Manganese (Mn) Version 3.3 19 July 2016

Manganese is a dangerous toxic heavy mineral that in New Zealand is often too high.

In 1963 I had to sack a 29% sharemilker in January for minor cruelty to our cows. He went to the sharemilker's Union and they came and agreed with me. At the time our water and soils were very high in manganese, but we didn't know about the Mn stress/temper problem. Since then I've dealt with animal stress and abuse problems and solved them by **not** adding Mn to fertilisers and drinking water and filtering Mn out of drinking waters.

Dairy farmer Keith Rowling at Tauhei, Waikato, phoned me in 1999 and requested a visit because his cows were mucking a lot in the dairy, and were nervous, which made him stressed. His soils were wet, under-drained peat that needed LimePlus, so, without even analysing the pasture, I knew it would be high in Mn. He was also feeding a soluble mineral mix that contained Mn, which on the part of the supplying company is disgraceful, and sheer ignorance in New Zealand. Some less reliable companies copy northern hemisphere recommendations, which are seldom suitable for New Zealand. I got him to change to Solmin that has no Mn, but has optimum sodium (Na), magnesium (Mg), sulphur (S), Se, copper (Cu), cobalt (Co), iodine (I), and especially Zn, which neutralises Mn toxicity. Five days later he phoned to say that his cows had calmed down, and so had he! His bore water had not been analysed, but was most probably high in Mn.

Manganese can be very high, so toxic in wet acid soils, and in plants grown in them, especially if not analysed and limed sufficiently, but can be low and deficient in dry alkali soils, as in much of USA. Mn is very high in the Big Island of Hawaii, unless adequate lime has been applied. In September 2015 some learned that some people were aiming for too much Mn, which adversely affects human health, including the brain. Read Manganese (Mn) in Humans.

These cows, fed Agvance minerals containing 124 mg of Mn sulphate and 17 kg per day of high Mn pasture*, with high Mn water, were stressed as was their milking staff. These were so nervous of the farm owner and me that they stopped, then moved to single file and walked more nervously and quickly. Their milk was toxic and measured 35 compatibility. Read Muscle Testing.

* Note the poor pasture and buttercup in the paddock which had six tonnes/ha of LimePlus (See Calcium in Minerals in Soils, Plants, Animals) a year before, after none for up to 50 years, which improved the pasture and the palatability of the buttercup, which lime does, causing cows to eat some of it. More was needed.

High levels of copper (Cu), nickel (Ni) and or zinc (Zn) in soils (not in NZ) may inhibit Mn uptake by plants and induce Mn deficiency in animals and humans eating deficient vegetables - not in NZ. Adequate LimePlus with magnesium decreases Mn excesses.

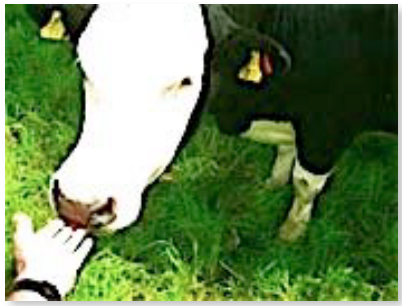
Some New Zealand consultants and fertiliser vendors, especially if trained in USA, wrongly add Mn to fertilisers and animal mineral mixes which makes animal health worse. Excess Mn causes more stress in New Zealand dairy cows than anything else, and is a factor in human stress and bad tempers when

handling excess Mn stressed cows that become then nervous, kick and scour. It is definitely a cause of human memory failure, so what does it do to animals' brains. See Human Health > Parkinsons disease. Manganese is in excess in a lot of NZ soils, waters, fruits and vegetables, even some organic ones, because it is high in New Zealand's damp acid soils. Applying sufficient agricultural LimePlus reduces soil acidity and so the surplus of Mn. Sulphuric acid used to make phosphate in Superphosphate available, acidifies soils so increases mercury, cadmium and manganese levels, so plants then absorb more. The higher Mn then stresses cows and people eating non-organic fruit, vegetables and dairy produce. Organically farmed soils are sweeter to Mn is less available.

