Iron (Fe) Version 1.3 5 December 2011

Introduction

edhb

Iron (Fe) is an essential component of haemoglobin, where most of the iron in the body is found, and is a major transporter of oxygen in the blood and myoglobin in the muscles. Some people have deficiencies and some have excess. I'm sure animals are the same, from correctly stocked farms grazing clean pasture on some Fe deficient soils, that serpentine (6% Fe) could correct, to over stocked mud eaters grazing short pasture.

Absorption of Fe occurs in the small intestine and varies depending on the age of the animal, the growth rate and the Fe concentration in the diet. Iron in animals increases the number of red blood corpuscles which carry oxygen, so give more energy.

Fe in pasture assists in the plants' production of chlorophyll.

If pasture growth elements such as lime, phosphorus, magnesium, nitrogen and some trace elements are deficient and then applied, pasture grows faster and produces more dry matter per hectare which uses some of all of these elements. The minor ones can reduce more noticeably because they are measured in ppm (or mg/kg), i.e., iron, zinc, boron, copper, cobalt and selenium. Nitrogen will have the same effect, but users of urea, including universities and research centres I've consulted for, even in Holland (University of Groningen) and many in North America, seldom allow for this.

Most soils growing grazed pasture contain Fe, so grazing animals seldom lack it, because they get a little soil as dust or mud as they graze.

The Fe level in Cocksfoot (Orchard grass) is 60 ppm, maize 60 and Massey Basyn Velvet grass 77, so may need watching for deficiencies. Ryegrass is 90 mg/kg, on which animal deficiencies don't normally occur, possibly because ryegrass pastures are usually highly stocked so grazed shorter, so Fe in the soil will be consumed. Some pasture varieties are over double the lowest figure above. See the Pasture Minerals Analysis spreadsheet for all pasture figures.

Availability of Fe from forages is good but not as high as from some inorganic sources.

On my client's farms, where serpentine with its 6% Fe is applied correctly, maize has 118 mg/kg of Fe, tonic plantain 180, lucerne 150 and white clover 130 mg/kg.

Alpacas need about 150 mg/kg, so they must originate from areas with high Fe soils and grasses.

The cost of getting blood and liver tests on an annual or even twice yearly basis is low compared with the possible health problems, loss of animal growth and production from animals that are deficient or over supplied with an element.

Animal Requirements

Most of the Fe is held in the blood. During late pregnancy cows need extra Fe for the calf to be born with an ample supply of Fe because there is almost none in milk. British feed formulations aim for about 50 mg/kg of Fe for lactating cows. Clean pasture usually has twice this amount, but if short and lush, its fast movement through the digestive tract means that less will be absorbed. Calves reared on mostly milk for veal need Fe supplemented. Grazing calves get enough.

A deficiency or excess of Fe can also weaken the animal's immune system.

Many farm waters have Fe, sometimes in excess, causing low absorption of some other elements such as copper. See Excesses below.

Animal Deficiencies

Iron deficiency in mature dairy cattle is rare, but veal calves fed all-milk diets, or milk replacer without grazing and/or grains, may suffer from Fe deficiency. Iron levels are sometimes a bit low in pastures, but a deficiency in grazing animals is still rare.

The first symptom can be whole herd daily milk fluctuations. Other symptoms include decreased appetite, which causes the young ones to grow slowly, rapid pulse rate and difficulty in breathing, very thin, pale blood and pale, anaemic whites of the eyes.

When Fe levels are low, animals lack energy and become sick more easily. Some have died before the farmer and vet could identify the issue and help them.

Deficient lactating cows can suffer daily milk production fluctuations, however, Fe is seldom low in the diet of grazing animals because they eat small amounts of soil which contains Fe from dust and mud on pasture and crops, especially when grazing turnips, swedes, etc., and when over-grazing muddy or dusty pastures.

If in a low cobalt area ruminants will not make enough vitamin B12 causing the animals to suffer anaemia from low cobalt, not from low Fe, except on raw (new) pumice soils which can be low in Fe until organic matter increases, which will happen under correct liming and fertilising and good grazing.

I use citrus trees as a barometer for some mineral deficiencies because they are found in most Waikato gardens, need fertilising twice a year and are high yielders, so show deficiencies which are fairly easy to identify. See Gardens > Vegetables and Fruit Trees. Most element deficiencies show up easily in cattle, but not Fe, so citrus helps as a rough guide.

Our citrus tree has had to have Fe sulphate applied, possibly because it needs, and gets, plenty of lime and serpentine. Two of our 20 camellia plants needed Fe and they get no lime. This leaf shows a deficiency in Fe. It turned dark green after getting a tablespoon of Fe sulphate.

Sheep don't show the symptoms that cattle show, so pasture analysing is even more important and using citrus is useful.

