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Improve your soils, animals, farms and profits with correct minerals.

## Mineral rules by NZ government

If you import, manufacture, sell or use fertilisers in New Zealand, the ACVM requirements outlined here apply to you. These products may also have requirements under other legislation such as the Hazardous Substances and New Organisms Act 1996, the Animal Products Act 1999, and the Biosecurity Act 1993.

## Defining fertilisers

Under the ACVM Act, a fertiliser is a subset of agricultural compound that is used to sustain or increase the growth, productivity, or quality of plants or, indirectly, animals through the application (to plants or soil) of nutrients and fertiliser additives.

## Good correct pastures with correct mineral levels are essential for all animals

These same-age yearlings originated from the same farm near Hamilton.

The better one on the right was grazed in a mob of 20 on consolidated peat that I developed with correct levels of LimeMagPlus and reactive phosphate fertiliser in Phosphate Nutrient Planner.xlsx and were fed Solmin through an on-line dispenser.

The poorer one on the left was one of the other half of 20 on a Hamilton clay loam, using the government department of agriculture (establishment) typical wrong advice of no lime and soil test based superphosphate fertiliser mixes, and without Solmin. The owner brought them to our better grazed and fed ones.



The bad one can be seen to lack copper (brown colour), zinc (hair on crown), sodium (rough hair and lack of sheen), magnesium (sad or starry eyes), iodine (swollen gland on side of jaw) and selenium (low head and low tail because of weak muscles). Its jaundiced brisket indicates a liver problem, most probably from facial eczema damage, which didn't occur on the good farm because it got about 8,000 kg per hectare of agricultural lime, and then 1,000 kg per annum to keep earthworm numbers up to eat the thatch on which facial eczema spores breed. Look at the stronger frame and legs of the Solmin fed one, thanks also to correct calcium, magnesium and its synergisms in LimeMagPlus and Phosphate Nutrient Planner mix.xlsx.

Cows fed Solmin from birth produce 15% more milk than those not fed it, eat less and need less or no worm drenching.

No mixtures of humans' foods or animals' pastures, forage crops or a mixture of them, is a complete and perfect food 'minerally'. If your animals don't look like below, or have bad health problems, or you want an easy way to prevent facial eczema, parasites and weeds, you need the nutrient advice in GrazingInfo. Even if dairying, read the chapter called 'Beef Profiting' for what correct liming and fertilising did for cattle and even for ducks. You'll be amazed.

Good pastures with minerals are essential for growing animals

These same-age yearlings originated from the same farm near Hamilton.

The better one on the right was grazed in a mob of 40 on peat that I developed with correct LimeMagPlus and reactive phosphate fertiliser and fed Solmin through an on-line dispenser.

The poorer one on the left was one of 19 on a Hamilton clay loam, using the government department of agriculture wrong advice of no lime and soil test based superphosphate fertiliser mixes, and without Solmin.

She can be seen to lack copper (brown colour), zinc (hair on crown), sodium (rough hair and lack of

sheen), magnesium (sad or starry eyes), iodine (swollen gland on side of jaw) and selenium (low head and low tail because of weak muscles). Its jaundiced brisket indicates a liver problem, most probably from facial eczema damage, which didn't occur on the good farm because it got about 8,000 kg per hectare of agricultural lime, and then 1,000 kg per annum to keep earthworms up to to eat the thatch on which facial eczema spores breed. Look at the stronger frame and legs of the Solmin fed one, thanks also to correct calcium and its synergisms. The owner brought them to the better grazed and fed ones.

Cows fed Solmin from birth produce 15% more milk.

Correct minerals in soils, feeds and supplementation are essential for both animal health and high levels of production. Deficiencies and/or excesses frequently lead to health problems. Two severe deficiencies can cause a double bad whammy, which can be fatal in some mineral deficient animals.

Feeding of minerals is best done through the soil to the pasture, because earthworms are animals and need the same minerals. I've seen them clambering over each other to access water overflowing from a drinking trough containing Solmin's nine minerals. I've also seen calves run up to drink as Bryce Wilson, south of Te Awamutu, Waikato, added it to their water trough. If he tried to fool them by making out as if adding Solmin, but didn't, they licked at the water and looked at him.

Now you'll say, "You are contradicting yourself, because it is not through the soil and feed."

You are right, but the problem is that, even with perfect fertilising, pastures can't take up enough of some minerals, especially sodium. So in New Zealand and other high rainfall and poor soil areas, mineral supplements are essential. They have also improved animal health and production in soils in many countries.

### **Dairy Herd**

This was the excellent herd belonging to the late Bill Chynoweth, Pukeroro Stud, Waikato, in 1989. When I started consulting for him, his cows were deficient in many elements, because they were being fed only salt, which most know is essential, especially with maize and maize silage. I did a pasture tissue (herbage) minerals analysis, which showed the typically low levels of essential elements, as found on most farms in most countries. LimeMagPlus at 4,000 kg per hectare, with deficient trace elements added, were applied, because typically Ca was the lowest of the main elements, and the most important to correct first.

Many farmers in many countries have never done a pasture analysis, which tells the farmer what the pastures are getting out of the soil, and what the animals are eating. Soil tests, even in 2014, aren't able to do this, and never will.

This is the herd eighteen months after correct LimeMagPlus was applied and getting Solmin through an online dispenser, not a very expensive metering one that can cost as much in annual maintainence as an online one costs to buy from Cook and Galloway Engineers Ltd, 5 Belfast Place, Frankton, Hamilton 3242, 07-847-7583, Lloyd Alderwick <lloyd@cookandgalloway.co.nz>

The cows were fed pasture and some maize silage, plus the Solmin, and produced twice the NZ national average production per cow, and nearly as well as the North American average production per cow in confinement on total mixed rations (TMR). The herd had big bodied cows always fully fed from birth.

Iodine is a trace element that most soils and pastures don't provide enough of to grazing animals, so must be fed in a soluble mineral mix. Coastal paddocks where prevailing winds blow from the sea can get some in the salty rain from the sea. Teat spraying with iodine supplies it to milking cows, but, is not a good way because it is sprayed after milking so gets into the milk 12 hours later. Iodine should be fed through soluble minerals such as Solmin.



## Responses

A farmer emailed me, “The reason I keep on thinking along the lines of liquid fertilisers is that, in the past, every time we have applied minerals to the soil (Selenium, Boron, Cobalt, Copper) the response has not been obvious at all.”

I asked him, “Did you measure the soils or plants? How deficient were your soils, animals and pastures before you started? Do you know the soil, pasture and animal deficiency symptoms? What were the Pasture Leaf Mineral figures? How much per hectare did you apply of each, and have you read Animal Health > Symptoms & Causes in Animals?”

Selcote Ultra should be applied at 1 kg per hectare, but pastures don't need it so won't show any difference. Borax (now OrganiBOR) at 15 kg/ha increased clovers by 9%. The now a DairyNZ scientist didn't apply lime and admitted to me at a consultant meeting that he got things wrong. Cobalt sulphate 1 kg/ha, improves nodulating and animal health. Copper sulphate at 3 kg/ha per annum in Poverty Bay steep hill country stopped lambs breaking legs - see Elements > Copper.

Animals need Se. Earthworms are animals, so they improve with it and the other elements, which means soils then improve, etc. See Elements > Se, about how cows grazed on Se fertilised areas rather than no Se areas, which means they prefer it or know they need it, so eat more, and produce more. Se makes meat redder which buyers like. See Minerals in Soils > Selenium.

Getting the following analysed is a waste of money because there is not much you can do about them, and if pasture mineral analyses levels are at the GrazingInfo recommended optimums in Pasture Mineral Analysis, they should be OK -

- Iodine leaches rapidly out of soils and costs \$46,000/tonne so applying it is a waste. Some consultants may recommend fertilising with it, so get another consultant, or do your own by using Hill Laboratories and Pasture Mineral Analysis, in Free spreadsheets, then Lime Nutrient Planner suggestions or Phosphorus Nutrient Planner suggestions in GrazingInfo spreadsheets.

- Chloride.

- Nitrate - Measure nitrates yourself when it is suspected to be high. See Animal Health > Nitrates.

- Crude Protein - When you enter the laboratory plant test N figure into my Pasture Minerals Analysis spreadsheet the Crude Protein comes up automatically, so it need not be bought.

- Acid Detergent Fibre. This and these below are useless deceptive things that those who change to analysing ryegrass or other plant leaves see are not necessary. Those using it, argue over the figures.

- Neutral Detergent Fibre.

- Ash.

- Digestibility (DOMD).