Organic vegetables can have too much Mn because very few organic farmers apply enough lime. Most believe that just by not applying superphosphate and other artificial fertilisers, makes them organic so everything will come right. Some believe that applying some of the organic fertilisers makes them organic, but very few do trials and measurements on plants their farms, or read those in GrazingInfo, which show that adequate LimePlus reduces the heavy toxic mineral levels and makes good minerals more available.

Only a very small amount of Mn (no more than 2 ppm) is needed for health and fertility, photosynthesis, nitrogen (N) metabolism, N assimilation, and conversion of amino acids to proteins. It is in some enzymes required for bone structure, joint lubrication, fat and carbohydrate metabolism, and the nervous system. Americans used to aim for more, but in September 2015 some found that they had aimed too high, but it is low in the dry high alkali areas of USA, so sometimes has to be applied or supplemented.

In some drier parts of the world, especially where grain, which is low in Mn, is a high portion of the diet, Mn may be needed. Most of New Zealand's pastures have too much, and grazing animals get more than enough by consuming some soil while grazing, which can increase Mn intake to toxic levels. Around Clevedon (south east Auckland) clean soil-free pasture tissue can have 140 ppm, and, if Calcium (Ca) is low, even more. It is also in many farm bore waters in Waikato and other parts of New Zealand.



When all known mineral levels are correct, animals become quieter, with some becoming as tame as a pet cat or dog. This Hereford/Friesian cross heifer, and other breeds in a mob of 62, on arrival were nervous and kept 20 metres or more away from humans for weeks. Three months later, this photo showed that correct LimePlus and Solmin in the water reduced Mn stress effects and made them tame as shown. Solmin contains no Mn and absolutely no other heavy metals, which is rare in NZ soluble mineral mixess for animals. Read 'Elements in Soils Plants & Animals' and 'Beef Profiting' for more. This heifer came up to me while I was photographing them.

Unfortunately, some inexperienced New Zealand consultants and marketers of animal minerals add Mn to them, which is wrong in New Zealand. At the 2010 NZ Fieldays I checked all soluble mineral mixes containing Mn and asked if it was designed in USA or UK. The salesmen asked how I knew? Those countries lack Mn while most of New Zealand has too much, and more so if correct liming of soils is not done. This became worse in NZ after the change to metric in 1976, because the required liming rates in tonnes per hectare seemed much higher, so less was applied.

One tonne per acre equals 2.5 tonnes/hectare, or one tonne per hectare equals only 0.4 tonnes/acre.

Mn can also be high in some farm bore waters, especially Waikato and South Auckland, which accentuates the excess Mn in animals and people who drink it, which then causes stress and after time, brain failure. I knew farmers who suffered Alzheimer's and Parkinson's disease from high levels of Mn in their water.

Most people working in Mn mines in many countries have developed Parkinson's disease.

Excess Mn is more common in New Zealand than a deficiency, so don't take any unless blood or other reliable tests show it is needed, which is almost never in New Zealand.

One NZ laboratory operator who worked in USA for a while has been known to recommend too much lime which reduces Mn and then show it is needed, when the fault is his for applying too much calcium.

Read the chapter on Water and get yours tested by Hill Laboratories, 1 Clyde Street, Hamilton 3240. Phone 07-858-2000. Irrigation water should not exceed 0.05 mg of Mn per litre and should preferably be under 0.01.

Mn animal deficiencies

This is rare in New Zealand, unless soils are over-limed.

Pastures generally have higher levels of Mn than grain, so deficiencies in grazing animals are less likely, especially because most grazing animals ingest some soil from the mud and dust on leaves.

Deficiency symptoms in non-grazing animals include anoestrus, silent heats, low conception rates, abortions and abscessed livers. Also, a higher percentage of male calves can be born.

Calves can be born with skeletal imperfections, weak bones and twisted or bowed legs, enlarged joints, stiffness, general weakness and uncoordinated movement, lameness, paralysis and impaired growth. They can be born with their back legs and hooves pointing backwards, so can't stand. Selenium (Se) deficiency can cause front feet to point backwards before birth.

