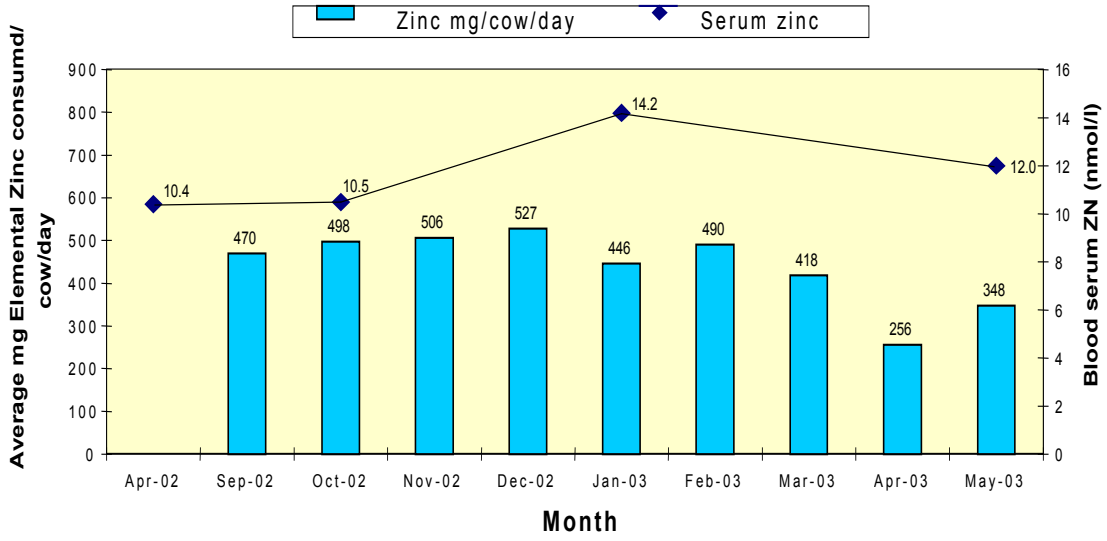

Figure 4: Zinc dose rates and serum blood test results.

Marginal Range for Blood Serum Zn (nmol/l) 7 - 12

Adequate Range for Blood Serum Zn (nmol/l) 12 – 18.5

Cobalt

Treatment

Cobalt sulphate was added to the concentrate drum at the required rate, and dispensed.

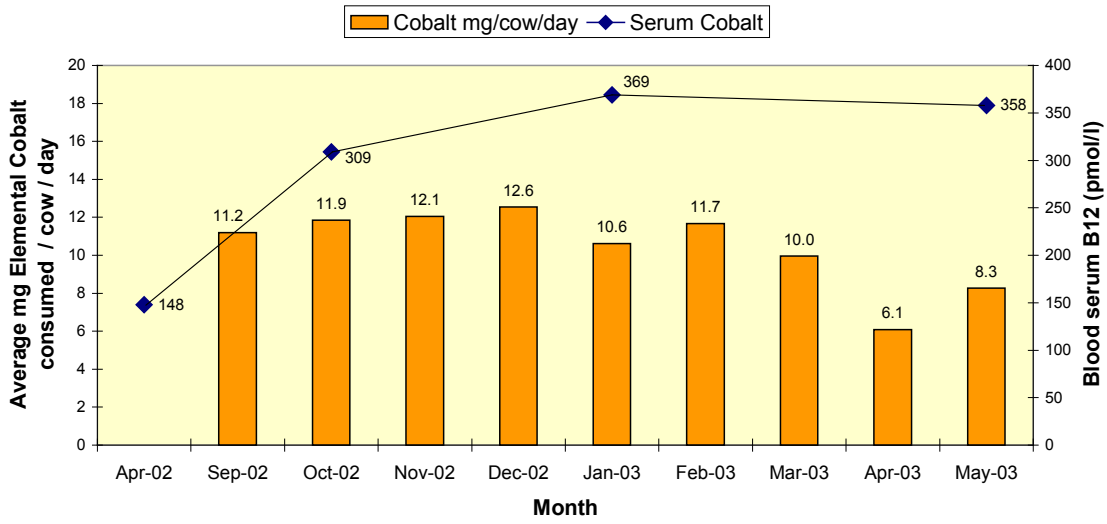

Figure 5: Cobalt dose rates and serum blood test results.

Marginal Range for Blood Serum B12 (pmol/l) 50 - 100

Adequate Range for Blood Serum B12 (pmol/l) 100 - 650

Iodine

The treatment programme for iodine was firstly based on the use of stock iodine, but later changed to the use of potassium iodide, and changed to the higher recommended dose rate.

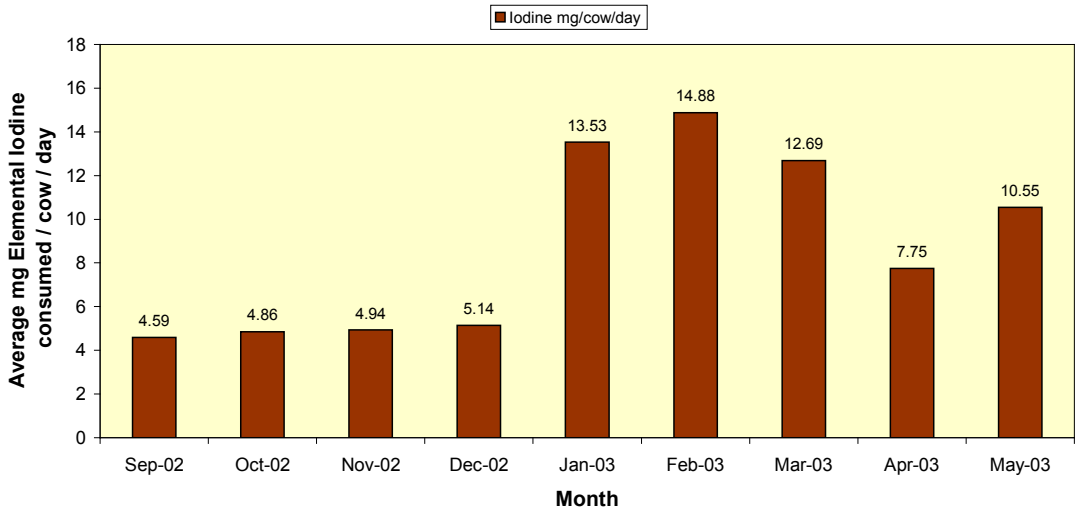

Figure 6: Iodine dose rates.