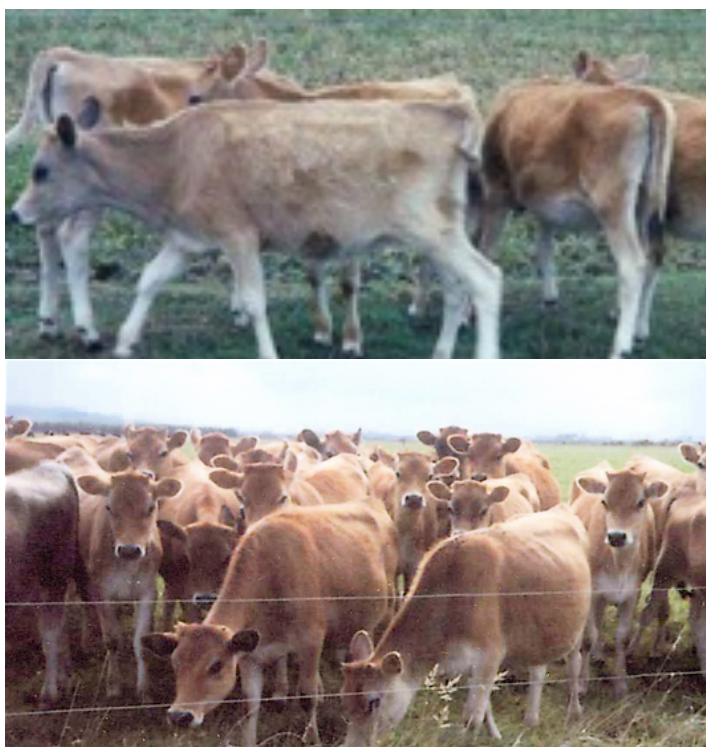
- Metabolisable Energy.

- Soluble Sugars.

## Diagnosis

The most important thing in farming (and life) is diagnoses. If you don't identify it, you won't fix it. At first glance one would think that our heifers were underfed, however they were moved to the best paddocks and not rationed at all. The next some might think is being infected with internal parasites, but one can see that there is no scouring and no swelling under the jaw from worms crawling up the throat. This leaves mineral deficiencies as the cause. The hair on top of the neck indicates a deficiency of cobalt. Horses have manes, healthy cattle don't. The rough winter coat, instead of being sleek, indicates a lack of sodium and possibly zinc. Low zinc causes hair to grow on top of the head.

A year later in 1972, soluble minerals were fed to all animals, after which all heifers shown here





were evenly well grown, however the rough hair indicated more salt was needed.

In 1984 our son-in-law and daughter, Ian and Sue Dobbs, share-farmed on our second farm and reared 160 dairy beef calves each year, on our consolidated peat farm on Greenhill Road NE of Hamilton. They divided the calves into two equal mobs of 80 and fed one mob minerals which we adjusted over three years until the animals were in perfect health, growing fast and not needing drenching.

These were not receiving minerals. They walked around a lot and kept going back to the water trough. Note the runny eyes (low zinc), brown coat (low copper), muck on tails (low selenium).

All pastures got LimeMagPlus and correct fertiliser with the necessary elements, based on pasture mineral analyses.

After six months of trialling, both mobs were mixed and all fed minerals. The difference in size was amazing. The one just right of centre was from the mineral group. The smaller one behind it was from the no minerals group.

As shown, they were fed clover-rich pasture daily.



### **World's first soluble mineral mix**

The recipe for Solmin that we developed over many years was fed through on-line dispensers on different soil types with excellent results. It was then sold throughout New Zealand. One thing I wish to make very clear is that I personally receive nothing from the sales of Solmin and I endorse it because I know it is the best soluble mineral mix available to animal farmers.

Our share-farmers, son-in-law and daughter, Ian and Sue Dobbs, who helped, noticed that those getting Solmin looked and grew better with less internal parasite treatment. Later Ian who was measuring the pastures with a PastureGauge© noticed that they ate less pasture and so Solmin cost nothing and gave a profit! Vets and semen sales people would ask users why their animals looked so healthy and performed so well. Herds using Solmin will start to look healthier (see photos in several chapters), have improved fertility, suffer less bloat and animal health problems. Mastitis and somatic cell counts have more than halved. Several have dropped from about 30 to 1. See Testimonials.

The Solmin soluble mineral mix mineral was so successful since 1989 that it was copied. However some copies have been unsuccessful for a number of reasons, such as economising and not understanding that the sulphates have only about 25% or less of the actual element. For example, magnesium sulphate has only 10% magnesium. One soluble mineral mix supplied by vets doesn't even contain salt. Salt is the most important supplementary mineral, because pastures, especially in the tropics, can take up other elements, but never enough sodium, irrespective of how much is applied to soils. See Elements > Sodium. Feeding salt, as in Solmin, can reduce vet bills to a third or less, so if all did so, some vets would go out of business and some farmers would profit more.

A copy made by a British company has manganese (Mn) because it is low in much of the UK. However, Mn is in excess in much of NZ, so Solmin has no Mn because an excess stresses animals. Never feed Manganese in any form to any animals in New Zealand. The few who do stress their animals.

A Tauhei, Waikato peat farmer phoned and asked me to visit him because his herd was stressed and so was he. His farm was under-drained, which increases Mn uptake by pasture. It also needed

LimeMagPlus, which reduces Mn uptake, and he was feeding a soluble mineral mix that contained manganese. On my advice he stopped feeding it and five days after changing to Solmin he phoned to say his herd was much better. I got his pasture analysed, and sure enough the pasture Mn was 90 mg/kg when it should be half that. In humans an excess can cause Parkinson's disease. Most of those who work in Mn mines end up with Parkinson's. See Elements > Manganese for full details on it.

More than one veterinarian got a laboratory to analyse Solmin to copy it because animals were doing so well, but most got it wrong because, for example, they didn't know that, there is only 25% of copper in copper sulphate, so Solmin has four times more copper than the analysis figure of copper.

The Solmin mineral mix has not been changed since I formulated it in 1987 and is now copied in many countries. Many try to imitate it, but none succeed because they don't know the growth and health details of minerals in animals. Example are; using oxides, chlorides, toxic elements such as manganese.

Solmin has no heavy metals whatsoever, which is not the case with many other mineral mixes. Some companies in New Zealand add manganese which is a toxic element in New Zealand because of the high levels in our wet soils, especially if calcium is low, which is the case in 90% of NZ soils. Lime makes manganese insoluble. The sulphuric acid in superphosphate makes the P available, but also the mercury, cadmium and manganese available. These then adversely affect animal health and that of humans eating animal and vegetable products.

### **Feeding minerals**

Correct mineral levels in soils and pastures are imperative. The same applies to animals. I used to think that New Zealand grazing animals well fed on correctly fertilised pastures were healthy. However, after consulting in USA from 1980, I saw the sheen on their best fed dairy cows which were fed total mixed rations (TMR) with minerals, and realised that ours needed minerals and trace elements. If you want health and healthy animals read all the chapters in Minerals.

A good soluble mineral mix fed in the drinking water is best, so that animals get the nine essential elements of sodium, magnesium, sulphur, zinc, copper, cobalt, selenium and iodine evenly all day and night. Bodies can store some elements, but not others such as magnesium. The minerals improved their coats, condition, conception rates, milk fat, and protein percentages and temperament, and lowered milk somatic cell count levels. Some areas need boron, but fertilising with it is best because legumes and some crops, especially maize need it (See Forage Crops > Maize). The same applies to calcium, phosphorus and potassium. Never feed any of these. If deficient apply them to the soil.

Some of the elements required such as copper and magnesium are bitter, so animals don't consume enough, if any. Mixing elements with salt encourages some to eat the minerals and is also be used to limit consumption. However, some animals still won't eat enough and some will eat too much. Supplying it through an online dispenser to the drinking water is the solution. Extreme accuracy in feeding is not essential. Four times the recommended daily rate per animal for a short period does no harm.

See the spreadsheets for the Feeding Minerals one which shows how much to feed to various animals.

Metering dispensers need adjusting to increase the minerals in rain and cold weather, and decrease them in hot weather. If a leak develops on the farm, a week's supply of the minerals in the supply drum can be lost, whereas on-line tank dispensers lose only the amount added for that day. Therefore, the best and most accurate way of supplying minerals is through a non-moving part, 100% plastic on-line tank system. This system ensures that high producing cows requiring more water drink more, so therefore ingest more minerals, while calves drink less, so get less.

Red colouring with the on-line dispenser to see when the mineral flow stops. Adjust the taps so that before milkings there is still a very small amount of colouring in the water. It can be measured by opening the drain tap. If there is no colouring, it means that the trough will have no Solmin in it for the first drinkers at the next grazing of that paddock. This is just a small thing, but is part of the essential meticulous farming necessary to succeed without stresses, such as milk fever. A herd of cows can go into a paddock and graze before drinking, then two hours later the first ones can drink the water that doesn't yet have minerals, and may not have had at the previous drink five hours before.

### **Dispensers**

Cook and Galloway Engineers in Hamilton make the simplest cheapest online dispenser. They are

all plastic so no metal to rust. They have no moving parts and no servicing.

Lloyd Alderwick <lloyd@cookandgalloway.co.nz> <http://www.cookandgalloway.co.nz/>  
5 Belfast Place, Box 5117, Frankton, Hamilton 3242, 07-847-7583

If connected to town water, a non-return valve must be fitted into the main water pipe before the dispenser, to prevent minerals going back into the town system during a water pressure drop.