In much of North America Mn is very low. Many of their mineral supplements made for dairy cows have it added, which I agree with there, but not in New Zealand, because much of USA feed is maize (corn) silage which has very low Mn levels. See the Pasture Analysis spreadsheet columns L, M and N.

Mn animal excesses

Excess Mn stresses animals, which then stresses farmers. Most USA feed formulators recommend 40 ppm of Mn and British ones 50 ppm in the total feed of lactating cows. I recommend 40 ppm in pasture tissue, and NONE in NZ mineral supplements. New Zealand pastures are frequently two to five times too high, so Mn should NEVER be fed in NZ. If a consultant of fertiliser company recommends MN, change them because try could make other mistakes.

In September 2015 much of USA found that they were recommending too much Mn and cut right back. I repeat, grazing needs less that grain fed.

Many New Zealand animals get too much from grazing pastures, especially in under-drained and under-limed soils. Mn can be in some bore waters which accentuates excess Mn in animals and people drinking it, which causes stress in both. Livestock (and human) drinking-water should always be analysed; if any elements are too high, they should be filtered out or neutralised. Read Water.

Liming soils correctly lowers Mn levels in pastures because lime makes Mn (and heavy metals) less available, and good metals such as Mg, more available.

Very wet soils release more Mn, so pasture levels are usually higher in wet soils and lower in dry soils. Draining peat correctly halves the Mn level in ryegrass, to its optimum of about 50 ppm.

Ruminants can only handle excessively high levels of Mn for short periods. High Mn levels in water can corrode the copper and the elements in a water heater in a year.

Symptoms of excess Mn in animals include stress, cystic ovaries (a stress symptom), anaemia, reduced appetite and slow growth, and abdominal problems, which can be from liver damage.

With many minerals, surpluses are passed through the animal. However, as with Fe, Mn in water makes it unpalatable. Hill Laboratories pasture analyses records and mine, show that low levels in New Zealand are extremely rare, while high levels are frequent, especially on wet soils and around Clevedon, south east of Auckland. Parts of the North Island's East Coast can have pasture levels up to 400 ppm instead of about 50 ppm! Adequate Ca and zinc (Zn) levels in pasture soils are essential to keep Mn at correct levels.

Many farmers have been stressed, and had stressed and sick herds because of high Mn in pastures, water and from feeding it in minerals recommended by some trained in USA, where some can be needed, but in September 2015 they found that they had been recommeding too much.

The late Bill Chynoweth, shown here with his heifers, couldn't believe how quiet his animals became after applying LimePlus and feeding Solmin in their water. In the past they had many warts (a sign of low Ca) which, as with other herds, disappeared after correct LimePlus to reduce high Mn levels in pasture tissue, correct fertilising and feeding Solmin.

Animal health expert Gladys Reid, who had two farms in Eastern Waikato and gained many awards (See her awards in Animal Health > Facial Eczema),

wrote in the NZ Dairy Exporter, March 2003, that 100 ppm of Mn in feed could cause Mn overload in livers.

High facial eczema spore counts, high nitrates and high endophytes also stress livers. All three high is common. When combined with low selenium levels, scours can be severe. Read 'Beef Profiting'. Information in it also applies to dairying.

I see a lot more ruminant scours and loose watery dung from high Mn and low Se and low Ca in dairy herds now than in 1950 to 1980. Urea was hardly used then and pastures grew more slowly so had higher mineral levels. Most farm ryegrasses are usually less than half the Ca optimum of 0.9%.

Hill Lab recommends pasture tissue Mn levels to be between 60 and 150 ppm which is more than 250% difference. Mn should be about 40 ppm. Anything over 80 is much too high. It is a highly toxic heavy metal. I've seen herds and farmers severely stressed when pasture levels were 200 ppm.

Gladys Reid reported -

"It was found that Mnin the spores of plant fungi increased the germination of the spores. The more manganese, the faster the growth of toxic spores.

"As Mnlevels in Waikato are sky high in many soils and pastures, especially where calcium is low, I have wondered why Mnis considered a suitable additive to fertilisers and stock remedies. Our pastures may contain up to 10 times more iron and Mnthan required by livestock."

Iron, Mnand aluminium become more soluble (available) in acid soils, so more is taken up by plants. Liming reduces the acid-caused solubility, and so the availability of these unnecessary, undesirable minerals.