Mineral cost details

The cost of the supplementation of the minerals through the water supply varied throughout the season depending on the dose rate at the time. The average cost for the programme over the year for the minerals selenium, copper, zinc, cobalt and iodine was 0.84 cents/cow/day. The higher dose periods during September, October and November averaged approximately 0.96 cents/cow/day.

Table 6: Cost of Minerals (cents/cow/day)

Trace Element	Sep-02	Oct-02	Nov-02	Dec-02	Jan-03	Feb-03	Mar-03	Apr-03	May-03
Selenium	0.502	0.532	0.433	0.338	0.286	0.419	0.357	0.218	0.223
Copper	0.149	0.158	0.161	0.167	0.142	0.156	0.133	0.081	0.110
Zinc	0.179	0.189	0.192	0.200	0.169	0.186	0.159	0.097	0.132
Cobalt	0.067	0.071	0.072	0.075	0.064	0.070	0.060	0.037	0.050
Iodine	0.055	0.058	0.059	0.062	0.162	0.178	0.152	0.093	0.126
Combined Cost	0.952	1.008	0.917	0.843	0.823	1.009	0.861	0.526	0.641
Magnesium *	2.900	3.071	3.125	2.440	1.376	1.513	1.290	0.788	0.000

* $MgCL_2$ only

Water quality

We can also look at the quality of the stock water in relation to the amount of dissolved solids in water. The recommend rates for the $MgCl_2$ is 3-3.5 g/litre of stock water. This is the main contributor to the total quantity of dissolved solids in the stock water during spring period. This is reduced from November to December, when the rate of $MgCl_2$ drops to 1.5 g/litre. Table 7 shows the quantity of dissolved solids for the highest dose rate used, 1.2%, for the 2002-2003 season.

Table 7: Water quality—dissolved Solids.

	Concentration of solids (g/litre)		
Dissolved solid	Highest dose rate	Typical dose	Max. target level
Magnesium chloride	3	2 - 3	≤ 3
Sulphates (all included)	0.104	0.07 – 0.104	< 1.0

Conclusion

- To determine the success of any supplementation programme monitor trace minerals by soil, pasture, blood and liver sampling.
- Know the cost of any supplementation programme, and which trace elements/cow/day the programme will supply.

- When using a water treatment system, adjust the dose rates during prolonged periods of wet weather or supply minerals or trace elements with supplement fed.

The monitoring programme for the new Lincoln University dairy farm has been running for two seasons now, with a trace element dosing programme for the stock water supply in place for only the 2002-2003 season. The results that we have achieved have been encouraging, and we will continue to monitor and adjust as required in the future.

Workshop summary

Outcomes

- A target of this mineral programme is to lower cow wastage, and metabolic issues.
- A year round simple system allows trace element levels to be maintained. It is easy for staff to manage, is cost effective through inline water supplementation, ensuring productivity is not reduced.

Further discussion points

- There is variability associated with blood tests for zinc; however, the testing programme overall gives trends which allow accurate decision making.
- Will liver testing cull cows only skew the results? At the Lincoln University dairy farm, random culls are liver sampled, while Leo Donkers specifically liver tests of any empty culls to indicate which minerals may have an impact on empties.
- Are sulphates damaging the cows gut? This is a recognised grey area, however dosage rates are low, and cow wastage has not been increasing, therefore assume sulphate is not having negative impact. Leo has been using sulphates for nine years.
- Is there a cash benefit to having minerals and trace element levels in the high range? On both farms the target is to maintain consistent levels in the better than "low but adequate" range.
- Would it be better just to provide minerals in the risk periods of the year and then cease mineral supplementation? Having a year round system is simple for staff, and provides consistency to the cow.
- Leo Donkers pasture analysis has indicated high Mg levels year round, yet cows have required Mg supplementation, suggesting cows are not uptaking Mg from the pasture.
- Selenium is required by the animal, not the plant, therefore it may be more effective to simply provide selenium needs through the inline dispenser rather than prills.
- Dose rates, are they calculated through cow requirements, or pasture samples? Specialist advice is used to decide on appropriate dosage rate given pasture samples. A yearly review is undertaken to set required levels.
- The mix is kept simple for staff through providing a recipe on the wall, and pre mixing small volumes in water to allow more accurate measurement.
- Minerals are sourced from one supplier in Leo's case, and for Lincoln University dairy farm where the best price is offered.
- The minerals have been found not to corrode the water supply system.
- Why go above the low "adequate" level, how have you chosen the most desirable level? The low "adequate" level sees us teetering on the edge, therefore a level slightly up the range is preferred.
- Why selenium in water as opposed to prills which is cheaper? Ease.
- Off farm wintering requires dusting to provide minerals.
- Young stock, how do they adjust? Leo finds young stock are never at the right levels and require special treatment when they return to the dairy farm.
- Blood tested cows are the same year by year, with sampling across age groups.
- Feet are the main reason for zinc.