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Selenium is an element, not a mineral. It helps the muscles. It was discovered in 1817, but only found to be an deficient animal nutrient in New Zealand in 1958. In South Africa where I came from in 1954, cows didn't scour like many do here, and badly on our peat farm in 1956, so I asked Ruakura to help find out why, which was the low blood Se level of about 600 nmol. Feeding it gave such an overall improvement that the two vets helping us, and I, started taking animal Se, before human Se was available, and we all benefitted from it. The NZ human average blood was 600, so considered by our doctors to be OK. In the UK the human average was then 1,200. NZ doctors then aimed for 1,200 nmol (now for 2,000). Auriel and I now keep ours at 2,000 using Good Health Premium Vision capsules. Because men need more, I also take half a teaspoon a day of Philippines coconut oil which has natural selenium and natural boron. Others I've tested don't, and or have heavy metals. Read Human Health Selenium for more for people.

Selenium is an essential health element for animals and humans (See Human Health Elements > Selenium). Se supplements and fertilisers were not available to buy in 1956, but after I showed the authorities the improvements in our cows, they sourced it.

Selenium is found in nearly every cell and muscle in the body. This cow is an excellent example of a correct selenium level shown by the strong high held clean tail, and clean back end. Look closely at the tail base. Not many cows or beef cattle have strong tails.

Applying Se with LimePlus or with fertilisers and adding it to the drinking water have given profitable returns and substantial animal health benefits.

Ruakura's JH Watkinson and EB Davies found that spraying Se onto mixed pasture didn't increase tissue levels much, compared with applying Se to the soil which costs much less and is no work because it could later be bought in fertilisers. Most leaves have a slightly oily surface, so most sprays run off unless an equal amount of Codacide or another organic vegetable oil is added to the spray to make the contents spread evenly over the leaves, rather than run off in drops.

Half the amount of the spray need then be applied which reduces costs. I'm not recommending spraying pastures because it is costly in product and machine time and is usually not needed if everything else is done correctly, but do so for sheep onto a small part of the day's pasture, because they don't drink much so can't be supplemented through the water.

Selcote Ultra slow release Se with LimePlus or with fertiliser at one kg per hectare is the best way, costing only \$8 per hectare with no extra spreading cost. Don't apply more than recommended which used to be no more than one kg of 1% Se per hectare, but one fertiliser company recommends their own selenium fertiliser which is organically, but not slow release, so their pasture levels have gone too high and not lasted because it is water soluble, whereas Selcote Ultra is slow release lasting for ten months, so should be organically approved.

If calcium is low in pastures because it is low in soils, Se will be low and leach. Applying superphosphate in any form (Pasture Plus, etc.) causes acid soils and leaching of Se and other good elements, and an increase in heavy metals adversely affecting animal health and milk, because the sulphuric acid made to make P available in superphosphate, also makes the heavy metals available in their cheap (\$60/tonne wholesale) poor quality rock phosphate used.

Earthworms are animals, so need what grazing animals need, so Selcote Ultra is best and costs the least when supplied through the soil.

This chapter may look a bit long and heavy reading, but if Se is lacking in you or your animals,



you'll be glad that you read and applied it. Please at least read Warnings near the end, and read the other Selenium chapter in 'Human Health Elements' that is if you want to be healthier and live longer in New Zealand, where Se is extremely low everywhere.

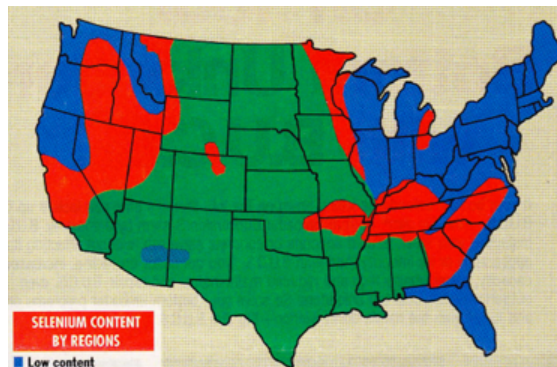
Selenium is widely distributed in the world's soils, but concentrations vary from none to excesses, depending on the rocks, ancient evaporated seawater, etc., from which the soil was derived, and the rainfall levels because Se leaches, especially out of sandy and low humus soils. The North West, South East, and Great Lakes states of USA have low levels because as in most of New Zealand, their soils were derived from volcanic deposits, and most of these areas have higher rainfall so Se is leached. Soils developed from cretaceous shale, such as found in South Dakota, Montana, Wyoming, Nebraska, Kansas, Utah, Colorado, and New Mexico and Senegal in NW Africa, have higher levels, especially in drier areas. Rain and irrigation leach it. **The blue areas are very low, red low and green adequate, but not always.**

Many farmers don't measure their ryegrass Se levels. Northern Hemisphere cattle confinement grain feeding farmers usually aim for 0.3 or 0.4 mg/kg in cattle total mixed rations, and 0.1 mg/kg for horses. See the 'Plant Mineral Analysis spreadsheet. Row 34 has the optimum levels for 20 different plants. Type your pasture or feed analysis figures into it and read the effects if high or low. Then copy and paste the figures to the 'Plant Minerals Analyses Records' spreadsheet for future reference. The levels I recommend are for farmers doing all things correctly.

This 1907 photo from the Dairy Nation book shows severe scouring caused by low selenium which, because they could not lift their tails caused muck to be on them, and then spread around their rear end. I had never seen scouring like this in South Africa where I lived and farmed until 1955, so I researched it here. The reason was unknown until I and two Ruakura vets and one we communicated with in coastal Oregon, USA, which has similar high winter rainfall as in NZ, discovered it in 1958/9. The above dirty tails and rear ends in 1908 were mainly caused by low Se, not from worms (parasites), the symptoms of which are less spread and darker in colour, sometimes from blood, especially if coccidiosis is present.

A New Zealand vet wanted these just bought yearlings drenched for worms, but I disagreed, and said that Se would fix them and it did. Repeated drenching when not needed develops 'parasite worm drench resistance'. This was taken with a zoom camera because on 18 August 2008, two days after they arrived on Barry Brunton's Waikato beef farm, they were nervous. This was because of being low in essential minerals and most probably high in manganese which is in excess in most NZ lime deficient, wet soils, and in pastures and waters, especially when calcium is low.

The heifers cost NZ\$425 each. Their tails and bodies cleaned up within four weeks of getting the correctly limed pastures and Solmin soluble mineral mix which has eight soluble minerals, in their water, consisting of 80% sea salt, sulphate forms of magnesium, copper, zinc and cobalt, and Se and iodine. It was added daily for a month because they were low in most elements. Selovet 5 was also added at 3 mg per animal per day for the first three weeks. They were fully fed on correctly limed and fertilised pastures that also had, over a year, two lots of three tonnes of LimePlus (96% Ca lime and



2.3% Mg and needed trace elements based on ryegrass analyses). Note how pastures improved. This is the same animals 2 months and 13 days later on 29 October 2008, just after being moved to this new paddock. The 15 mineral levels in the pasture leaves were close to optimum. The liming helped achieve 0.33 ppm of Se in ryegrass. It is hard or impossible to keep Se level at the optimum when soil Ca level is low or when soils are sandy or



low in humus. Calcium should be 0.9% in ryegrass leaves and stems, and Se should 0.3%. See the Pasture Mineral Analysis spreadsheet for other levels.

On 8 November, 2 months and 23 days after buying them, 17 sold for NZ\$940 each. A week sooner they would have got the better schedule price of \$1,000, so I suggested in future to buy sooner and move faster to feed them more.

I and son-in-law Ian Dobbs developed Solmin over four years of reading and adjusting, for animals grazing pastures with optimum mineral levels, then DeLaval made it. We get no royalties, except the happy successes of farmers and their testimonials. It has not been changed since 1987 and vets have phoned me to ask what is in it that makes animals so healthy. Vets don't like it when I consult for a farmer because they don't then need a vet, except for calf injections against diseases once a year.