TABLE 3. MINERAL CONTENTS OF PALM KERNEL CAKE

Calcium (%)	0.21 – 0.34
Phosphorus (%)	0.48 – 0.71
Magnesium (%)	0.16 – 0.33
Potassium (%)	0.76 – 0.93
Sulphur (%)	0.19 – 0.23
Copper (ppm)	20.5 – 28.9
Zinc (ppm)	40.5 – 50.0
Iron (ppm)	835 – 6130
Manganese (ppm)	132 – 340
Molybdenum (ppm)	0.70 – 0.79
Selenium (ppm)	0.23 – 0.30

Palm kernel extract (PKE) from Malaysia and countries in the area is very high in Mn - up to 340 ppm, as shown in the table here. It should be lower than 60. Excess PKE has killed cows in New Zealand and Australia. See Feeding. More than 2 kg per cow per day of PKE risks toxicity of excess iron, Mn and Cu which should be 12 for cattle and 8 for sheep. Some commercial soluble mineral mixes contain Mn, which has stressed cows and farmers. See Elements > Manganese. There should be none added in New Zealand. Parts of USA are low in it so needs up to 2 ppm, not New Zealand's 40 ppm and more.

The sulphuric acid in superphosphate makes the P available which is its job, but it also makes toxic elements available such as mercury, manganese, aluminium and lead. These are then taken up by plants and affect the animals (and humans), and increase the toxin levels in milk. See Dairy > Milk.

Soil & plant deficiencies

New clover leaves low in Mn are pale green and/or bright yellow, except the veins. Brown spots can then form, and leaves fall off prematurely. The chlorosis (lack of chlorophyl) symptoms develop first on younger leaves. Leaves can also be small and cupped, with scorched and distorted edges. See the Boron (B) chapter for symptoms of low B, and S which, when low, causes clover leaves to be a light yellow all over.

Manganese deficiency

Irregular, grayish-brown lesions, which coalesce and bring about collapse of leaf (grey speck symptoms).

Iron deficiency, which is very rare in New Zealand pastures (although New Zealand citrus can be low), has similar symptoms, except that the leaves turn a stronger yellow between the veins. Low **magnesium** (not manganese) causes yellow to almost white, lines running from the clover leaf tips inwards, and from the base up. A few affected plants scattered around a paddock or farm are not a problem. A ryegrass leaf and stem analysis by Hill Lab tells all.

In the UK, where Mn levels are sometimes low, wheat can go yellow.

Correct drainage and liming lowers Mn levels in pastures. Deficiencies can occur in heavy soils where the pH is high, which is associated with poor physical condition of the soil

because of low calcium.

While some wet, acid, peat soils are high in Mn, some dry peat soils are deficient in Mn, as are some sandy soils with a high pH, particularly when the organic matter is high.

Pasture Mn uptake is reduced in wet and cold weather, and if good growing conditions follow a cold wet spell.

Mn deficiencies can be corrected in legumes by spraying with a 2% solution of Mn sulphate, after which normal colour will return within a week.

If one pasture analysis shows low Mn, don't try to correct the levels until pasture samples from other areas of the farm have been taken. A Horsham Downs (Waikato) very dry, over-drained hydrophobic (Extremely dry and won't hold moisture because of lacking agricultural lime.) peat pasture had only 4 ppm, while pasture on poorly drained acid peats can have 150. The 4 ppm was not a problem for animal health because the rest of the farm was high.

Also, check the Mn levels in the drinking water. These are sometimes excessively high, supplying stock with excess of Mn, despite its absorption rate being low.

Lime is necessary in most of New Zealand because of wet acid soils and very few farmers applying enough for decades. Only 1% of the 500 clients I've consulted for had been applying enough lime. Avoid over-liming, which can reduce Mn and some other minerals such as Zn, in pastures, and cause deficiencies, in animals, especially on sandy soils. Twice yearly analyses of pasture leaves allows the correcting of mineral problems.