Where there is no water reticulation system (piped water to all or most troughs), but there are water drinking troughs, Peta dispensers can be used. See <http://www.peta.co.nz> These float in the troughs and dispense the minerals slowly. If not available, placing the animals' daily requirements in an old milk sock or in a nylon stocking, and then in the trough, can do the job. Learn to place it for optimum dispensing within the time required, which can be 8 hours under 12 hour grazing, or 20 hours under 24 hour grazing. The position may be under the inlet, or away from it.

See the spreadsheet Minerals in Soils Pastures & Animals.

Where water is available only from natural sources, such as streams or dams, it is better to feed a good loose mineral mix than nothing. These mixes should have enough salt to make them palatable, but not so much that animals don't consume enough. If the only way to feed minerals is loose, don't buy mineral feeders that can rust, rot, or poison stock if made of copper, chrome and arsenic (CCA) treated timber. Use any of the following.

On farms where animals are moved frequently, use tyres cut in half by professional tyre cutters, and attach a chain, rope or baling twine doubled or tripled, to pull it with a vehicle to the next paddock. Add enough minerals to last until the next move. For large mobs use large tyres. Drainage holes may be necessary. During heavy rain minerals need not be fed for a day or two.

On farms with fewer paddocks, use discarded wide flotation tyres that will stand up on their own and can be tied to a post. Position them with a side to the prevailing rain and the minerals should not get too wet. In very wet areas a hole may have to be drilled or cut in the bottom, to allow surplus water to escape. If using plastic 44 gallon (55 US gallon) drums, cut much of one side out, so stock can put their head in and reach each end. Fly-control ear tags for face flies can be attached to the top or sides of the opening, where drips over the tags won't fall into the minerals. Tie the feeders to trees or fence posts, or special posts. In all cases choose raised areas to avoid mud, and move them occasionally to avoid dust. Over-sow the bared areas about three or four days before moving them, so the seed gets trampled in.

The New Zealand exchange rate also affects the price our meat exporters pay for animals. Our dollar has been too high for decades, because so many people see New Zealand as a safe investment country (none of our banks has gone broke, and NZ is top of the 'Fraud-free' country list), so money pouring into our banks strengthens our exchange rate, at the expense of exporters. About 90% of New Zealand beef and dairy products produced are exported.

After selling his beef heifers, Barry Brunton emailed me, "That's better than I've ever done. Your lime, trace elements, fertiliser advice and mineral mix Solmin deserve considerable credit."

See Beef Profiting for the full story on them.

I developed Solmin over about six years in the 1980s after a two year agricultural course and farming in South Africa for six years where some minerals are also deficient, and farming on peat in New Zealand, and consulting world-wide from 1979, learning a lot from the northern hemisphere where mineral imbalances are a major cause of low animal production.

Solmin has not been changed from the initial recipe optimised in the 1980s. High magnesium Solmin has more magnesium and less salt for the month pre-calving, and after calving until in calf or for as long as long necessary.

### **Solmin**

Other soluble mineral mixes that have been tried have not achieved what Solmin has, so some members are mixing their own Solmin with great success of healthier, quieter, tamer cows, less mastitis, cleaner troughs,

### **Solmin Composition**

Salt - Solar	81.45%
Magnesium Sulphate	15.00% Increase to 18% in winter and decrease Salt to 78.45%.
Copper Sulphate	1.50%



Zinc Sulphate	2.00%
Cobalt Sulphate	0.030%
PVP Iodine	0.015% (Organic Solmin has calcium iodine).
Sodium Selenate	0.0008%
Sulphur (sulphate) is in the above.	
<b>Total</b>	<b>100.00%</b>

Dissolve it in lots of water for at least 12 hours before adding it to the dispenser.

For sheep, decrease copper to 1% and increase zinc to 2.5%

If mixing a tonne, multiply salt's 1,000 kg by 81.45% = 814.50 kg of salt. Slightly more of salt would not be a problem.

Insist on Solar salt. It has not had minerals removed.

If you can get Himalayan salt, do so, and please tell me the source.

### Surveys of Solmin while developing it done at 12 and 14 months and then by 20 users.

No other feed mineral supplement producer I know of anywhere, has done surveys of theirs.

	# Months	Cow	Heifer	Animal		Cow	Retained			Milk	Milk	Young
Location	Used	Temp't	Temp't	Apper'ce	Dung	Cycling	Placenta	Mastitis	Milk	Fat	Protein	Stock
Matamata	2	O	O	B	O	B	O	O	U	U	U	O
Matamata	3	B	O	B	O	B	O	D	U	U	U	O
Te Aroha	2	O	B	B	B	B	B	D	O	O	U	B
Pukeroro	4	O	B	B	B	B	O	O	U	U	U	B
Patetonga	3	O	O	B	B	O	B	D	O	U	U	O
Whitikahu	12	O	O	B	O	B	B	O	U	O	O	B
Tatuanui	4	O	O	O	O	B	O	O	U	O	O	O
Tirau	3	O	B	B	O	B	O	D	U	U	U	O
Waharoa	2	B	B	B	B	B	B	O	U	U	U	B
Walton	4	B	O	B	O	O	O	O	U	U	U	O
Matamata	2	B	O	B	O	B	O	O	U	U	U	O
Waiuku	2	O	O	O	O	B	O	O	O	O	O	O
Kereone	3	B	B	B	O	O	O	D	U	U	U	O
Rotorua	2	B	O	O	O	O	B	D	O	U	U	O
Matamata	2	B	O	B	O	B	B	O	U	U	U	O
Tauhei	2	B	B	B	B	B	B	D	U	U	U	O
Putaruru	2	O	O	B	B	B	O	O	U	U	U	O
Waharoa	2	B	B	B	B	B	O	D	U	U	U	O
Matamata	14	B	B	B	B	B	B	D	U	U	U	B
Matamata	3	B	B	B	B	S	B	S	O	O	O	B
Waharoa	6	B	O	B	O	B	B	D	O	O	O	O
B = Better, U = Up, D = Down, W = Worse, 0 = No change sometimes because already feeding minerals.												

### Minerals in Pastures and Crops

In most areas of the world, even after correct fertilising of pastures and crops based on pasture mineral analyses, pastures aren't able to provide all the minerals that high producing animals need, therefore it is highly profitable to supplement them. The cost is nothing, because animals then have improved feed conversion efficiency, and grow faster, and are much healthier.

The survey below shows the benefits of feeding Solmin soluble minerals. No other mineral mix in and achieved such good results. Forage crops and crop silage, such as maize, can be a major part of animal feed when pasture growth is limited, so they must be fertilised correctly with all the necessary minerals.

When chisel ploughing for maize, Bill followed my recommendations and applied 8,000 kg per ha of Rorison's LimeMag (agricultural lime with 97% calcium carbonate and Serpentine added as required) plus trace elements, based on a pasture analysis. The resulting maize crop had the maximum possible of minerals and trace elements, and yielded 33,000 kg of dry matter per hectare. The area average is 24,000 kg per hectare. The extra is value is about worth \$3,000 per hectare. Some herds are

fed large amounts of green or silage maize, so it is important to have the maximum possible quantity of minerals in it. See Forage Crops > Maize.

New Zealand has all the elements Solmin has, and no other has done and published such extensive trials. Its cost is nothing, because animals then have improved feed conversion efficiency, and grow faster.

A 1986 milking cow trial showed a 388% return on the cost of a good mineral supplement, improved conception rates and gave a further cost benefit. A sign of optimum correct minerals and good health is when cattle hold their heads up above their backs, as shown in the heifer on the right. She received Solmin in the water, and had been grazing correctly limed and fertilised pastures on the Gallagher 1.5 m deep peat farm I developed from gorse, ragwort, buttercup and blackberry, all without spraying. Rather than spraying, I applied adequate lime, serpentine, magnesium and trace elements as dictated by ryegrass mineral analyses, and avoided overgrazing causing soil eating. The other heifer, from the same herd, had been grazing on a better mineral soil (old volcanic Hamilton clay loam), but without correct fertilising and without soluble minerals.

I've seen and read about many calves grazing pastures and suffering cold, heat and health problems, while those fed Solmin thrived.

Unfortunately, some farmers (especially organic minded ones) change to grazing and think pastures provide everything. In reality pasture has a lower mineral content, especially if there are no legumes and herbs in the pastures, and fertilising is not based on pasture tissue analyses.

Fast growing tropical and nitrogen forced pastures are lower in some elements than slower growing temperate pastures.



### **Quantity & Type of Minerals to Feed**

Solmin minerals should be fed at 0.006% to 0.008% per kg of animal live weight per day, which is more than their suggested 20 grams per cow per day. Bill Chynoweth fed his big bodied Holstein 600 kg cows 50 grams and produced twice the national average of milk solids.

Other products have their own instructions.

Optimum levels in ryegrass are below -

(For optimums of other grasses see the Pasture Mineral Analysis spreadsheet columns on the left).

Nitrogen (N) 4% = crude protein 25%

Phosphorus (P) 0.4%. Ryegrass leaves have 10% less Ca than stems, so always sample ryegrass 25 cm high and cut the top 20 cm to sample.