Vets and others have had Hill Laboratories, 1 Clyde St, Hamilton analyse it, and many have copied it, but most get it wrong, by omitting things by not asking for them, especially Se and salt. See Minerals.

Selenium helps protect the body by reducing free radicals that harm cells. It helps in regulating blood pressure and dealing with inflammation, and helps detoxify the body. Low Se and/or copper, decrease the ability of white blood cells to kill bacteria.

Superphosphate, high rainfall and irrigation all leach selenium, dangerously so when organic matter is low. Nitrogen boosted pasture increases scouring, decreases earthworms and increases repeated drenching for worms, which increases drench resistance.

Read the 'Beef Profiting' chapter for evidence of scouring being from low selenium, not always from parasites.

Type your ryegrass analysis figures into 'Plant Minerals Analyses' and read the effects of high or low. Then copy and paste the figures to the 'Plant Minerals Analyses Records' spreadsheet for future reference. The levels I recommend are for farmers doing all things correctly.

To get ryegrass to its optimum Se of 0.3 mg/kg needs ample humus in the soil which then holds Se (and especially cobalt) and an optimum Ca level of 0.9%, which helps increase humus.

Muscles are strengthened with Se and then help hold the joints together. Without it, human osteoporosis fractures are more likely because the muscles are weaker. Osteoporosis is not only a human problem. Low boron levels in pastures on New Zealand's 3,000 to 5,000 mm (120 to 200 inch) per annum rainfall areas on the South Island's west coast have caused osteo type pains in cows so severe that they sometimes can't stand up after calving, and, when they do, they just stand. If they walked, their pin joints clicked which any osteo sufferer knows can be painful. Milk fever is worse and harder to cure when boron is lacking. See Animal health > Milk fever. Human's clicking knees is also a symptom of low boron in joints that lack lubricant. See Exercise > Stretching.

Se strengthens muscles. Look at this strong tail muscle compared with the low-hung dirty ones on page 1 when they arrived.

Read the 'Horses' chapter in Animals - Other, and its reference to a deficiency causing nutritional muscular dystrophy, and an excess crippling them very badly.

Low Se can cause animal suffering which is unnecessary and costs very little to correct, because of higher milk and its protein and other benefits, such as reducing worm drenching, completely, when all is correct, so cost nothing for the Solmin and Selcote Ultra. Most soluble minerals don't have all nine essential minerals and some contain toxins



such as manganese, oxides, chelates (man made mixes often using mercury as a binder and with toxins) all of which are quite unnecessary. Read 'Minerals in Soils, Plants and Animals' > Manganese and Read Chelating.

Animals getting Solmin become tamer. This one came up to me while photographing.

Spraying 24 grams per ha (0.34 oz per acre) of Se as sodium selenate on to Bermuda grass in Florida improved animal health at a time when Selcote Ultra fertiliser had not been approved there by their bureaucrats. Correct minerals in fertilisers and fed through the water will also make animals tamer as shown here two months after they arrived wild on Brunton's farm. I was a stranger photographing them when this one walked up to me. Read Beef Profiting for the full information on that farm.



Good New Zealand animal farmers fertilise with Selcote Ultra annually, and feed it in the drinking water in Solmin, because it pays to have healthy, fertile animals. Commercial vegetable growers don't because there is no financial benefit to them to do so. In Finland it is legislated that all farmers must apply Se with fertilisers, and it should be the same here in New Zealand. The cost at \$8/ha pa gives an excellent return through animals, so would through human health.

In New Zealand, the high leaching of Se in low humus soils means that Selcote Ultra should be applied at half the recommended rate (0.5 kg per ha) twice a year.

Discoveries

In USA in 1930 excess Se was identified as the cause of Alkali Disease and Blind Staggers in cattle and more so in horses. It occurred in the extremely high Se soils, in some dry parts of North America. If farming in these areas ask locals about the plants that are high in Se and how to prevent new animals from eating them and poisoning themselves. Animals do adapt to living in high Se areas. Bodies adapt by learning to excrete surpluses, rather than digest them and suffer, but ones new to the area can poison themselves by eating too much high Se level plants.

Animals in New Zealand grazing green pastures and getting selenium, thrived, while those in north-west similar winter rainfall areas in USA didn't, because they were grain fed which has no vitamin E, until in 1960 when they found that vitamin E was necessary to go with the Se because they are synergistic (need each other to work as do soap and water). Trials have shown that the vitamin E in pasture is better than synthetic ones. Their stall fed animals were not getting fresh green high Se and vitamin E pasture that New Zealand grazing ones get.

Growth rates of animals on Se deficient pasture improved after the use of Se as a fertiliser, or drench, and since 1988, a soluble mineral mix through the drinking water that I developed over three years called Solmin. Initially it was criticised by many vets in New Zealand, because they weren't selling it, but after some saw the large number of herds using it and the animal health improvements, they phoned me to ask what was in it. Some then got it analysed and had copies made to sell. Not being experienced in minerals, some made errors. An example is that the analysis figure for copper could have been x% so they added x% of copper sulphate, but copper sulphate has only 24% copper, so some soluble mineral mixes have only 24% as much of the elements as Solmin. The same occurred with other minerals. This made their mineral mixes cheaper, but less effective, which made some farmers go back to Solmin.

A Reporoa, NZ, dairy farmer who added Selovet 5 to the drinking water at 1.5 ml/cow/day had milk fat and protein levels increase by 12% and 19% respectively within two weeks in Autumn 1992. After taking off the cost of four cents/cow/day, the profit per cow per day was 52 cents, with better health into the bargain. Solmin achieves a lot more because it has nine minerals, including salt which most vets avoid feeding because it improves animal health so much that vet visits become seldom necessary.

Visually deficient selenium herds hold their heads lower and have zigzag droppings. High manganese also causes a thinner scouring. and when older, stopped scouring and increased milk production by 4.5 litres/cow/day within days of being given Se. Many farmers have had similar results.

In 1990, a survey I did of 21 farms feeding Solmin which have the maximum Se allowed by the NZ Animal Remedies Board, 11 farmers reported a reduction in mastitis after a few months. See Minerals.

Cows grazing Se fertilised pastures in Eastern Waikato containing 0.1 ppm of Se in the ryegrass increased milk production slightly and milk protein by 19% within seven days of supplementing with 1 ml per cow per day of Selovet 5, or Selovin 5 or Selmit 5, in their water. Endophyte staggers symptoms

reduced slightly within three days, and more so later. The cows started to look healthier and the two to three metre long zigzag loose droppings shown here, stopped, and their manure gradually firmed. Zigzag cattle droppings like this in paddocks, not in lanes, are a definite sign of low Se. One Good Health Premium Vision capsule a day increased my blood Se to 1,000 nmol. Later it went up to 1,400 thanks to our correctly fertilised vegetables and rose to 2,000 nmol when eating Organic Virgin Coconut oil from Philippines which has high amounts of Se and boron. It is low in cholesterol and is GMO free. We had to cut back to one deserts spoon of Coconut oil we were eating. The Australian certified organic coconut oil we tested contained toxins.

In Mississippi, supplementing with Se reduced ryegrass staggers caused by high endophyte fescue grass, and I achieved this with many clients' calves in New Zealand with Solmin through the drinking water.

In Hawkes Bay in 2011 AR37 endophyte caused staggers, but the complainers didn't check the Se levels of their pastures.

In South Australia where ewe blood levels were between 0.016 and 0.035 ug Se per ml, improved ewe fertility occurred following Se supplementation. Feeding Se with swedes in Southland, NZ, improved hogget health. Se applied to the far end of all paddocks on one Waikato dairy farm caused cows to walk to them and graze those areas first and shorter. This was caused by air spreading Se around the farm and running out.