Parts of USA are very low in Mn. According to the University of Maryland Medical Center, up to 37 percent of Americans may fail to consume enough Mn regularly. Fava beans are an excellent source of Mn, providing 1.6 micrograms in every cooked cup. This amount is nearly 100 percent of the RDA for women and 70 percent of the requirement for men. Manganese supports the function of the nervous, immune and endocrine (blood feeding) systems and is required for the working of powerful antioxidants. A diet with adequate (not excess) Mn may help prevent arthritis, osteoporosis and diabetes. Adequate boron does the same. It may also help decrease the severity of premenstrual syndrome.

Excesses

High Mn levels decrease Mg, P, Co, Cu, Mo & Fe levels.

Maize is tolerant, while lucerne (alfalfa), edible beans, and small grains are more sensitive to Mn toxicity.

High Mn levels (>120 ppm) reduce the plant uptake of Cobalt (Co), Copper (Cu), Magnesium (Mg), molybdenum (Mo), phosphorus (P) and iron (Fe). High Mn reduces legume nitrogen fixation and stresses animals. Pastures on some soils take up very high levels of Mn, especially on poorly drained, water-logged and acid soils such as peat. Pasture on well drained soils after prolonged wet periods will also take up excess Mn.

Small, cupped, scorched, distorted clover leaves indicate high Mn, and/or high aluminium (Al).

Extremely high Mn levels (>200 ppm) in pasture analyses could be caused by soil contamination in the grass sample, which would also show high Co and Fe readings (200 ppm or more), so another grass sample should be taken. The high number of pasture analyses I see with high iron from soil pollution show this is a problem. When Mn levels are higher than 100 ppm, Mo and Ca must be at the optimum levels. Correct calcium levels (close to 0.9% Ca), based on ryegrass analyses, can reduce Mn from being too high to being correct.

Sources

Mn sulphate is in two grades - Mn sulphate and Mn sulphate soluble for dissolving in water for foliar sprays, which are very seldom needed in NZ.

Mn oxide is not water soluble and is slow release for fertilising, NEVER for consumption.

Mn carbonate is alkali and insoluble in water.

After welders in USA got restrictive pulmonary disease, a court case required companies to give welders masks, and to ensure that ventilation was adequate.

Get your Mn level in your body measured and if necessary, drained out by Chris Rhodes (See Human Health Specialists See the Human Health Mn chapter.

Medical problems resulting from Mn fumes were noted in scientific journals as early in 1837, and

welders began claiming harm and suing welding-rod makers in the 1970s.

KFM declined to comment on the welding fume and particulate exposure, citing the litigation. If KFM is sued, it would both be part of a national trend and a foray into new legal territory.

Medical problems resulting from Mn fumes were noted in scientific journals as early in 1837, and welders began claiming harm and suing welding-rod makers in the 1970s. For decades, none succeeded - eight lawsuits in five states ended with verdicts in the rod-makers' favour.

But in October 2003 a Madison County, Ill., jury awarded Larry Elam, then 65, $1 million in his case against three welding-rod manufacturers. Elam developed symptoms similar to those of Parkinson's disease after 30 years of welding.

``The (welding rod) industry tried to keep everybody in the dark about it, including the employers,'' said Elam's attorney, Robert Bosslet. “They had known for a long, long time about these hazards and just put their heads in the sand.”

Thousands of individual federal lawsuits from across USA were consolidated into a massive multi-district litigation pending before one judge in Cleveland. Similarly, Alameda County Superior Court Ronald Sabraw of Oakland now presides over a coordinated proceeding - an assembly of similar lawsuits from state courts in several California counties, on welding-related Mn poisoning.

Berkeley attorney Philip Hanley said his plaintiffs in the California cases are welders or pipe fitters who worked near welders for roughly 20 to 40 years. But he noted two major differences between California and the federal litigation.

The state cases involve only ‘true Mn poisoning cases’ with symptoms similar to Parkinson's, Hanley said. Many of the federal cases allege welding fumes caused actual Parkinson's.

The other difference is that while the federal cases are almost solely against welding-rod manufacturers, the state lawsuits in part target owners of the job sites where they claim the exposure occurred. For example, ChevronTexaco was sued by welders who worked at the oil giant's refineries.