Potassium (K) 2.7%

Sulphur (S) 0.4%

Calcium (Ca) 0.8%

Magnesium (Mg) 0.28%

Sodium (Na) 0.25%

ppm

Iron (Fe) 90 ppm. More than 100 indicates soil pollution in the sample which will increase cobalt and manganese levels and make them wrong.

Manganese (Mn) 50 ppm

Zinc (Zn) 50 ppm

Copper (Cu) 13 ppm (Less for sheep.)

Boron (B) 22 ppm

Molybdenum (Mo) 1.5 ppm (It will be higher in wet soils and lower in dry soils.)

Cobalt (Co) 0.13 ppm

Selenium (Se) 0.3 ppm (Less for horses.)

Iodine (I) 0.5 ppm. Teat spraying with iodine provides enough to milking cows.

Aluminium (Al) < 80 ppm



### Daily Requirements by cows

18 kg of correct pasture dry matter supplies -

Calcium (Ca)	0.08 kg	0.8% = 0.14 kg
Phosphorus (P)	0.03 kg	0.45% = 0.08 kg
Potassium (K)	0.19 kg	2.8% = 0.50 kg
Sulphur (S)	0.04 kg	0.35% = 0.06 kg
Magnesium (Mg)	0.05 kg	0.25% = 0.05 kg
Sodium (Na)	0.05 kg	*0.2% = 0.04 kg
Iron (Fe)	1.8 mg	150 ppm = 2.7 mg
Cobalt (Co)	0.002 mg	0.13 ppm = 0.002 mg
Copper (Cu)	0.27 mg	13 ppm = 0.23 mg
Manganese (Mn)	1.1 mg	50 ppm = 1 mg
Zinc (Zn)	1.1 mg	45 ppm = 0.8 mg
Iodine (I)	0.01 mg	0.5 ppm = 0.01 mg
Selenium (Se)	0.004 mg	0.2 ppm = 0.004 mg

\* 0.20% Na will only be achieved in temperate pastures near the coast or if fertilised with coarse agricultural salt at about 40 kg per ha (40 lb per acre) twice a year. Pasture sodium levels in inland USA States (except on salt plains) and inland countries such as Switzerland are about 0.02%. Tropical grasses don't take up much sodium even if applied as a fertiliser.

For those who prefer percentages, immediately post calving Ca should be about 1% of the diet so 25% legumes in pastures with their 1.3% Ca help achieve this.

For two to three weeks before calving recommendations are Ca 0.5%. Temperate grasses with no clover have about 0.6% Ca (ryegrass 0.8%) and 0.35% Mg, but temperate grasses with no clover have only about 0.22% Mg unless on a high Mg soil as around parts of the Great Lakes and alluvial parts of Hauraki Plains and Whakatane in NZ.

The above figures show that pre-calving cows on pasture need Mg supplemented. Mg and potassium are antagonistic so the higher the K level in pastures, the more Mg needed. In New Zealand Mg oxide is sometimes dusted on to pasture, preferably with a soluble mineral mix added to make it more palatable to reduce waste, and to ensure that all cows eat it. Some cows avoid magnesium oxide because of its bitterness, but the salt in good soluble mineral mixes corrects this. Some farmers are allergic (biliousness) to oxide so wear a mask when spreading it or get someone else to do it. Mixing a soluble mineral mix like Solmin, which is based on salt, dampens the Mg oxide so reduces the dust.

New Zealand cows are smaller than North American ones, but produce nearly as much milk solids (fat and protein) so require roughly the same amount of minerals. Overseas critics of milk production per cow in NZ, talk litres, but we are paid for solids with a penalty of about three cents a litre for transporting and evaporating costs.

Cows on pasture can get too much potassium, but not enough sodium, zinc, selenium and iodine so will benefit from a soluble mineral mix in the drinking water.

It is not economic to maintain pasture iodine levels at 0.5 ppm by applying potassium iodate at NZ \$28,000 per tonne. Supplementing it and the other deficient elements in the drinking water is far better.

Boron is also required by clover and animals, although some dispute this, but they don't quote farmer results in B deficient areas such as extremely high rainfall areas like Westland where farmers fertilise with it to reduce milk fever cows taking a long time to get up - or not getting up, even after getting calcium boro (boron) glucenate, the standard treatment for milk fever. Boron is needed by legumes in particular, so is best added to fertilisers.

The typical 4.5% nitrogen in many clover-based pastures equals 28% crude protein, which is too high for optimum animal health, and is one reason why animal health and production usually improve when top quality silage and/or hay, with a quarter the N levels, is fed by some farmers when pastures are lush. Some farmers who have never seen a pasture analysis have fed urea to supply more nitrogen. Doing so to animals on high protein pastures has been fatal.

Phosphorus is a mineral that can't be dissolved and fed in water, and is better applied to the soil to increase pasture and crop yields and levels to optimum - not above (See Elements > Phosphorus). Applying lime releases phosphorus fixed in soils, which is much cheaper than buying it. Lime also reduces the incidence of facial eczema dramatically, by encouraging earthworms, which decrease the

dead vegetation that supports facial eczema spores. Many farmers who lime regularly have less or no facial eczema compared with neighbours who don't. We always limed adequately and had only one slight eczema on a heifer, which may not have been facial eczema, from 1958 to 1987 when we gave up farming.

Potassium can be dissolved, but this is also far better used as a fertiliser. Farmers who use soil tests usually apply too much K, which can reduce clover and adversely affect animal health.

Calcium in correctly limed and fertilised soils is usually adequate, sometimes in pastures at higher rates than is needed, so if grazed by animals before parturition, can bring on milk fever.

Iron is seldom necessary and can be consumed to excess when grazing animals eat mud and/or dust on whatever they are grazing.

Zinc sulphate is added to some soluble minerals, and can be added to fertiliser mixes at 6 kg per hectare. Copper sulphate is present in most soluble minerals, and, if low in pasture mineral analyses, should be added to fertilisers.

Molybdenum is needed by legumes to form nitrogen filled nodules, so is best in fertilisers.

Cobalt sulphate is added to some soluble minerals, but not Solmin because it is required in soils so is added to LimeMagPlus and fertiliser mixes, if shown by a pasture analysis to be deficient.

Selenium is covered above.

Iodine is low in most New Zealand and some other countries, so should be added to most soluble mineral mixes. Iodine is uneconomical to fertilise with because it costs \$ and is very water soluble so soon leaches.

Aluminium is toxic, so not necessary, and should be avoided by not using aluminium troughs or containers. Avoid all toxic containers and troughs - copper chrome and arsenic treated timber troughs have also adversely affected animals.

Remember to see the full information on each mineral in Elements and in the spreadsheet called 'Interactions in Blood, Soils & Pastures'.

### **Soluble mineral mixes (SMM)**

While some element levels can be high in pastures, animals need more of most than pastures can provide, so correct minerals should, if possible, be supplied in the drinking water to animals on pasture all year. Most pastures are low in some elements, especially salt, even when it is in the soil. Fast growing, tropical and nitrogen forced pastures are lower in elements than slower growing pastures.

Sheep don't drink much, so need dry licks, but be careful with them, to avoid excess copper and smothering (See 'Sheep').

I belong to several internet discussion groups that have discussed mineral feeding, and all end up in favour of administering them through water.

Blocks are worst (see below) and self help were second worst because some ate too much and others none. Loose licks were third to worst and had to be kept dry and free from birds messing in them.

Many farmers have said that after they changed from drenching minerals twice a day during milkings, to providing the same amount of the same soluble mineral mix in the drinking water through an in-line dispenser, animal health improved. The success of TMR in the USA and TMF in the UK are reflections of feeding everything as a mixed feed, rather than separately. Minerals in the drinking water mix with the pasture all day and achieve this.

Some people who should know better have written that adding minerals to the drinking water reduces water consumption. If the minerals are balanced with salt as the main element, which it should be because it is the most needed, animals will drink more water. Animals find salt highly palatable. If you don't believe this, buy one bag of a good SMM containing the nine essential elements, and add some manually to your calves' drinking water at 0.006% of their live weight and mix it in. On a weight basis this is three grams per 50 kg calf per day, and thirty grams per 500 kg cow per day. Within a few weeks the calves will wait for you to add it and then drink. I've seen a farmer try to fool the calves by walking up and going through all the motions, without adding the SMM. The calves ran up and started to drink then stopped and waited.

Good, nine-mineral, soluble mineral mixes reduce the growth of algae in water troughs and tanks and make the water taste better for animals which then drink more, helping cows produce more.

When checking, remember that in most areas (even those with coast breezes) salt is essential, so, if not the main ingredient, then the product is not as good as those containing adequate salt. Also,

insufficient sodium, a digestive aid, reduces Mg absorption. Magnesium is the next most required mineral in most areas of New Zealand. After analysing your pasture tissue and fertilising with what is practical, you will be able to see what additional minerals are required. Use Pasture Analysis and Fertiliser Order spreadsheets. The first explains 17 element levels, and the second helps calculate how much to apply, based on pasture analysis. Vague, undefined, and non-specific supplements can be a waste of money, with few benefits.