Conrad in Ohio, reported retained placentas decreasing from 38% to none after supplementing with Se.

In USA they found that supplementing with Se and vitamin E gave red meat better keeping qualities and made it retain its red colour for longer. The article didn't say how much, or what the pasture or feed levels were. Buyers of red meat like it to be red, so supplementing with Se where necessary, should be worthwhile for beef farmers. NZ meat is usually redder because of grazing green clover based pastures which are high in vitamin E which is synergistic (needed) with selenium, which most NZ farmers apply.

Agricultural Research Service, USDA, reported in 1999 that Se deficiency is a major livestock and wildlife problem in the higher rainfall states, and costs beef, dairy and sheep producers an estimated \$545,000,000 in losses every year. USA members should see the 'Selenium USA Map' in GrazingInfo in 'Minerals in Soils, Fert, Pastures & Animals'.

It is known by some that Se helps many enzymes, muscles and some heart conditions. It is a muscle.

Despite the above and thousands of hours on research, hundreds of papers (Google for Selenium and you'll see them) and several books on Se world-wide since the 1960s, ignorance is still common in New Zealand and other countries regarding human and animal health. There are many bureaucrats in establishments who should know better, but do nothing about it, almost as if Se use is being blocked by some who are keener on making money from selling their services and medicines used to treat symptoms rather than to prevent them.

If pasture is the only feed, Se should be added to the drinking water through a filter stock or inline dispenser.

Clovers can have higher Se levels than grasses where the grasses are tropical, because in New Zealand clovers are lower than most of our temperate grasses.

In countries where Se is not as deficient as it is in NZ, deep rooting plants can have more than shallow rooting ones. This doesn't apply in New Zealand because soil levels are low at all depths, so the only Se is what is added with lime or fertiliser.

Most plant levels can be seen on the left of the free Pasture Analysis spreadsheet.

Modern pasture species have been selected and bred for fast growth and high yields, not for their mineral content.

Fertilising with Se

In New Zealand since 1982 it has been legal to correct low Se levels in soils by fertilising with Se. Animal growth rates and health on Se deficient pastures improved dramatically following the use of Se as a fertiliser at 1 kg per ha per annum of Selcote Ultra.

Selcote Ultra slow release prills contain 1% of elemental Se and can achieve 5 mg of elemental Se in 17 kg of pasture DM, which is needed for good health.

Northern hemisphere research shows that animals do best with 0.4 ppm in their total feed, however, even with correct liming and fertilising it is hard to keep modern pasture leaves at even 0.3 ppm. It is therefore necessary to supplement with Solmin, a 9 mineral complete soluble mix with Selcote 5 (or equivalent) added if necessary, through the drinking water to give animals enough.

Selcote Ultra fertilised pasture supplies Se to animals, but if calcium (and therefore humus) is lacking, soils won't hold selenium. Selcote Ultra prills at 1 kg per ha release their Se in a bit under a year in high rainfall (>1,000 mm) areas, to close to 2 years in low rainfall (<500 mm) areas. If you are elsewhere in the world and you can't find a supplier of Selcote Ultra, email Mike Shirer <agbioresearch@xtra.co.nz> at ICI Crop Care, New Zealand. He appoints international distributors. The extra milk protein produced and other benefits more than reimburses the cost of Selcote Ultra and Solmin and added.

Selenium chips are water soluble and not slow release, so can make the Se level go much too high, which can be dangerous, especially for horses.

Selenium chips should not be applied at more than 0.5 kg per hectare, so needs to be applied twice a year. Even then, the Se will go too high and then within a few months be too low.

In North America, applying Se was not allowed until Selcote Ultra was invented and tested to ensure that there was no leaching, as Se chips do. Each State has to approve it. Not all have, partly because dry, States with alkaline soil have toxically excess levels so will never need it.

I worked with Principal Research Scientist, Dr Umesh Gupta of the Canadian Department of Agriculture who accepted for the whole of Canada that leaching and pollution from 1 kg of per hectare of Selcote Ultra prills did not occur, so all of Canada is allowed to use it.

Organic farmers in New Zealand are not allowed to use Selcote Ultra fertiliser prills because they are not BioGro approved (because of the coating which slows the Se release, so provides Se to animals grazing pastures for a year, rather than the immediate release of organic approved ones which increases pasture Se levels much too high). The coating has a wide range of ingredients, some of which aren't allowed under the NZFSA Technical Rules. When one considers that it is only the thin coating on 1 kg per hectare (0.9 lb per acre) of prills, one wonders what possible harm it could do? So meanwhile, organic farmers have to fertilise with the fast release chips twice a year, which each time increases Se to as high as 2 ppm, which is seven times above the maximum recommended level of 0.4 ppm. See Selenium Chips below for more information.

Selenium prills and chips should be mixed with fertiliser, lime, or sand as a carrier to achieve even spreading.

NZ Se fertiliser products must not exceed 1% of elemental Se and not be applied at more than kg per hectare, so they are safe to handle, but care should be taken because excess Se is poisonous. Use a shovel or gloves, and wash your hands after use. Most fertiliser suppliers can mix it in with fertilisers. Some, however, just throw it on top the load, which should not be allowed, because it is a such a toxic element, and too much has made animals, especially horses, very sick, and ruined some when an alternative type fertiliser company applied too much Se to a fertiliser mix.

Don't trust any person or company adding elements to fertiliser or feeds because mistakes occur too frequently. Check the mixes against amounts recommended in Lime and Fertiliser Nutrient Planners. NZ Overseer doesn't help with trace elements, so again be careful.

Calves, that are highly selective, would not graze pasture fertilised with excess Se in fertiliser that had the Se spread on top of the load, and tested ten times the optimum level in pasture of 30 ppm instead of 0.3 ppm. Watch your animals grazing, or not grazing, they are barometers.

Selenium can get low again in pastures four months, or less in high rainfall, after applying Se chips, especially if applied with a water-soluble fertiliser such as superphosphate which leaches it. Slow-release Selcote Ultra keeps levels up for close to a year, depending on rainfall and calcium and soil humus levels.

The maximum amount allowed by New Zealand law is 1 kg of Selcote Ultra per hectare or 0.5 kg of Selenium Chips per ha per annum. Both have 1% of pure Se so that is only 10 grams (three teaspoons) per ha. This shows how important thorough mixing is at the source. Check every load when it arrives. Some spread minerals on top of the lime or fertiliser and charge for mixing. The practise of spreading trace elements on top of loads has caused calves to not eat pasture and copper poisoning to damage guts. Don't tolerate it. All elements should be mixed in thoroughly before loading.

Selenium Chips (not prills) are the only organic approved ones which is a pity because it releases too

quickly in pastures so at 0.5 kg per hectare the Se pasture levels go to three times too high, then drop, so there is insufficient after about four months, even if applied twice a year.

Selenium fast release chips at 0.5 kg per ha are made for summer and winter forage crops. Longer growing high yielding crops such as maize can have one kg per ha of selenium chips which increases the maize Se level to a closer to optimum level of 0.2 ppm. Summer crops can be 75% of the ration in droughts, and maize silage 50% in winter, so it is important to fertilise with organic approved Se chips rather than Selcote Ultra when growing forage crops in Se deficient areas.

Supplementing in drinking water

Recommended rates in animals' total feed -

Dairy cattle 0.4 mg/kg* equals ppm, but is by weight.

Beef cattle 0.3 mg/kg.

Sheep 0.15 mg/kg

Pigs 0.2 mg/kg.

Horses 0.1 mg/kg. A little too much Se has been severely toxic to horses.

Poultry varies with age, but aim for 0.1 mg/kg of Se from 5 weeks on, and more if free range and eating about half their diet in low Se New Zealand pasture, not fertilised with selenium.