Where pasture Fe levels are low (below 50 mg/kg) and lime is required, avoid applying too much at once. Apply smaller amounts of lime (about 800 kg/ha or 720 lb/a) each year, rather than larger amounts less often that can lower animal Fe absorption. When calcium is low, which, in New Zealand is 99% of farms and home gardens and lawns, a lot is needed - about 3,000 kg per hectare, per year for three years.

Animals need copper to absorb Fe, but an excess of copper and/or heavy metals in the soil can lower plants' uptake of Fe. High levels of potassium can do the same. Again, pasture analyses make management easy, soil tests don't.

Animal Excesses

Excess Fe can cause diarrhoea, hyperthermia, metabolic acidosis, reduced feed intake and reduced growth. High levels in drinking water can discourage drinking, resulting in reduced pasture consumption and causing obvious problems. Iron in water can be accentuated by bacteria that can be controlled. See Water.

When some perennial ryegrasses, on high aluminium soils and low in calcium and phosphorus, pull out the grazing animals can get a ration of Fe in the thousands of ppm as well as an excess of molybdenum and sulphur, all of which reduce animals' absorption of copper, selenium and zinc. Applying lime with other deficient elements can correct these levels.

Excess Fe can cause liver damage, lower milk production and adversely affect the brain. Top veterinarian, the late Dr Harry Dewes of Hamilton, New Zealand, found that animals grazing wet, pugged pastures and dusty ones in dry weather can consume up to a tonne of iron-laden soil a year.

When Fe intake is high, copper supplementation could be necessary, so liver levels should be checked. See Copper and the Blood & Liver Spreadsheet.

Soil & Plant Deficiencies

There are up to 20,000 kg of Fe per hectare in the top 15 cm (6 inches) of many soils, so most soils are unlikely to be deficient.

Although Fe is not a constituent of chlorophyll, it is a catalyst and, if deficient, can cause the low chlorophyll symptoms of chlorotic leaves, with major and minor veins remaining green for longer, creating a netting look. A deficiency in Fe causes chlorosis and yellowing of young clover and turnip leaves to almost white, while mature leaves are close to normal and the principal veins remain green or a darker colour. These symptoms are similar to manganese deficiency, which is extremely rare in New

Zealand, but does occur in North America when animal manganese levels can be low because some of their soil levels are low.

Applying high rates of soluble phosphates (superphosphate, DAP, MAP), which is common when farmers aim for faster pasture growth, can make Fe unavailable to plants and grazing animals. This can happen in both acid and alkaline soils. It is more common in dry conditions and sandy soils that don't fix as much of the excess soluble phosphates as clay soils do. Roots growing in moist soils take up more Fe than static ones because respiration at the root tip creates a high concentration of carbon dioxide, which helps make the Fe more available for uptake.

Iron is usually lower in soils with high pH and high calcium. When Fe is low, phosphorus and potassium can be higher. In acid soils Fe is usually available to plants, but in some neutral (pH7) or alkaline soils it can be unavailable. High pH sandy soils with high calcium carbonate are more likely to suffer low Fe levels. Pumice soils can also be low in Fe. Pasture takes up Fe more readily from high organic soils. All of this shows that pasture analysing is needed every spring and autumn.

If below 50 mg/kg in pasture, applying iron sulphate at about 20 kg/ha may be necessary, in which case expect a marked improvement in pasture health and growth within ten days and in animal health after a few months. Serpentine with its 6% Fe gives a longer lasting Fe than iron sulphate. However, make sure that your plants are definitely deficient in Fe before applying it, and if you do, apply it carefully and strictly according to the directions. Too much Fe can damage a plant. This won't happen from serpentine even at 500 kg per hectare.

Yellow leaves can be a sign of low nitrogen or, in legumes, of low sulphur. Yellow stripes on ryegrass leaves indicates low magnesium.

Many acknowledge that grazing animals don't suffer from low Fe unless they are made anaemic by parasites, disease or something else. Fifty mg/kg is all that is required in feeds.

Soil & Plant Excesses

Iron acidifies soils. If the Fe level in a pasture sample is high (150 mg/kg or higher), suspect soil contamination, in which case cobalt and manganese levels in the pasture analysis results (depending on the soil) will be incorrectly high.

If they are above 100 mg/kg in the pasture mineral analysis, suspect soil contamination in the pasture samples, which can (not from all soils) increase cobalt, aluminium and manganese figures.

High levels of Fe in a soil-free sample reduce copper, selenium and zinc.

Sources

Iron sulphate usually has 20% Fe and 11% sulphur. It is a very fine, black powder which can usually be obtained in a granulated form for ease of, and more accurate, spreading.

Serpentine has 6% Fe which is useful because higher amounts of serpentine are usually applied for its magnesium silicate.