Palm Kernel (PKE) is extremely high in manganese and copper, so should not be fed at more than 2 kg per cow per day. I would not feed it at all, because of the health problems and deaths it has caused and there is no profit in it at a payout below \$8 per kg of milk solids. Reducing cow numbers is far more profitable. See Testimonials.

Read the labels. In New Zealand they should contain enough of the nine essential elements of Na, Mg, S, Cu, Co, Zn, Se and iodine. Some areas may need manganese. When boron is low, it is better applied with fertiliser, because soils, legumes and maize also need it.

### **Soluble minerals & fly nuisance**

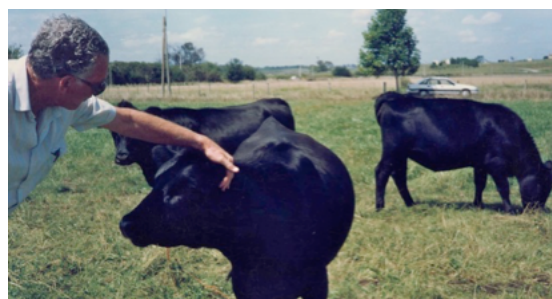
Rukuhia, Waikato, hobby farmer Des Holmes had a 4 ha (10 acre) peat block, and another mineral soil one. He soon found out that animals on the peat needed something more, so was recommended to contact me. We worked out correct fertilisers and he started feeding Solmin mineral mix in the drinking water. Calves leapt ahead and all animals thrived. When summer came he noticed that the calves on the Hamilton Clay mineral soil bunched up and fought the flies, while the calves on the peat spread out and grazed as usual without flies. He phoned me and asked why. I asked him if was feeding the calves on the mineral soil soluble minerals. He wasn't. Within a few weeks of supplying minerals through a dispenser in the water the bunching and biting flies stopped and didn't recur.



Another cause of flies is inadequate earthworms to eat the dung quickly, so flies breed in it. Applying sufficient LimeMagPlus increases earthworm numbers.



Soluble minerals in the water don't always solve fly problems, but can often help (See Flies). These yearlings were fed Solmin minerals from the first week of life, which almost eliminated worm drenching on Des's farm, which had such bad calf rearing problems after 20 years of rearing calves, that his vet advised him to sell the property because it was "worm infested". Look at the excellent pasture on the raw poor Rukuhia peat, correctly limed and fertilised. Des was amazed at how tame they became even to strangers like this visiting client of mine. Many have reported this improvement of tameness in animals after feeding Solmin.



Bryce Wilson of Te Kawa Rd, Te Awamutu, Waikato, also found his calves lay down more because flies stopped worrying them. Two of his calves changed from being very deficient to healthy in three months. I said that the two should be eliminated. Three months later he proudly asked me to point out the two in his mob of 30. It was difficult.

### **Ad-lib free-choice minerals are a disaster**

In New Zealand it is not allowable to supplement with any mineral mix without Animal Health Board, now called Agricultural Compounds & Veterinary Medicines Group, approval, because animal products are consumed by humans.

Making the 16 essential minerals freely available to animals is of little use. It is a fallacy that



animals will actively seek all the minerals or trace elements in which they are deficient. The main reason that animals eat some free-access minerals is that they like the taste of some!

Some lick mixes are purposely made to be palatable by adding molasses. Animals can then consume too much, which is wasteful, costly and sometimes dangerous. Cornell University, USA wrote in the 1990s that lick blocks don't work because high producing cows would have to lick all day to get enough, and the worst thing is that some take none.

Some farmers have put the needed minerals in separate boxes and hoped that animals would help themselves, but it doesn't work.

A US beef farmer asked on graze-1, an international farming discussion group, if self feeding minerals separately had been tried. Another replied, "Yes, unfortunately, around here that is a recipe for dead animals, poor performance and weak lambs."

Another wrote, "I would like to report my experience with 'free choice minerals'! I went back to the farm and took over the management of ours as a new BSc graduate in 1956, with an animal science speciality in small dairy operation of 30 cows. During my undergraduate years I focused more on our family's pure bred beef operation and the nutritional requirements of beef cows. As a result I wasn't really up on the needs of dairy cows. I didn't, however, realise that at the time.

"I knew that the cows required a calcium/phosphorus supplement so I purchased one with the proper proportions and made it available free choice to my dairy cows in the exercise yard. This was about the same time that we started using artificial insemination in our dairy herd (1956). One day our AI technician (my brother-in-law) reported that we had the poorest conception rate in the whole AI unit. It was about 45%. He suggested that I contact our veterinarian. Our vet did some examinations and reported that, from his experience, the cows appeared to be phosphorus deficient. He also noticed the cows in the exercise yard eating dirt and chewing on sticks of wood!

"He suggested that free choice minerals were the culprit. We started incorporating the mineral mix in the grain mix at rates that would meet the dairy cows' requirements and within a month our conception rate was up to almost 70%. Free choice minerals were indeed the cause of our bad conception rate.

An Australian university student I was helping emailed, "I've now learned that my university education had not taught me everything I needed to know!" This was after I told him about pasture analysing, and his tutor knew nothing about it!

The problem with most universities world wide is that the tutors were taught by tutors, etc., who had never farmed.

The cows pictured here were on a Ruakura Research farm in March 1988. Their low heads show they are deficient in selenium and unwell, simply because Ruakura didn't, and worst of all still don't (2015), believe in analysing pasture minerals, or in liming. Doug Edmeads, their ex soil scientist wrote that none of New Zealand needs lime, so Ruakura got none for decades, until I persuaded the manager of one of their farms to lime one paddock. A year later he did them all.

Our second farm had not been limed sufficiently by the two previous owners, who went broke, so we had to catch up by chisel ploughing in about 8,000 kg per hectare after maize, before resowing it to pasture. The neighbours told us we were mad, but, after our pastures stayed green and grew no weeds, some applied lime!

Calcium (Ca) and phosphorus (P) make up about 70% of the minerals in the body, with about 99% of the calcium and 80% of the phosphorus in the bones and teeth, where they are a reservoir of both. Feeding these two direct to animals, rather than applying them to the soil, causes all sorts of animal health problems, as the animals' digestions cannot process them effectively. Moreover it doesn't feed the soils, earthworms, soil microbes, pastures and animals as well as through the soil and pastures.

Animals also need sulphur. Pasture containing 0.4% S, and feeding the sulphate forms of minerals can provide it. The oxide forms are not soluble in water, and, because about 10% of people are allergic to oxides, they are best not used unless essential, such as when dusting pastures with magnesium, because magnesium oxide doesn't wash off pasture as fast as magnesium sulphate. Magnesium oxide is bitter, so unless it is mixed with salt based minerals to make it more palatable, some animals avoid it and therefore don't get their supply of magnesium (See Elements > Magnesium on how to overcome this and for full information). The pasture tissue mineral level of magnesium should be at least 0.24%. See Free Items > Pasture Mineral Analysis for the optimum levels in all of the 17 important minerals. It is free because it is so important for farmers to use it. It is the only one in the world like it.

Iodine is also essential in some areas - in minute quantities - so it should not be fed ad-lib.

Feeding self-help dry copper sulphate is dangerous, and has killed animals.

Selenium should not be fed ad-lib, because it can make animals so sick that they became useless.

Many farmers and universities in the USA have shown that self feeding minerals doesn't work satisfactorily, but some still hope they will work. Decades ago in New Zealand, farmers found that self-help salt in lanes didn't work, because some animals consumed too much, while some ate none.

### **Licks - but be careful**

If there is no other way, feeding mixed minerals (not blocks) may be necessary to provide trace minerals, some of which can be unpalatable, or made so palatable with molasses that they are gorged, so salt is used as a carrier to overcome both problems. Salt can reduce excess consumption, except if animals have been deficient in salt, causing them to gorge on it when first supplied, so be careful and ration it initially, until all have their craving satisfied, which can take a few weeks.

Animals can also gorge on other minerals (palatable ones) if they are deficient and are suddenly given them. Deficient sheep have smothered each other to death when trying to get to minerals given in troughs, so be careful. Poultry have poisoned themselves on salt.

Placing the minerals within about 20 metres of water troughs encourages consumption.

### **Drenching, dispensing & dusting minerals**

When adding minerals to the water drinking system is not possible, I suggest -

- Dissolving the soluble minerals and pouring the thick solution over ALL the supplementary hay or silage EVENLY, so all get it.
- Feeding Causmag on deficient pasture can reduce milk fever to about 1%, and can increase milk production by up to 15%. Some cows may still get milk fever, either because they are prone to it or because they dislike Mg oxide so much that they avoid it on the pasture. Try licking magnesium oxide. It is bitter. Also some of the Mg oxide is not eaten so is wasted. When mixed with a good SMM, all is eaten and is even licked off the ground.

Some people are allergic to oxides. Dairy farmers spreading it on pasture can become unwell (nausea) and off colour, and can blame it on winter stress when it is simply oxide allergy. Zinc oxide can do the same in summer when used for facial eczema prevention, because the farmer has not kept up with a fifty year old system I developed. Read Facial Eczema in Animal Health.