* The 0.4 mg/kg in feed for cows has been decided on in the USA where the best are extremely well experienced in mixing total mixed rations (TMR). In pastures it is not easy to maintain levels that high with Selcote Ultra fertiliser prills especially in dry conditions, so supplementing through a good soluble mineral mix is necessary. Selenium is held in organic matter so if soil organic matter levels are low, pasture levels will be low. The pasture cobalt level tells us the soil organic matter level, and soil and earthworm inspections confirm it.

Green pasture has more and better available vitamin E for animals, than when fed as a supplement. The organic fast release chips increase Se levels in pastures to double or triple that, and then drop after about four months, depending on rainfall and the calcium levels in the soil.

Supplementing milking cows with 3 ml per day of Selovet 5, (or Selovin 5 or Selmit 5) in a drench or drinking water for three months over spring, on pasture with 1.5 ppm of Se, caused no ill effects. Some vets have recommended 6 ml per cow per day, which in my opinion is excessive. All three are solutions for animal oral consumption. Blood levels rose to 800 nmol per litre of blood. My recommended minimum is 1,200 nmol per litre.

Confinement farmers, please note that Vitamin E which is needed to make Se work is low in other than good pasture and pasture silage.

There is a map from Dairy Herd Management June 0994 in GrazingInfo > Elements under Selenium USA Maps. Even in high Se levels, animals can still need more because if on dry pasture they won't be getting the essential vitamin E in green pasture, or supplemented, to absorb enough Se.

With grazing animals, measure the 15 elements in pastures and then decide how to feed to achieve optimum levels.

Before using any form of Se product, measure the levels in animals' blood and all feed, including pasture ryegrass or the item there is most of. Plantain, dandelion, chicory, which although deep rooting are usually low in Se in New Zealand because there is almost no Se naturally) and weeds eaten, as one sample. Northern hemisphere totally mixed rations (TMR) aim for 0.4 ppm. Plants don't need Se. The rest is best made up with approved soluble minerals in the water.

Measure your pastures' 17 mineral levels and use the free VJ 'Pasture Analysis' spreadsheet from GrazingInfo to monitor and guide you, and use the spreadsheets called 'Fertiliser or Lime Nutrient Planner' to achieve optimum levels. Knowing all levels is essential, because pasture with high potassium (K) and the following low, will cause low animal production - boron (B), calcium (Ca), cobalt (Co), copper (Cu), iodine (I) and selenium (Se).

Se can be measured accurately in the blood and should be at least 1,000 Se nmol per litre. Top USA farmers aim for between 1,000 and 1,300 and their milk production per cow is above most of New Zealand's. Under confinement they don't have our green pastures so add vitamin E. Obviously their cows are bigger and are better fed. Incidentally when Northern Hemisphere farmers rear NZ animals, they grow bigger and produce a lot more than here, because of Ruakura's, and now most dairy farmers' craze for more cows per hectare, which is their biggest and most costly mistake. Each cow cost about

\$1,500 a year to keep and milk. In every case, after dairy farmers use the 'Dairy cow numbers for max profit' spreadsheet, and apply the results, their profit increases, because they sell about 10% of their cows, reduce their mortgage and interest payments, feed their animals better so the remainder produce about 10% more, so their profit goes up by more than 10%.

Blood and liver levels should be measured at drying off to make corrections, and after calving to monitor the dry period feeding levels. A top Waikato, NZ, dairy herd, did as I recommend, i.e., tested the two highest producing, two average producing and two low producing cows (not any eight as usually recommended by vets) and wrote their Se levels next to their milk production figures. When funds are low, two or even one average 'health and production' cow is better than doing none.

Production Se nmol per litre

High producing cow 1,400

High producing cow 1,200

Average producing cow 1,000

Average producing cow 1,000

Low producing cow 990

Low producing cow 830

After the vet saw the above, he changed to the same system, but expressed concern about the 1,400 cow, but as shown it was in good health, and was the top producing cow.

One kg of Selcote Ultra annually was applied with LimePlus (see Elements > Calcium). Northern Hemisphere farmers who feed totally mixed rations (TMR) with added minerals aim for 0.4 ppm Se. Also 50 grams per 550 kg cow per day of Solmin containing the maximum allowed Se was being fed through the drinking water. These figures show the importance of adequate Se to help achieve high milk production.

Each spring and autumn, some animals, when slaughtered, should have their liver levels measured for copper which is not accurate in blood. For optimum levels see the Excel spreadsheet called Blood and Liver Levels.



Calves

I believe that the liver Se level should be about 3,000 nmol per litre, but in new born calves it should be about 20,000. The reason that calves are born with high levels is because there is very little Se in milk, so calves need a reserve until eating solid food - in the hope that it has adequate amounts of 0.3 ppm, which very few pastures have. Another problem can be dry brown pasture and brown dry feed which don't have enough Se and have no vitamin E, and certainly not enough for in calf cows. I repeat that Se is dependant on vitamin E in green feeds for absorption by animals.

Most Se is transferred to the foetus during the last two months of gestation, so the dams should be well supplied with it then. They also need ample Se when milking heavily, during hot periods, when on facial eczema antiquated zinc control (Read Animal Health > Facial Eczema), and when on low maintenance winter diets. It costs comparatively little to supply with LimePlus or fertiliser, Solmin in the drinking water, or as a slow release injection if the other options are not possible. In Solmin it costs nothing because of the many benefits to all ruminants that it gives, including no worm drenching needed by calves, provided all other things are correct. Read Mineral Feeding.

Sheep

Sheep and goats are even more susceptible to low Se and/or low vitamin E than cattle.

Sheep don't drink much water, so, where levels are low in feed and Se fertilising is not practised, 5 mg of Se drenched once a month to ewes before mating, and for a month before lambing are the NZ recommendations to prevent infertility and white muscle disease in lambs, followed by 5 mg doses once every three months for general health. Calves need twice this amount every three months. Slow release

Se injections for sheep and cattle are available, however fertilising and/or oral supplementation in the drinking water for cattle are easy and best solutions by far. One sheep farmer told me that his sheep drank water with Solmin. Could sheep farmers please comment on this to me if they have notice their sheep drinking more water when containing Solmin.

At Armadale, NSW, Australia, it was found that Se deficiency was associated with increased embryo mortality in sheep.

Halpin and others (Australia 1981) observed that the water-soluble sulphur in single superphosphate (0-9-0-11) depressed both pasture Se levels and the Se levels in sheep blood. This has also been found in New Zealand and USA pasture analysis that I've got done, possibly because repeated superphosphate leaches P and other elements and reduces organic matter in soils.

Sheep need to be exposed to the sun's ultra violet rays for body synthesis of vitamin D and the metabolism of calcium. In the winter, sheep of all ages, but especially hoggets grazing brassica crops, can suffer white muscle disease in spite of regular Se dosing. This might be from either the typical high sulphur in the crop or a low vitamin E level, or both. Grazing some green pasture, as well as the crop, supplies vitamin E.

White muscle disease is so-called because of calcium deposits that look white. Most sheep farmers are aware that a deficiency of Se in lambs causes white muscle disease, weak muscles shown by stiffness and paralysis of hind limbs, the death of newly born lambs from heart attack, etc.

Langlands and others in 1982 reported that Se blood levels in sheep were not lowered by high stocking rates where Se levels were adequate. However, heavy stocking in wet weather seals the soil surface so soil sulphur can't escape. High iron consumption from water, muddy or dusty pastures, and high molybdenum, lower Se absorption, which is also lowered when sporidesmin is present, and when feeding high rates of zinc for facial eczema control.

Very high Se can depress zinc absorption, while low zinc can decrease Se absorption, so ensure that pasture levels are correct.

