Aluminium (Al) Version 2.2 22 April 2017

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Introduction

The earth's crust contains more aluminium (called aluminum in USA) than any other mineral. Aluminium levels vary between 0.4% and 10%. Al is of no use in farmed soils and can cause toxicity when the pasture tissue level is above 80 ppm, which can be higher when calcium (Ca) and P are below their correct levels, of 0.9% Ca, and 0.4% P.

With high aluminium comes soil deterioration, hard pans, shallow horizontal ryegrass rooting (shown here) increased acidity, fewer ryegrass plants and more weeds. Applying agricultural lime with its synergisms (LimePlus) reverses this negative process. Dozens of my clients have confirmed that in these conditions of low calcium, applying LimePlus grows up to 150% more pasture and always improved their pastures for longer. Ryegrass roots start growing down as shown here.

Applying adequate LimePlus when C is below 0.9%, followed by reactive phosphate with elemental sulphur when needed, reduces the bad effects of ryegrass pulling shown below at 40 plants per m2 pulled on a Walton, Waikato, farm in summer before applying 4 tonnes/ha of LimePlus.

In 1992 on client Colin Marshall's farm near Te Awamutu, superphosphate fertilised ryegrass pulled out while equal-cost per hectare reactive phosphate with elemental sulphur, didn't pull at all. After low Ca problems in soils caused by using pH instead of measuring Ca in ryegrass leaves, applying urea and superphosphate are the worst problem farmers have. The high aluminium and ryegrass pulling increasing is not a new problem. Clark 1982 and Davidson 1987 both wrote that aluminium toxicity causing hardpans and ryegrass pulling were rising on farms using chemical fertilisers and artificial nitrogen. Unfortunately they didn't emphasise that it was caused by low calcium and its synergisms. Levels vary between 0.4% and 10%. With high aluminium comes soil deterioration, hard pans, shallow ryegrass rooting increasing acidity, fewer ryegrass plants and more weeds. Applying agricultural lime with its synergisms (LimePlus) reverses this negative process. Ryegrass roots go down, as shown. Many members have confirmed that in these conditions of low calcium, applying LimePlus grows more (up to 150% more) pasture and always improved pastures for longer.

Applying adequate LimePlus when C is below 0.9%, followed by reactive phosphate with elemental sulphur when needed, reduces the bad effects of Al, which are hard pans

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The high aluminium and ryegrass pulling is increasing, not a new problem. Clark 1982 and Davidson 1987 both wrote that aluminium toxicity causing hardpans and ryegrass pulling were rising on farms using chemical fertilisers and artificial nitrogen. Unfortunately they didn't emphasise that it was caused by low calcium and its synergisms.

Read Elements > Minerals > Calcium and see ryegrass roots going down after two applications of LimePlus totalling 8 tonnes per hectare to catch up, following four decades of almost none.

Animal Excesses

Aluminium can accumulate in some plants and cause animal health problems. Al is antagonistic to Ca and P and visa versa, so high Al causes low Ca and P which then lowers magnesium absorption and increases K levels in pastures, causing grass tetany (hypomagnesaemia) in cows and other animal health problems.

Excess Al lowers Ca levels in pastures which impairs bone growth, so slows the growth of young animals. I saw this on a Te Puke, Bay of Plenty, NZ farm where, following AgResearch advice, lime had not been applied for decades because the soil pH was not below 5.7. Two of my clients' yearlings grazing there from 1 June to 1 August had been given ample pasture and hay from the same farm, but were not eating much and had hardly grown. Close to mating, they had to be moved to a farm that had adequate calcium levels, and they started eating more and growing within weeks.

Poultry then lay eggs with thin shells because Ca has been suppressed, resulting in weak chicks with low birth-weights.

Soil & Pasture Deficiencies

In perennial ryegrass and clover pastures the tissue level should be less than 80 ppm as in this ryegrass on the right.

If in a very high Al area and you can't apply sufficient lime and/or reactive phosphate to lower it, try to sow tolerant grasses such as Cocksfoot, Yorkshire Fog (Velvet grass), not affected by Al, but are lower yielding with low palatability. Some perennial ryegrasses are being developed hopefully to cope with Al, but a high Al level indicates the requirement for Ca and P which are essential for soils and their health and that of pastures and animals, so should still be applied. Bealey NEA2 is currently the best ryegrass.