An on-line dispenser is the easiest way to supply minerals, is more effective than drenching and is reasonably reliable for bloat control.

If you plan to mix your own minerals, get approval from animal authorities, or if farming organically, also from the organic authorities.

For drenching systems or on-line dispensers, dilute each one separately before mixing them to prevent reactions. You may then ask how a premixed mineral product avoids this problem. It is because they have a buffer added to overcome clashes of elements. However they should also be dissolved in plenty of water before mixing with other products. If you don't dissolve each separately, they can cause chemical reactions which can make the mix go thick, cause some elements to settle out, or make some elements ineffective. Good SMM's have stabilising additives. One farmer mixing his own minerals had Cu settle in the bottom of his on-line dispenser and build up there, rather than staying in the mix and going to the troughs. Some waters accentuate these reactions, while others are no problem.

When dissolving a bloat oil, pour it into the water, not water into the bloat oil, and dilute the bloat oil first in ample water, then add the other products, after also diluting them.

Drenches that close the animals' reticular groove and bypass the rumen can be a problem, especially if a bloat preventer is being used, because bloat occurs in the rumen. See Animal Health > Bloat.

Much of the digestion occurs in the rumen, so it is important that minerals enter it and are not allowed to bypass the rumen. This can occur when drenching, if the cow is handled roughly or stressed, the drench gun is pushed too far down the throat, if the drench contains some minerals (salt, Cu and others), or is too concentrated, has too much of some, is bitter, and/or if the water is very cold. However, Ruakura trials showed that with some cows even plain cold water can cause a rumen bypass.

All figures and suggestions are given in good faith and relate to successes or failures, but

supplementing of all elements must be done with knowledge and care, to avoid creating imbalances and toxicities. Some feeds and minerals are toxic. In New Zealand avoid anything with manganese, and PKE. Both have killed cows in NZ and in other countries.

### Ratios

Some people emphasise ratios between minerals, however ratios can be useless. If both levels are low, but the ratio is perfect, they will be of little use, and, if both are high, they could be dangerous. It is better to aim for optimum levels of each element in each pasture type and in animal blood and livers. See Free Items > Pasture Analysis for optimum levels of pastures and most grazed plants.

The correct balance of all minerals in a soil is more important than having sufficient of any one element. When soils become a little drier than usual, plants which suffer from toxic levels of some elements start to wilt, although soil moisture may still appear to be adequate. Adequate calcium (agricultural lime) reduces wilting. See the photos under Gardens > Vegetables > Tomatoes and Broad Beans. Wilting symptoms in pastures are not as easy to see, but, after farmers apply lime to deficient pastures, they notice improved growth in dry weather.

As plants mature, the percentage of trace elements of the whole plant tends to decline. Mature grasses vary in their element content between leaves and stem.

### Preferences

Animals prefer water that has the nine important minerals, as in Solmin minerals. Where farmers add it to drinking water for calves, they will run up and drink immediately. The preference for minerals in water is advantageous in wet weather when animals could drink from puddles, which means they don't get the essential minerals, or, even worse still, they can become infected with liver fluke.

Spraying minerals on to pastures is promoted by some suppliers. It is extra work and a machinery cost, and in rainy weather when minerals can be most needed, rain can wash them off before they are eaten.

Zinc sulphate has to be fed at 25 to 30 grams per cow in much of New Zealand and parts of South Africa, France, Canada and North America (and possibly other countries) in summer and autumn, to prevent facial eczema, where the spores are breeding because the farm doesn't have the right conditions to breed enough earthworms which eat the thatch that facial eczema sports breed on. Read Facial Eczema.

If an animal craves a dry lick that contains copper sulphate, it can kill itself by eating too much, which is not very much. See Elements > Copper. The same amount in drinking water will cause no harm because it is consumed over a day. Always be extremely careful with supplementing minerals, because almost all in excess can kill, or stress, animals, as with manganese. It is safest to use a commercial mix from a reputable company. In New Zealand DON'T buy a lick that contains manganese, because it is in excess in most soils here. See Elements > Manganese.

Some proprietary products often contain minerals that are being oversupplied already from pasture such as manganese, while some do not contain enough of those that are deficient such as selenium.

As with all things, there are good companies supplying good products and good advice, and the opposite. Some magnesium oxides and other useless ones are coarse, hard, of low quality and not absorbed in the digestive system of animals. Supplementing with a good magnesium oxide, such as Causmag from Australia, gives the best results in Australasia.

Some poor quality minerals can contain cadmium (See Elements > Cadmium). Always insist on an analysis of minerals and fertilisers. Once cadmium gets into your soil it remains for a long time.

### Boluses

The system of placing a bolus in the rumen has merit, but not if the bolus has elements your animals already have plenty of, or need more than the bolus will release. Feeding minerals through the water allows farmers to adjust the amount to suit, and to give more when animals are grazing lush high moisture pasture.

Some mineral supplements are designed in other countries and then used in New Zealand, so in one case manganese was included which is low in UK and parts of USA, but adequate, or often too high, in some of New Zealand's acid soils, and in some other countries.

A farmer believes that his calves were adversely affected (grew less) by getting trace boluses when



they were about 200 kg live weight, compared with his father's, which didn't get boluses and were grazing in the same mob. Trace boluses are made for adult stock.

I've seen calves with zinc boluses still showing zinc deficiencies, and cows with cobalt boluses showing cobalt deficiencies. See Elements > Cobalt.

### Chelated minerals

Chelating is sometimes used to allow patenting of a mineral that can't be done with a generic product like say magnesium sulphate. Some might claim that they are improving the mineral to bind with amino acids or organic molecules, and claim to reduce antagonism and increase absorption. Note the word 'claimed', because I and farmers have seen the opposite when compared to the feeding of them.

How much more beneficial they are than standard minerals depends on many things, such as other elements mixed in, the quality of the drinking water and the extra cost. They are promoted as superior with the use of flowery words, but with no facts or comparative cost trials.

I have seen no written evidence proving on an equal cost basis that chelated minerals are more profitable than sulphate forms. Chelated minerals cost more than natural ones, partly because of profiteering. All comparative trials should be done on an equal cost basis, otherwise they are useless. I've been suggesting this to Ruakura and NZ research people for 50 years, but still very few do it. This makes the millions of dollars spent on research, a complete waste and some of it is farmer's money!

It is known that copper, zinc, and some others as oxides and chlorides are poorly absorbed by animals - and toxic to animals and people. Absorption figures are as low as 3% for some elements.

All the Solmin minerals are sulphates, none of which are toxic and all are better absorbed. The very small amount that is not absorbed by the animals benefits the soils, pastures and earthworms. Try a little Solmin on some of your plants and half your earthworm breeding area and see what happens.

Low mineral absorption is not just from supplements, but also from pastures and other feeds. It is natural and is a form of recycling.

My top Waikato client from the 1980s fed Solmin soluble minerals with excellent results from 1989 until 2005, when his son was 'sold' more expensive chelated minerals. Since then his cows have become smaller and show mineral deficiencies. This one is an example. Despite being a crossbred, it is smaller and shows severe cobalt deficiencies (long hair on neck) and low zinc (long hair on the crown) and thinner bones. It also tells me that he has too many cows per hectare, as is common in New Zealand now, mainly due to farmer ego to milk more cows than anyone else and from Ruakura, AgResearch and LIC recommendations of 'more cows', from which LIC profits more.



Waikato clients, B & T Fernyhough of Walton changed from chelated minerals to Solmin minerals which, along with other improvements, reduced milk fever from about 10% to almost none, with a dramatic improvement in overall animal health and production. Calves were never healthier.

From Florida University, "In ruminants, chelated minerals have been of less concern due to the rumen microbes and their involvement in digestion. Under certain conditions ruminants have responded to mineral chelates, but it is not clear whether this response is due to the form of the mineral or simply to increased mineral feeding, and cost was not included. Information presently available does not consistently show advantages for chelated minerals in the diet."

A student from Wisconsin University wrote publicly, "Scientific studies do not support the idea of chelated minerals being better for growth or health."

I've been to the USA on consulting business 20 times and been invited to lecture at universities there and can assure readers that much of their research is company sponsored, so been set up to prove what is wanted. Cornell University rubbished grazing when the grain industry was scared that farmers would change to New Zealand's intensive grazing pastures and crash the price of grain, so Cornell told me and said publicly that the New Zealand grazing system didn't apply in the USA. 10 years later Cornell University stated that if US farmers used the New Zealand grazing system, milk and meat production costs would be lower, and their profits higher. Hundreds of farmers have shown this.

When Googling for chelated minerals there are many supplying companies that rave about them, and some users do the same, but I've not seen cost comparative trials by any. Mine comparisons show

the opposite. One farmer I know who changed to chelated minerals had sick looking animals when I last saw them and another had ketosis which he had never had before.