Worm drench resistance in sheep is becoming a problem in New Zealand. I know that when calves and older animals get all the necessary minerals in pastures and drinking water, worm drenching decreases to none, or to very little, compared with mineral deficient calves, so there is no reason why the same doesn't apply to sheep, but they drink little so pastures must be at optimum levels and in some cases licks may be needed. If sheep are low in minerals which are then supplied, the flock can clamber to get at licks and smother each other. Don't let minerals get low, and when first supplementing with them, have plenty of troughs and stand by with good dogs to move them if necessary.

Cobalt is also an important element. Lambs won't finish (fatten) on low Co pastures and internal parasites increase. See Cobalt.

Supplementation with Se, where needed increased ewe growth rates and wool yields by up to 12% and improved its fibre diameter.

Milkers

High producing milking cows in North America and UK, are fed six milligrams per day or 0.4 ppm in the total mixed ration (TMR). Beef cattle get 0.2 ppm. Requirements are higher when S intake is high and vitamin E intake is low, and when diets contain heavy metals such as silver, cadmium or mercury. These are not common, but can occur in some feeds and in feeds from areas where high cadmium phosphate had been applied for years.

Dairy scientists at Washington State University found that dry cows consuming insufficient (less than 4 mg) Se per day (less than 0.4 ppm in all feed) had higher somatic cell counts in the subsequent lactation. This agreed with Ohio State University that reported the same. They reported that Se supplementation during the dry period both protects the calf from a deficiency and helps reduce mastitis incidence in cows.

Dairy cows are mass production machines, so usually need supplementing with more Se when -

- Fed mostly pasture in high rainfall or irrigated areas.
- Milking heavily.
- In hot climates.
- On facial eczema control getting large amounts of zinc.
- On maintenance winter diets of about 8 kg of pasture dry matter per day.

The 8 kg per 500 kg animal per day is sufficient to survive on, but the mineral content of even the best limed and fertilised pastures is not, so soluble minerals should be fed.

The above adds up to feeding minerals all year. One kg of Selcote Ultra per hectare fertilised annually and a good soluble mineral mix, can do this. If any low Se symptoms still occur, add 3 ml of Selovet 5 per cow per day to the water, or drench.

If lacking, expect your milk protein percentage to increase within a few days of getting the optimum amount.

A Waikato herd in autumn not getting any mineral supplements, on pasture or maize silage, showed severe Se deficiency (heads well below back level, tails low and dirty, and back end dirty, and zigzag dung on pasture) improved dramatically within five days of getting the maximum Se allowed.

Horses

If Se deficiency is suspected, horse owners should consult their veterinarians for confirmation by blood test before attempting to supplement because many feeds, mineral blocks and supplements already contain selenium, and as you will have read above, the daily Se intake recommended is a very small amount, especially for horses. Read the Horses chapter in Animals Other.

Fertilising with selenium

This increases Se in pastures and crops, PROVIDED high water-soluble sulphur fertilisers such as gypsum (calcium sulphate, $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$, 23% Ca, 18% S) or Single Superphosphate (0-9-0-11) are NOT used with it, because the high S leaches and lowers pasture Se uptake. Elemental sulphur can be used with reactive phosphates and with Triple Superphosphate to provide slow releasing S which doesn't lower Se because the sulphur releases slowly. If your soil pH is above 6.3 reactive phosphates may not work unless the soil is really 'live' with more than 20 earthworms per spade spit of 20 by 20 by 20 cm (8 inches) and a good crumbly structure. Chisel ploughing reactive phosphate improves soil contact so makes it more available.

In New Zealand's South Westland pastures where rainfall is between 3,000 and 5,000 mm (118 to 200 inches) per annum, Se fertiliser has proven highly successful in improving animal health, as it has in dry NZ areas getting only 300 mm (12 inches) pa, and all without any ill effects or environmental problems of leaching this highly toxic element.

Se levels in some feeds are sometimes published, but vary considerably depending on soil levels, so, to be of use to you and your animals, yours need to be measured.

In extensive grazing situations, fertilising 10% of each paddock or 10% of paddocks, if all are grazed by each mob, helped animals in NZ trials on very low Se peat in 1970 at Ruakura Animal Research Centre, but spread evenly over all paddocks is best.

When deficient, a profit (financial benefits higher than costs) can be made from applying Se as a fertiliser, feeding it as a soluble mineral mix in the drinking water, in a drench or with grain, or as a slow release injection. Read all instructions carefully, because excess Se can kill.

Don't overdo Se in fertilising or supplementing, and, if using either, monitor pasture and animal levels preferably twice a year, but at least once a year.

The concern of some people in North America banning its use as a fertiliser, saying it could pollute waterways is unlikely to occur because -

- Se is not transported by clean water, and good pasture farmers don't have dirty eroding water running off their pastures removing their asset (top soil).
- To move from where excess is applied or dropped by animals, it would have to be transported in soil, that means by erosion. This is a separate problem to be avoided, and hardly occurs under pastures, and should not be used to stop pasture graziers from using Se in fertilisers.
- Using Se as a fertiliser in New Zealand shows that when Selcote Ultra slow-release prills are applied at the recommended and normally adequate rate of 0.5 to 1 kg per ha, most is used up by the pasture and grazing animals within a year, and all within two years. The fast release Selenium Chips for crops and stipulated for organic farmer use (the other is prohibited) increases levels excessively. It should be applied every six months at half rates (0.5 kg per hectare).

Other sources

Avoid fast release Se injections because blood levels can rise to 3,000 to 4,000 nmol per litre within a

few hours of injecting, decreasing to about 1,000 after about two days. Slow release Se injections don't cause this rise and last longer.

Se bullets are available, but the cost is greater, and, in at least one case, when used with magnesium (Mg) bullets, Se release was accelerated, causing some animals to die. Their Se liver levels were 82,000 nmol per litre. This could be because Mg is alkali so could make Se more available. In the alkali areas of USA Se levels are usually very high, and sometimes so high that animals die. In acid soils, Se is usually low, but increasing the pH doesn't help much, while increasing the calcium level as measured in pastures tissue does increase Se levels and animal health.

Animal deficiencies

Zigzag scours as shown in page 3, arched backs and low tails as in a client's old Angus cow in Virginia, USA, and the scouring (dung stuck to its tail because its tail muscle is too weak to lift it) are signs of low Se. Pasture Se levels were only 0.02 ppm instead of 0.4. Hair on top of the neck shows low Cobalt, and on the crown of the head, low zinc.

Se deficiency is still (in 2013) a major cause of animal and human ill health in many countries. I've seen cows suffering severely from low levels in USA, Switzerland and New Zealand where Se is applied in fertilisers. Some countries have approved the slow release fertiliser, Selcote Ultra (made in NZ), as safe and beneficial.

If more than 10% of cattle have zigzag droppings in the paddock, try supplementing with 1 ml of Selovet 5 (or similar) per cow per day and monitor the protein percentage in milk. If it goes up within a week, scouring reduces and cows look healthier within a month, they were low in Se, and may need even more.



The term White Muscle Disease in lambs and calves is called this because of calcium deposits from low Se reducing muscle activity. Muscle lesions are also noticeable in the thigh and shoulder. The University of North Carolina has done tests and found that viral mutations occurred more often when Se was lacking. See Human Health > Viruses, Vaccines, Mutations, Evolution of Influenza.

States east and northeast of Missouri (i.e., Illinois, Michigan, Ohio, and Indiana) produce feed grains and forages that are deficient in Se (less than 0.1 ppm selenium). Generally, cattle feeds grown on sandy or acidic soils in other areas may also be deficient in selenium. Some Missouri soils fall into these categories.

Deficiencies Cause-

- White muscle disease in lambs causing death of new lambs from heart attack. The heart is a muscle.
- Weak muscles, shown by stiffness, arched back and paralysis of the hind limbs.
- Scouring and ill health.
- Slow growth.
- Reduced wool growth.
- Increased embryo mortality.
- High somatic cell counts.
- Young animals on milk only, born from dams low in Se, may develop nutritional myopathy (muscle wasting) that can lead to failure of hearts and death.