Soil & Pasture Excesses

A pasture mineral ryegrass test is the only way to accurately measure Al, and a dozen other elements, in soils and leaves. You might ask how it measures levels in soils. It is because the

amount the plants take up tell how much is in the soil, and available. Anyone who has done a number of soil tests will have found the variations to be unbelievable. See Pasture > Analysing Tissue, Versus Soils.

Undeveloped raw peats growing Manuka scrub may need 17,000 kg per hectare of agricultural lime containing about 95% calcium carbonate applied and rotary hoed then chisel ploughed in thoroughly to 40 cm (16 inches). Sandy loams may need only 7,000 kg per ha (6,000 lb per acre). Don't apply these high rates unless chisel ploughing to mix it in thoroughly. Mouldboard ploughing doesn't go deep enough and doesn't mix the lime into the soil, so achieves less control of Al in soils. If not cultivating, use only a fifth these rates, and repeat them every two or three years until the high Al problem is reduced.

Monitor the pasture molybdenum level, to avoid it getting too high (not above 1.5 ppm in dry weather when copper is at least 12 ppm for cattle), and the ryegrass Ca level (0.9%).

Reactive phosphate also lowers Al toxicity. Regular adequate good reactive phosphate powder helps over time. It and lime in the right amounts create healthy soils, which encourage earthworms and other soil life, which move calcium and rock powder down to lower levels and decrease Al toxicity.

Herbage Al levels vary between plants.

Al in ground water can damage the roots of trees and shrubs (Kiwifruit).

Shallow rooting on peat like this is not from Al which is very low in peat soils, but from shallow cultivation and insufficient lime. They base their liming on pH which is usually made high by too much potassium, based on MAF's excessively high K recommended figure and using soil tests.

Sources

If soils have to be made more acid, don't use aluminium sulphate, use what is low in your plants' leaves, for example sulphur, iron sulphate or sulphate of ammonia, or Ammo with its less S will help.

To make hydrangea flowers blue, see Garden > Flowers. Many farmers don't know about Al toxicity. Read Elements > Calcium and see the photos and figures from trials I organised in Japan.

A pasture tissue test is the only way to measure if Al is adversely affecting pastures, however, a spade can show ryegrass roots growing horizontally like those above.

The use of large quantities of nitrogenous fertilisers is causing the slow acidification of many soils.

Aluminium in water

If you consume bore water, get it tested for Al, manganese and other elements and faecal coliforms. High concentrations of aluminium can occur in the ground water of acidified soils. Guam has high Al levels in their water and 10% of people die of degenerative brain disease (Alzheimers). Aluminium sulphate (alum) is sometimes used in the treatment of water to help keep it clear. During the process, a fine precipitate is formed which removes many contaminants, including the spores of dangerous pathogens. Before leaving the treatment plant, the water should be filtered to remove the flocculate and most of the aluminium. If this is not done, those drinking the water will be slowly poisoning themselves, and encouraging Alzheimers's.

Much research wastes money

The following summary is an example of scientists wasting money, presumably to help farmers, who would not read it like it is, and to digest it, would have to read it two or three

times.

Anyway, in most areas liming would fix many problems that are researched, such as Aluminium, Phosphate Fixation, Loss of Clovers, Growing More Pasture With N, and lime needs to be applied, and nationally available Superb Serpentine from 021 81 0045.

The brilliant VA Tiedjens (see Further Reading in Free Items) and I, know that correct liming has increased many farmers' profits substantially, but scientists and researchers don't recommend lime, yet spend millions on vague wasteful research, when correct liming would eliminate the need for that research. Is it because lime at about $25/tonne at the mine, doesn't make enough to sponsor researchers? However, who would pay for the above waste on aluminium research? This leaves the real reason, as I and many see it. The high margins in fertiliser at 30 times the cost of lime allows sponsorships to encourage farmers to apply more fertiliser and less lime.

Another failure many AgResearch trials have is they research only one effect rather than all effects, so read grazinginfo.com agricultural lime, and Superb Serpentine New Zealand.