Curtis W. Richardson, Extension Dairy Specialist, Co-operative Extension Service, Division of Agriculture, Oklahoma State University, wrote in Minerals and Vitamins For Dairy Cattle -

“Chelated minerals are those mineral elements that have undergone a chemical reaction intended to affect its absorption and utilisation by the animal. For chelated minerals to be economical in rations they must either improve animal performance or cost less than other mineral sources. Statements such as, “The bio-availability of minerals is improved” mean nothing.

I’ve asked chelated mineral manufacturers for figures based on costs and returns to show that chelating is rewarding, but not received a single one. Most are trying to rubbish Solmin because it is 100% natural and the best.

Proteinate systems are now also being pushed as the latest and greatest, and some say ‘colloidal’ is the best form, but until one sees cost/benefit comparisons, feeding the lower cost and 100% safe sulphate forms in drinking water should be continued.

If anyone has evidence of the financial benefits of chelated minerals please send them to me or tell me where I can access them. Thanks.

Meanwhile Solmin is the only complete soluble mineral mix containing nine essential elements.

### **Immune system**

To maximise immune functions, some minerals are needed on a regular basis. The immune system is complex and intricate. Some minerals act as keys which unlock the ability of the immune system to ward off invaders. Correct mineral supplementation will not eliminate diseases, but will allow an animal’s immune system to work to its ultimate ability to maximise health.

Underfeeding and parasite infestation can cause mineral deficiencies, and conversely when mineral levels are correct, animals can tolerate most parasites much better. If infestation is not too high, animals need not be treated and can build up resistance to the parasite concerned. See Drench Resistance below. If you doubt this, then how is it that old animals can thrive, while young ones in the same mob suffer severely from parasites.

See Animal Health > Ill Health Symptoms & Causes.

### **Rumen acidity**

Ruminants fed two to three week old pastures on correctly limed and fertilised soils, don't have acidity problems. They’ve been grazing natural pastures for thousands of years. Nitrogen fertilised pastures and/or feeding a little over two kilograms of concentrates, grains or Palm Kernel Extract, or too much acid silage can change this without enough pasture. Correcting acidity can increase milk production by a litre per cow per day, which more than pays the cost. Better still reduce cow numbers, saving \$1,300 per cow per year, and benefit from more milk per cow from the fewer numbers, happier cows and milkers and improved pastures and farm that is not over-grazed. Use the ‘Dairy cow numbers for max profit’ spreadsheet to get exact numbers and profit.

### **Soil Eating**

When grazing, cattle can consume up to a kilogram (sheep 400 grams) of topsoil a day, which can harm digestion. High rates occur in dusty and muddy conditions and can adversely affect the balance of minerals in the body. However, where animals are lacking some minerals, especially sodium, they will deliberately eat subsoil from banks.

I saw foot prints from birds, wild pigs, deer and beef cattle, showing that they had been eating the subsoil below pasture root depth from a bank on a farm in Ohio. Animals seldom eat topsoil for minerals, which is just as well because some topsoils contain listeria. Some wild animals travel miles to eat minerals, especially salt, from some soils.

Animals eating soil in New Zealand can supply them a little cobalt (Co), which is low in much of New Zealand, and especially in sandy and pumice soils, but



obviously it is better to supply Co in a soluble mineral mix.

Decades of crop and pasture farming to a soil depth of about 15 cm (6") depletes trace elements, which remain depleted unless replaced. Animals and people are then fed on what grows in this depleted top 15 cm, so no wonder both suffer unexplainable deficiencies.

When the deficient minerals are mixed with solar dried complete sea salt, which has most things, and fed to animals, soil eating usually stops. Sea salt can give the benefits of seaweed. Vacuum-dried table salt which has had Ca, Mg and other flavours removed for human consumption is not as beneficial, but in New Zealand it often has iodine added, which gives it higher levels of I than sea salt, so iodised table salt is better for humans. In New Zealand soluble mineral mixes for animals should include iodine.

### **Elements in seaweeds and seaweed products**

The levels of most elements in kelp, and other seaweeds and their products, are so low that they will not prevent deficiency symptoms in areas very low in any particular element. Some claim that feeding a little kelp will supply some minerals, but as an example kelp copper is between 1 and 10 mg/kg. 13 mg/kg is necessary in the animal's total feed, kelp zinc is between 10 and 50 mg/kg. 40 mg/kg of zinc is necessary in the total ration so, kelp has no more of these elements than correctly fertilised pasture, so feeding it won't increase mineral levels.

The following from a farmer in Maine, USA, is one of many examples that show that there is not enough Se in kelp. "I've fed kelp meal (didn't say which one or how much, and they do vary in quality) and salt for 2.5 years now. Last March, shortly before lambing, we lost a ewe to an unknown cause. The vet during autopsy diagnosed a Se deficiency."

However, the above refers to elements we know of. I'm sure that we don't know all of the beneficial elements present in seaweed and fish products. When gardeners use fish or seaweed products some notice an improvement in plant health, and organic farmers achieve improved animal health, but their cost on a farm scale is not always profitable.

Sea salt has the same elements in higher proportions, so always insist on sea salt in your soluble minerals. Salt from deserts are not leached by rain, so have higher levels.

### **Citrus Deficiencies**

You may wonder why citrus deficiencies should be included in a pasture grazing book. It is because many farms and gardens have citrus trees. Visually identifying deficiencies in pastures is not as easy as in citrus trees. Also, citrus responds to the applications of deficient elements within months during their growing season, which allows confirming whether a possible deficiency exists on your farm or garden. There are books with photos of deficiencies, so get one.

### **Vitamins**

Minerals are much more important than vitamins, and, when mineral levels are optimum in correctly fertilised pastures, most vitamins in the animals grazing it are too. A well known example is that ruminant vitamin B12 levels will be low if Co levels are inadequate. Ruminant vitamin B12 levels can be so low that ruminants die, while non-ruminants, such as horses, thrive. Before learning this in New Zealand, farmers in 1935 on low Co soils, which are usually low in organic matter, as in sand and pumice, were mystified. Organic matter holds Co. It is better to apply Co to the pasture, rather than supplement with vitamin B12, because Co is also needed by clovers to make nodules and N. Adding Co to most soluble mineral mixes is also advisable.

Another example is that zinc helps animals make their own vitamin A, which improves night vision, and so reduces the risk of animals going through electric fencing at night.

Evidence from the northern hemisphere, where vitamin supplementation of dairy cows has been researched and used for many decades, shows that ruminants can produce most of the needed water soluble vitamins through rumen fermentation. However, researchers have found that high producing confinement cows force-fed with concentrates, and not getting fresh clover based pasture, can benefit from supplementing with some vitamins.

Vitamin B3 (niacin) is fed to some confinement cows at the rate of 12 grams per day, to avoid ketosis (deficiency of energy through inadequate feeding). Some herds are fed six grams of niacin daily for the first 100 days of lactation.



In areas where Se is deficient, Se and vitamin E are added to diets. The vitamin E is for animals not getting green pasture, which contains more than enough vitamin E. It can, however, be deficient in pasture silage because vitamin E is destroyed during fermentation.

In New Zealand never feed manganese or any minerals containing it (Read Elements > Manganese and you'll see why).

Herd and breeds can vary in their requirements of vitamin supplements. Most vets know about vitamins, so discuss it with them, but animals fully fed on balanced pastures with correct minerals seldom have problems. Farmers overseas can see the recommended mineral mix in several parts of GrazingInfo, and mix their own, adjusted to their conditions.

### **Drench resistance**

This has had too much publicity, and created unnecessary work in planning drench rotations, and by companies developing new drenches to try to overcome scouring, thought to be caused by internal parasites, when most is from, or at least accentuated by, mineral deficiencies (See Elements > Cobalt, Selenium and others). Farmers and veterinarians test faeces for parasites, when they should be testing pastures and blood for minerals. Many farmers feeding Solmin soluble minerals correctly and grazing correctly, don't have to drench for internal parasites at all! If, however, they follow the "establishment's" recommendations of more cows and more urea, the resulting grazing of pastures to the ground, and a lack of cobalt in humus-depleted soils, can make parasite drenching necessary.

The nine essential elements give animals resistance to more than just parasites. Full details on all the minerals are in Elements > Minerals.

### **Summary**

Farming is so simple. Why do so many make it so complicated by following out-of-date mistakes such as soil testing. I soil tested once in 1956 and saw that it was plain wrong and inadequate, so never did it again. I used a spade and my eyes with comparative trials until pasture mineral analyses became available.

Believing the fickle soil pH system causes COSTLY problems. Pasture mineral analyses are so far ahead of soil testing, as are the farmers who use them.

The dyed-in-the-wool, never improve, blind soil scientists, consultants and farmers, led by the fertiliser companies, are costing New Zealand farmers and the country millions of dollars in lost money, and, worse still in today's world, pollution.

Soil tests have serious faults, which many know about, but no one does anything to correct. The soil K optimum figure is too high, so too much is applied, causing both a loss of clovers in pastures, and animal health problems. Superphosphate leaches it, but, when changing to reactive phosphate and elemental sulphur, leaching stops, so the high K remains a pasture and animal health problem.

The Olsen P takes years to rise, and then can become too high, so much so that if the correct amount of lime is then applied it goes up to the animal-toxic pasture tissue level of 5% (See Elements > Phosphorus).