1970 NZ trials by Frank van der Elst and Dr John Watkinson of Ruakura treated cattle on peat soils in the Waikato with Se and achieved significantly greater live-weight gains than the control group. They found that, 'Drenching Se at three monthly intervals was as effective as monthly drenching'. I prefer a daily supply through the pasture and/or drinking water because the very important intestine villi need Se daily to regrow, but, if this daily is not possible, then occasional drenching obviously works, because Se gets into the blood, but it doesn't last. When dairy farmers change daily drenching of Solmin to feeding it through a dispenser, animal health improves.

Deficiency symptoms -

- Weak muscled new borns, and not finding teats and not sucking.
- Difficulty in sucking and breathing.
- Death of new borns soon after birth.
- Front feet pointing backwards before birth.
- Stiffness and inability to stand.
- Stiff gait.
- Slow growth.
- Low milk production and low milk solids percentages in milk, especially low protein.
- Increased mastitis and high somatic cell counts.
- Increased chances of a heart attack (it is a muscle) when bloat, milk fever, facial eczema or other health problems causing any critical illness, because of low Se.
- Muck covered yards and dairies, and zigzag droppings in paddocks that can zigzag for two to three metres (6 to 10 feet). Long droppings in lanes are not necessarily a symptom, as they can be from animals being driven, so having to keep walking, although it is not natural for cattle to pass dung when walking, so excess dung in lanes can indicate Se deficiency because of weak muscles.
- Reproductive disorders such as erratic or silent heats, poor cycling and poor conception rates. Retained placenta because proper contraction of the uterus after calving doesn't occur, accentuating the possibility of infection and delayed cycling, followed by poor conception.
- Cysts on ovaries that reduce conception.
- Metritis (inflammation of the uterus).
- Foetus loss after 23 days, and early abortions.
- Iodine deficiency accentuated by low Se.
- Hoof and leg problems.
- More susceptible to endophyte symptoms of staggers. See Animal Health > Endophyte.
- Lowered resistance to diseases if either or both Se and vitamin E are low. Arched backs from weak muscles in older animals that have suffered low Se for years. See photo of old black cow at top of previous page.
- Lower antibody production.
- Unthriftiness and reduced weight gain.
- Anaemia.
- White phlegm, catarrh and itchy discharges from nostrils, causing animals trying to use objects to go up nostril as shown on the gatepost in the photo. This can cause damage and bleeding as shown.
- In poultry, feather and general growth are reduced.



Facial Eczema

Graziers should know how to avoid it, and if it occurs they know what to do. See Animal Health > Facial Eczema.

Se absorption is lowered when sporidesmin, that causes facial eczema is present in pasture, caused by feeding high rates of zinc to control it. Low Se increases the chance of animal heart attacks when facial eczema damaged animals suffer a double whammy of bloat or milk fever.

The 12 pages on Facial Eczema in Animal Health have full details.

Consuming mud or dust

Langlands and others in New Zealand in 1982 reported that if Se levels were adequate from correct fertilising and adequate liming for earthworms to make humus, Se blood levels in sheep were not lowered under high stocking rates causing the eating more soil because of grazing close to the ground. However, heavy stocking in wet weather causes pugging which seals the soil surface, so raises soil sulphur levels and increases iron consumption through eating soil, both of which (high iron and high sulphur intake) lower Se absorption by animals. Water soluble sulphur as in superphosphate leaches Se with it, and releases the bad metals.

High soil, and therefore iron, consumption from muddy and/or dusty dry pastures and high molybdenum all lower Se absorption, as do mercury (amalgam teeth fillings in humans) and some fertilisers, kelp and sea weeds and some waters.

Hydrogen peroxide as used in some countries to purify drinking water depresses Se just like low pH, excess iron and manganese in water, excess magnesium in some soils and sulphur do. If hydrogen peroxide is used, Se supplementation, where needed, may have to be increased.

Even slightly low Se levels cause contraction of the uterus after calving that may cause retained placenta, the likelihood of infection and delayed cycling. Deficiencies can also be a factor in poor conception rates.

Se is absorbed through the tips of the finger-like cells (villi) that increase the absorption area in the small intestine. Villi can be destroyed by some toxins, by drenching or feeding excess copper, by coccidiosis and by soil or coarse agricultural lime consumption off topdressed pasture. They have a life of about three to five days, unless prematurely destroyed. These cells require Se every day, and require adequate zinc and iron, all for replacement. Continued scouring can indicate that these cells are severely damaged and not re-growing.

The best way of supplementing Se is in the fertiliser through the soil and pasture, but this is not allowed in some countries and can't always be achieved in sufficient quantities, so supplementing with a good soluble mineral mix (Solmin) helps. If one is not available you can try to dissolve the best lick you can obtain, and add the liquid to a dispenser on-line system like Cook and Galloway or to a Peta trough dispenser, or use a used milk filter. See Dispenser.

Use an injection only if there is no other option, don't if pasture is close to optimum of 0.4 ppm and Solmin is being fed. Se injections three weeks before calving reduced retained placentas from 50% down to 10% in the UK where Se is low, but nowhere near as low as it is in New Zealand and in high rainfall parts of Australia and the high rainfall parts of USA. Discuss Se with your vet. It could be very low in your area and you may not have realised it. In high rainfall areas of USA, calves in low Se areas can die within days of being born. This rarely occurs in New Zealand, because the whole country is low in Se so veterinarians and farmers all know about it.

Adequate Se helps increase copper retention in animals, and adequate copper increases Se retention.

Decreasing blood Se levels were recorded in Vermont herds that were fed bentonite (See Dairying > Calf Rearing) for more than a few months at a time.

A comparison showed that Se deficient calves had a decreased ability to kill ingested *Candida albicans*.

Before Se was available from fertiliser companies, a Waikato dairy farmer who knew his farm and herd were low in Se hired a pilot and small plane to fly him around his farm while he threw out Se aiming for 0.01 kg per ha. He ran out when only half the farm was done, and that happened to be the back half of all the paddocks. His cows grazed the Se area shorter and his animal health improved.

Animal excesses

As with some other elements, some Se excess and deficiency symptoms are similar. Applying 1 kg per hectare of Selenium chips has increased pasture Se levels for a month or two to double what they should be.

Mild excess symptoms include -

- Smelly acetone breath.
- Stiff joints, causing animals to stand and walk stiffly with straight legs.
- Ataxia (imperfect control of body functions).
- Lethargy.
- Rapid weak pulse.
- Dullness.
- Scouring - the same as a deficiency.
- Arched back - the same as a deficiency.
- Elevated temperature.
- Emaciation.

Very high Se can depress zinc absorption, and low zinc can decrease Se absorption. Solmin contains Se and zinc and seven other essential elements at optimum levels, checked by Ruakura when launched

and proven since 1987 on thousands of farms buying 1,000 tonnes per annum.

Soil & plant deficiencies

Areas that can be low in Se include all those below optimum calcium of 0.8% in ryegrass and some high rainfall areas with low calcium levels, especially peats and pumices, and some soils in high rainfall areas that have been conventionally fertilised without lime for years. Those using soil tests don't apply enough lime if their soil has a naturally high pH as in Walton, Waikato, and Bay of Plenty light pumice soils.

Oral supplementation of Se costs little, but it is best to also fertilise with slow release Se (Selcote Ultra) at about 1 kg (\$8) per hectare, so that all animals on the farm get it. Earthworms are animals, so also need it. I have seen them clambering up on top of each other to Solmin added water overflowing from troughs and being larger and plumper in the dung of animals fed Solmin. See Soils > Earthworms.

1 kg per hectare of Selcote Ultra, which has 1% Se or 10 grams per hectare (0.14 ounces per acre) of slow release Se on pasture is sufficient for animal health, however high sulphur from superphosphate reduces Se and potassium, as was happening in parts of the Northern Hemisphere when sulphur (S) laden acid rain was common.

A lack of lime and excesses of some fertilisers lower pasture Se levels. Pasture analyses showed that Diammonium Phosphate (DAP) applied at 150 kg per ha (134 lb per a) on a Waikato clay loam farm lowered the Se levels substantially in pasture, compared with adjacent reactive phosphate and elemental sulphur (both slow release) fertilised pasture.

Young pasture shoots generally have higher Se levels than older ones. Levels are lower in spring after prolonged winter rain. Kikuyu has about 0.1 ppm which is half the levels of most grasses.

High rainfall and/or irrigation, continued farming (depleting the top 15 cm of soil) and normal N, P, K, fertilising, all reduce pasture Se levels and plants on poorly drained anaerobic acid soils take up less Se. The water soluble S in Superphosphate leaches it and potassium and who knows what else?

Animals on peat that we were farming from 1955, suffered dreadfully until Se fertilising and supplementing became available, however, it was not until supplying it in the soluble mineral mix I developed from 1984 to 1987, that animal health really shone.

Under confinement feeding adequate vitamin E with Se will help, as will buying feed from Se-sufficient areas. Generally, alkali and dry areas have adequate to excess levels, while high rainfall and irrigated areas can be deficient.

Vitamin E levels, while adequate in pasture and good pasture silage, are low in hay, unless very well made with minimum exposure to the sun and no over-drying, so aim to feed some pasture or silage where possible, or supplement with vitamin E.

If vitamin E is not taken with Se, very little benefit will be obtained, as vitamin E and Se are synergistic. Many don't know this, so some sell Se tablets without vitamin E.

Please note that in this chapter, whenever Se is mentioned, it means WITH vitamin E in green pasture.

The water pollution that is being feared by some in North America where Se is applied is more likely to come from feedlots and confinement dairies, and is highly unlikely to occur from grazed pastures.

In tomorrow's world, legislation against pollution is likely to increase, and some of it is likely to be unwarranted, so farmer organisations should pre-empt problems and collect facts and figures. The important point that we must remember is that, if we abuse the system, legislation will be implemented to prevent us doing so, and legislation is always worse than the voluntary prevention of problems. So it lies in farmers' hands. The well-behaved farmers should try and ensure that others comply. It takes only one to spoil it for the rest. This was written in 1990, and is happening.

Soil & plant excesses

Animals can be poisoned when eating the plants that take up excess Se from dry high pH soils containing extremely high levels. In some dry high pH areas high Se weeds with 15,000 ppm (0.4 ppm is adequate) can be poisonous, however, local animals usually learn to avoid eating them. I've read that new animals to these areas 'need to be watched', although I don't know how one would achieve this! Ask your vet and neighbours.

Lime releases Se that is more available in high pH soils, hence the term 'Alkali Disease'.

Much of my new consulting business came from farmers detecting problems on their farms.

A Morrinsville farmer phoned and asked me why his calves were walking around a paddock rather than grazing. I went and saw them and was mystified.

We moved the calves to another paddock and they started grazing normally. I took pasture samples from both the rejected and the grazed paddocks and had them analysed for the 17 essential minerals and found that the rejected one had excess selenium.

This showed that one paddock had got more Se in the fertiliser than others. This was in the days before slow release Se and before proper mixing plants at fertiliser depots - it was done manually with shovels and sometimes trace elements such as the 1 kg per ha of Se were just spread on top of the truck-load of fertiliser, as happened in this case, so when tipped, the top with Se slid down first on the back of the heap which was spread on the paddock.

Always check that your fertiliser has been correctly mixed. If not, mix it yourself with a loader and tell the company. If you don't have way of mixing it, ask the supplier to come and do it.

Organics & selenium

Se is a natural mineral, but, for those 100% organic, there are organic forms of Se in some yeast products. Organic farming is commended, but not to the extent where animals are allowed to suffer unnecessary deficiencies, and unfortunately I've seen this too often, because of the regulations. Animals are part of the environment and need caring for as much as the soils and waterways. Mineral deficient animals become infested with parasites, which then breed and spread. The spread of parasites can be a bigger problem in organic farming than the highly unlikely chance of excess Se from supplementing with it, or excess application in deficient soils. For optimum parasite control, all 17 elements should be at optimum levels in pasture, something that can't be achieved in grains, or single crops such as maize (corn) silage.

Sources

Oral, and slow-release injections, are available. If a fast-release injection is used, blood levels rise to between 3,000 and 4,000 nmol per litre within a few hours of injecting, then decrease to about 1,000 after about two days. Use slow-release Se, but correct fertilising and Solmin are better sources.

Some soluble mineral mixes have the maximum amount allowed, and when supplied through drinking water, animals getting correctly fertilised pastures get the right amount, provided the pasture contains at least 0.3 ppm. Maize has only 0.08 ppm, if it is the main part of the diet, Se may need to be supplemented in addition to what is in soluble mineral mix.

In deficient top soils deep-rooting plants such as lucerne (alfalfa) can take up more Se than clovers.

Some licks contain Se, but licks are the least efficient way of supplying it because of the erratic intake of licks by different animals in a herd. It is better to dissolve them in water and supply them through a water dispenser to drinking troughs when large animals drink more so get more and high producing cows produce more and drink more.

Feeding Se in drinking water at allowed rates have no restrictions in New Zealand.

For more information on Se, fertilisers and animal health (we are animals), see the animal section in Elements > Minerals > Selenium.

WARNING

There is no known treatment to reverse the bad effects of Se poisoning. Often the animal dies before a diagnosis can be made. See Human Health Minerals > Selenium in Humans.

When fertilising pastures with fast release Se made for crops, and used by organic farmers because the slow release Selcote Ultra is unjustifiably not allowed, pasture levels can rise within weeks to three times what is required, so avoid oversupply that can occur if Se is also being fed.

Fast release fertiliser Se chips, designed for crops which will not be grazed for months, should not be applied to pastures which could be grazed sooner, unless at quarter rates and then more frequently than slow release ones, because it is short lived especially for year round pasture growth. The safer slow-release Selcote Ultra should be used.

Se can be dangerously high in low rainfall and high soil pH areas as in the USA midwest.

Se in drinking water should not exceed 0.01 ppm.

I repeat, treat Se products and items containing it, like the toxic elements they are, by using gloves and washing hands after use. I've not heard of any problems.

Human Health

Also see Human Health Elements > Selenium to see the benefits Se can give people.

Horses need less Se so can suffer Se toxicity

by Amy Gray

Yet another one of the challenges of keeping horses in Colorado is the high concentration of selenium found in our soil. Selenium is a trace nutrient, actually required by horses for healthy living. Too little selenium in the diet causes muscular dystrophy in foals, but is not often seen in this part of the country. However, selenium toxicity is fairly common, particularly in dry years. The following provides information on the symptoms of selenium toxicity, possible treatments, and how to identify the potential for a problem, before it occurs.

Symptoms of Selenium Toxicity

Horses suffering from chronic selenium toxicity are said to have "alkali disease." The excess selenium causes the loss of mane and tail, the first indicator that your horse may be suffering. Many horse owners mistakenly label an innocent pasturemate as a tail-chewer when this occurs. However, upon further inspection, hair loss areas appear to have had a set of clippers run over them. A dull coat normally accompanies the hair loss.

Cracking, brittle hooves are another, more severe, sign of toxicity. A horse with this condition needs to see both a veterinarian and experienced farrier as soon as possible. Without treatment, the hoof may slough away from the coronet band and drop, exposing the sensitive laminae to the environment. This causes extreme pain and lameness for the horse. Even with treatment, the horse may be susceptible to abscesses until the new hoof capsule is regrown.