When K is too high, animal calcium, magnesium and sodium deficiencies can occur, and the incidence of grass tetany (hypomagnesemia) and milk fever (hypocalcemia - parturient paresis) increase. Oedema (accumulation of fluid) can occur around the udder pre-calving. Higher than normal calcium (not before calving) and magnesium should be provided to animals. Both these are best done by fertilising with LimeMagPlus, and growing clover. When I explained the cause of the high K problem to Doug Edmeades, then Ruakura soil scientist at a Ruakura conference, he got up and walked out. A friend told me that he did the same thing to him. So progress halts, and some agricultural consultants get \$12 per tonne, and fertiliser companies keep selling farmers too much K and P. In Australia commissions are not allowed to be paid to consultants of any kind. If that were the case here, I am sure that more lime would be recommended.

If K, P and manganese are all too high, and selenium is too low, mastitis and high somatic cell counts will increase.

### **One of a hundred testimonials -**

1. Tony & Gwen Ashford, Ngatea, Waikato, NZ.

We invited Vaughan Jones to our farm in 1989 after our farming had gone off the rails. Our peat

was dead from not applying surface LimeMagPlus, and we'd had bad spring and bad facial eczema. We had many cows with red udders and facial eczema damage every year, but got none within two years of applying LimeMagPlus as recommended by Vaughan. His recommendations included ceasing blanket weed and facial eczema spore spraying by helicopter, and changing from 30% potassic super (0-6-15-8) to a good reactive phosphate, no potassium, and with the necessary trace elements based on pasture tissue analyses. He also suggested dispensing Solmin soluble minerals through an on-line dispenser to the drinking water. Our stressed cows that made milking unpleasant calmed down and we never looked back. After three years our same number of cows could not fit in the yard because they had become bigger and production had increased by 22% from the same 150 cows, with no animal health problems and no milk fever.

Bloat used to be a really bad problem, but since liming and fertilising with reactive phosphate, elemental sulphur and deficient trace elements, including 40 kg per hectare of coarse agricultural Dominion salt, and feeding Solmin soluble minerals we've only had to add bloat oil to our in-line dispenser for a few weeks this year and have not lost a cow with bloat for years.

I phoned our vet in October to come and inject our calves. He asked where I was now because he had not been called for seven months whereas last season he had been called weekly. "Using Vaughan Jones." I said.

Did the vet ask what we were doing, and tell his clients? Not likely, because he would lose 90% of his business and medicine sales.

Thank you, Vaughan.

### **From Vaughan Jones -**

Vets couldn't believe what Solmin was doing to improve cow appearance, quietness and health in all herds using it, which cut vets visits to almost none, so some got laboratories to analyse it and tried to copy it. Some were accustomed to recommending quantities of copper sulphate to give per cow per day and had no experience in elemental levels so didn't know that the copper figure from laboratories had to be multiplied by four to equate the copper sulphate figure and the cobalt had to be multiplied by five.

Despite the tremendous success of the nine mineral Solmin (no others have as many), some vets wrongly told users that the copper, cobalt and selenium levels were too low, and recommended their mixes which didn't even contain salt.

The worst vet group wrote to a customer who was feeding Solmin that it was deficient in selenium, cobalt and zinc and in the same letter gave the herd's levels which were optimum. That is greed and commercialism gone crooked. Some farmers believe what their vet says without checking the figures in the spreadsheet called Blood, Liver & Urine Levels. They are my figures from agricultural college and farming since 1946 to now and from farming and consulting for 500 farmers since 1960.

Solmin was launched in 1988 and has not been changed. Some vets saw the large volume of Solmin being bought by farmers and copied it to produce their own for some of the business. Most made the same mistake in interpreting the laboratory analyses, so their mixes had a quarter to a fifth of some critical elements. Manganese (not magnesium) was added to some which caused dreadful animal health and stress problems because in most of New Zealand, manganese is already much too high in pastures and water. The stress caused more kicking, dunging and nervousness, which has been a cause of staff abusing cows.

Solmin is not being made at present, but hopefully will be available soon. Watch our Newsletters.

Minerals - humans need them at correct levels, as do animals.

I'm fascinated by what I'm learning and recording in 'Intelligence From Minerals'.

Read

More and more we read about people with unknown ailments, and babies being born with sicknesses, or suffering them as a child. Many are from pollutions (sprays) and toxic minerals such as mercury, manganese, lead, aluminium,

### **Toxic Minerals**

Excesses of even good minerals can be toxic.

Fluorite composed of calcium fluoride, it's commonly found in veins of other ores like iron, coal, and copper. The stone can be used as a smelting flux, though it's more often seen in jewelry and the

lenses of telescopes. And when mixed with sulphuric acid, fluorite produces hydrogen fluoride, an important industrial chemical precursor.

However, fluorite can be quite dangerous to both those who handle it regularly and those who simply happen to live near a fluorite mine. Fluorite contains fluorine, a soluble mineral that readily leaches into groundwater supplies and can be absorbed by the lungs if ground into dust or burned in a coal-fired stove.

Once fluorine is in the body, it causes skeletal fluorosis—a painful disease that weakens bones and damages joints. Many rural communities throughout India, China and the rest of Southeast Asia have been beset by outbreaks of the disease due to people drinking contaminated water, as is the case in India, or inhaling the mineral as a fine particulate, as is the case in China. An estimated 10 million people are thought to be afflicted by it in China's Guizhou province alone.

From optics and electronics to abrasives and fire starters, quartz is both the second most common mineral in the Earth's crust and the first most widely used mineral by humanity. In fact, its value as a firestarter (quartz produces a long-lived spark when struck against iron) is thought to be the impetus for mankind's earliest mining activity. Today, piezoelectric quartz crystals are a ubiquitous component in radios and electronic watches.

Just don't grind it up and inhale it—that is unless you want a case of silicosis. This respiratory disease is characterized by swollen lungs and lymph nodes which makes breathing difficult. Normally, this only occurs after about 20 years or so of exposure, however a subset of those afflicted may see symptoms in as little as 5 to 15 years. And if you grab a big handful of quartz dust and go all Scarface on that pile, you can cause acute silicosis whereupon your lungs will fill with fluid and you will drown in your own juices.

It may also very well just give you lung cancer. Since this disease is closely associated with specific industries like mining, abrasives, and glass manufacturing, OSHA has implemented strict guidelines dictating that workers wear fumigators to limit their silica intake.

lead. The Romans loved lead—they used it in everything from pipes and flux to paints and tablewares—and we still rely on it today: lead is often found in batteries and bullets, high energy shielding (such as X-ray blankets and nuclear reactor enclosures), formerly as an additive to paints and gasoline, and as a storage solution for corrosive chemicals. But, come on, it's lead.

It's not as bad as mercury, which will kill you immediately outright, but lead doesn't get flushed out of your system. It accumulates over the years, eventually reaching toxic levels. Once that happens both you and your kids pay the price, as lead toxicity is carcinogenic to you and is teratogenic (causing severe birth defects) to your offspring.

The phosphorous in your garden fertilizer and fluoride in your tap water very likely came from a rock like this, called Apatite. These phosphate minerals come in three varieties, each respectively containing elevated levels of OH, F, or Cl ions—the Hydroxyapatite version being a major component of your tooth enamel and the Fluorapatite version constituting what's dumped into civic water supplies to prevent cavities. And while having strong teeth and bones is a good thing, exposure to Hydroxyapatite (either by mining or processing it) will deposit those same minerals on your heart valves, effectively petrifying them.

Crocidolite, better known as blue asbestos. It was once widely used for a variety of commercial and industrial applications thanks to its strong, fire-resistant, and flexible nature—from ceiling tiles and roofing materials to flooring and thermal insulation.

But then, in 1964, Dr Christopher Wagner made the connection between asbestos and mesothelioma and the market for these products disappeared overnight. Unfortunately, cleaning up asbestos-laden buildings throughout the country has taken far longer and continues to this day.

Possibly the single most common use of lead today is for soldering (i.e. every single electronic device in your life right now). Lead solder is extremely common thanks to its fantastic performance, low melting point, and stability. There are many lead-free solders available but they just don't beat the original (e.g. higher solder temperatures, more stringent contact cleaning requirements). While the



Reduction of Hazardous Substances (RoHS) laws in Europe have effectively eliminated lead-heavy solders from the European market, most other markets around the world still use solder with lead in it. Now, for the consumer this doesn't really mean much, unless you make a habit of licking your circuit boards or burning electronics in a fire. In the long term, though, it means that a lot more lead ends up in landfills or in the bodies of the poor third world people who tear apart electronics to recapture some of the precious elements used to make them.

Vaughan Jones, ONZM Queen's honour 2013, for services to the farming industry. NZ M.Mkt.I. Dairying 99% Honours Award 1948. Waikato Most Improved Dairy Farm Award 1959. International Agricultural Consultant & Journalist. Represented NZ in Agricultural Journalist Congresses in USA in 1992 and Austria in 1994. Managing Director of GrazingInfo Ltd, compiled since 1970.