Finally, excessive selenium has been known to cause bone lesions and twisted legs in foals. Acute selenium toxicity, which is rare, may cause the death of the horse when massive amounts of selenium are ingested.

Possible Treatments

If you suspect your horse has selenium toxicity, there are two steps that demand immediate attention. First, remove your horse from pasture. Second, call your veterinarian. Your vet will likely take hair and blood samples to confirm diagnosis of the toxicity, although this is not always mandatory if the symptoms are severe enough. Upon affirmation of the toxicity, your vet can recommend the best course of treatment. Often this will mean draining any abscesses your horse may have sustained. Or, if the hoof wall has broken off, special boots may be applied until the hoof has recovered enough to hold hoof repair materials. Diet changes may be recommended as well.

How to Identify Potential Problems

There is a set of plants called indicator plants. These plants are known to proliferate in areas with high levels of selenium. Identification of indicator plants in your pasture means that you will have to closely monitor the levels of nutritious forage available. When these begin to drop, typically at the end of the summer or during drought, your horses will turn to the normally unpalatable indicator plants for food. The problem begins here, as the indicators contain high levels of selenium in their cellular structure. Species of milk vetch, woody aster, salt bush and goldenweed are all indicator plants to watch for. Information concerning the effects of these plants can be found at Colorado State University's [Veterinary Teaching Hospital](#) website.

You may avoid a problem with selenium by providing supplemental forage at critical times, irrigating, avoiding overgrazing, and application of pasture-approved herbicides. Provision of a high-protein, low selenium diet has also proven to be useful.

End

In New Zealand, toxicity can be caused by overdosing, by fertilising with other than Selcote Ultra or by using more than one selenised product at a time. Symptoms of selenium toxicity include abnormal movement, dark watery diarrhoea, high temperature, weak and rapid pulse, laboured respiration, bloating

and abdominal pain, pale and blue mucous membranes, and dilated pupils. Most animals with selenium toxicity are found dead, and there is no antidote for those found alive.

Selenium deficiency can lead to White Muscle Disease, which causes degeneration of the skeletal muscles, stiff gait, and other problems.

Good valuable horses were ruined by a bad so called fertiliser company adding too much fast release selenium.

Recommended selenium rates in deficient areas in total feed - not in fertilisers.

Horses 0.1 mg/kg. Avoid high levels. They can damage and even kill horses.

Dairy cattle 0.4 mg/kg

Beef cattle 0.3 mg/kg.

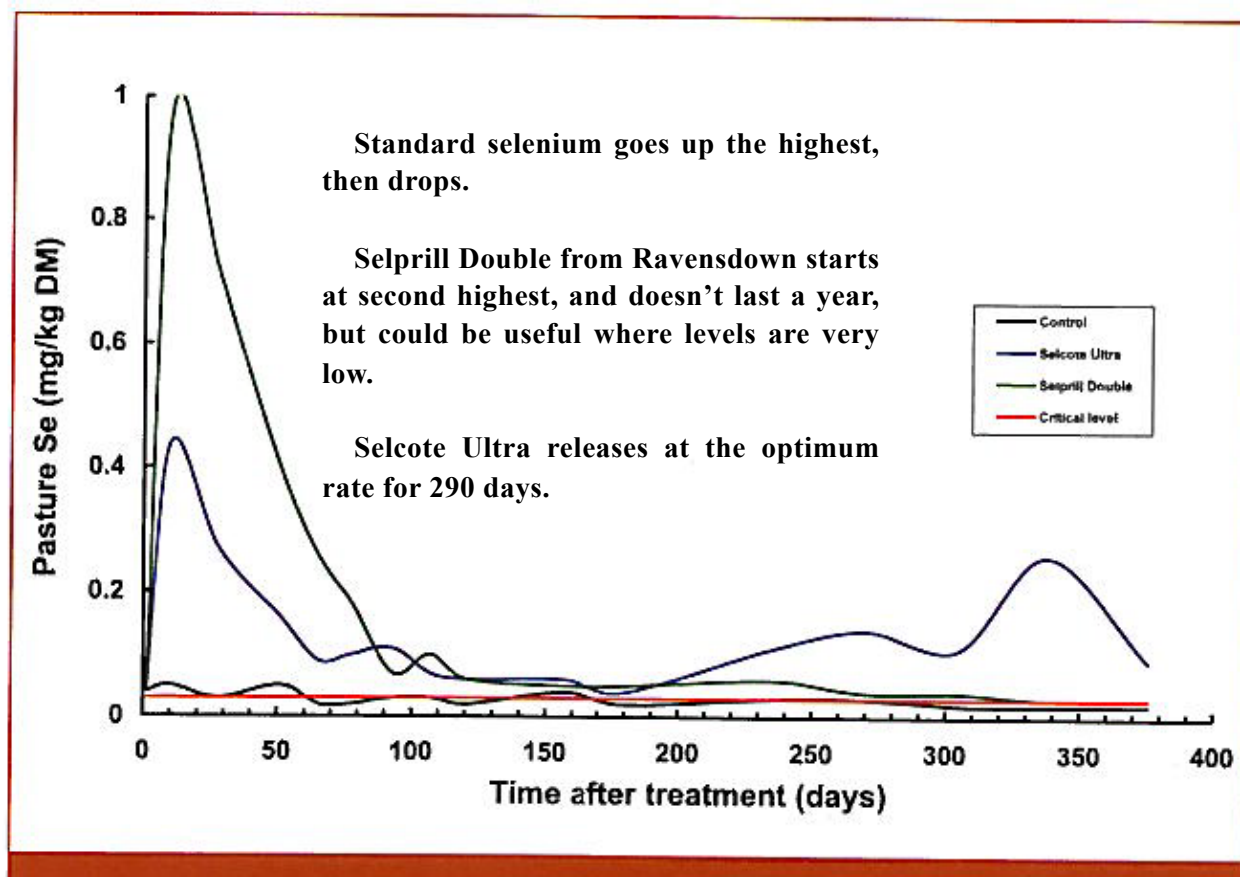
Sheep 0.15 mg/kg

Pigs 0.2 mg/kg.

Poultry varies with age. Aim for 0.1 mg/kg of Se from 5 weeks on, and more if free range and eating about half their diet in low Se New Zealand pasture, not fertilised with selenium, which it should be.

With grazing animals, measure the 17 elements in grasses and enter them into GrazingInfo Pasture Minerals Analysis spreadsheet, the use the Fertiliser and/or the Lime Nutrient Planner and Phosphate Nutrient Planner spreadsheets to calculate fertiliser and lime requirements for your farm.

This below shows what happens after fertilising with conventional selenium, Selcote Ultra, . The red line is the optimum level which is what Selcote Ultra at 1 kg/ha obtains.



Selenium application regulations from Mike Shirer, AgBioResearch Ltd.

Hi Vaughan,

The regulations, to the best of my knowledge, specify not more than 10g elemental Selenium per hectare per year - which is 1kg of Selcote Ultra per year and 0.5kg Selprill Double (Ravensdown product - 2%w/w Se) per year. The Ravensdown product is based on sodium selenate alone and although they claim to have made that granule a 'slow release' product, it is very hard to slow the release of sodium selenate, as it is very soluble.

A way may be 0.75kg at six month intervals. It is worth spending the money on regular Se blood tests (every 3 months on the same 4 animals until optimum).

I don't speak for Nufarm, so this is not their official recommendation, but I recommend using Selcote

Ultra from them.

If you are not getting the selenium response you require on low organic matter properties, then increasing the amount applied is an option, though the selenium blood levels should be monitored, especially if the farmer is tempted to use other supplementation methods as well, which is not a good practice except for a few weeks to newly bought animals.

Optimum levels are also important for good conception, and in humans.