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Farmnote

Trace element deficiencies in sheep and cattle

By Tony Higgs, Senior Veterinary Officer, Albany

The trace elements of concern to livestock producers in Western Australia are cobalt, selenium and, to a lesser extent, copper. Trace element deficiencies are seen mainly in the higher rainfall areas of the south-west, particularly along the coast.

Pasture growth and persistence requires adequate copper in the soil. Pasture copper levels that are adequate for plant growth will also be high enough for livestock. However, excessive iron, molybdenum and sulphur levels will reduce the amount of copper that is available to ruminants.

Cobalt is required in minute amounts by bacteria that fix nitrogen in legumes, but livestock requirements for cobalt are higher. Cobalt is essential for the production of vitamin B_{12} by rumen microbes. Selenium is not an essential nutrient for plants, but it is needed to maintain animal health and production.

Obvious clinical disease from trace element deficiencies is less frequent now than in the past. The cause and distribution of these deficiencies have been extensively studied, practical solutions have been developed and the information is widely available. There are many options available to farmers to prevent deficiencies.

The more recent interest in trace elements has been to find out whether supplementation will improve production as well as prevent disease.

Factors affecting the trace mineral nutrition of livestock

Paddock characteristics

Although the soil level of each trace element is important, there are several complex interactions that can affect the availability of an element to pasture plants. Generally, liming (increasing pH) decreases plant uptake of cobalt but increases selenium and molybdenum uptake.

Pasture composition also influences trace element availability. Clover plants are less efficient at taking up selenium than grasses but more efficient at taking up cobalt and copper.

Poor paddock drainage will increase cobalt and selenium uptake by pasture but reduce copper availability.

Season

The trace mineral concentration in plants is reduced by the dilution effect of rapid growth during spring. Higher levels of sulphur in green feed may reduce the availability of copper and selenium.

Animal health

Stress will increase the effect of a deficiency and, in the case of selenium deficiency, may trigger clinical disease. An animal's trace element needs increase during pregnancy, lactation and growth.

Management

Rotational grazing will increase an animal's chance of correcting a trace element deficiency. Subtle differences between paddocks may mean that trace elements are more available in some than others.

Deficient areas in Western Australia

Copper

Copper is recommended for all new land in the south-west of the state but recommendations on repeat applications have changed steadily since the 1940s. Current research suggests that there is no decline in the residual effectiveness of copper fertiliser up to 25 years after application. This period is likely to be extended after further monitoring.

Excessive soil levels of molybdenum will induce a secondary copper deficiency by combining with copper and sulphur in the rumen to form the insoluble product copper thiomolybdate. Also, some molybdenum is absorbed by the animal and then directly affects the function of copper. Excessive use of molybdenum fertilisers should be avoided. One application of 75 g/ha of molybdenum will be adequate for 10 to 15 years on slightly acidic soils (pH 6.0 to 6.9). More frequent applications (within three years) may be required on acid soils (pH 4.0 to 5.0). Often the best way to correct a molybdenum deficiency in the pasture is to lime. If molybdenum is applied to the pasture do not allow cattle to graze until after heavy rain.

Cobalt

Cobalt deficiency is seen in areas receiving more than 450 mm of rainfall. Soil types derived from acid igneous rocks such as granite (karri loams) and those subject to leaching (banksia and tuart sands of the west coast) are frequently associated with deficiency, as is intensively cropped land. Cobalt deficiency can be seen in association with heavy liming of pasture.

Selenium

Selenium deficiency is seen in areas receiving more than 410 mm of rainfall, particularly on lighter soil types. The higher the rainfall the worse the deficiency, because of leaching and the degree of spring flush. Low vitamin E levels may be associated with a selenium deficiency when pastures are dry.

Clinical signs in sheep

Copper

Abnormalities of the wool (loss of crimp, steeliness and depigmentation) are seen in the early stages of copper deficiency. Anaemia, scouring, ill-thrift and infertility may occur in extreme cases. Bone fragility in lambs can occur in spring. Affected animals develop fractures of the ribs and limbs. Unweaned lambs may develop a condition known as enzootic ataxia in which lambs up to four months old progressively lose coordination in their hind limbs.

Cobalt

Sheep suffering from cobalt deficiency gradually lose their appetite and fail to thrive. Continued deficiency leads to signs of prolonged malnutrition due to the effect of anorexia and impaired nitrogen metabolism. The disease is most common in spring and early summer. Growth, lactation and wool production are severely retarded and wool may be tender or broken. Anaemia may occur late in the disease. White liver disease has occurred in Western Australia. Weeping eyes, leading to matting of the wool on the face, is a classic symptom of cobalt deficiency.

Selenium

Deficiencies of selenium and/or vitamin E cause nutritional myopathy in lambs (in autumn and winter) and weaners (in summer and autumn). The disease affects heart and skeletal muscle and is often associated with some other stress such as shearing, salty water supplies, lupinosis or heavy worm burdens. Affected stock may have a stiff gait, or be unable to walk. Some may go down when driven and die soon afterwards. Heart damage can cause sudden deaths.

Clinical signs in cattle

Copper

Cattle lose coat colour and the coat becomes rough. This can occur in the absence of any production losses. The classical spectacled appearance may occur, where the hair around the eyes loses its pigmentation.

Ill-thrift, decreased milk production, infertility and anaemia can occur in adults, and calves have poor growth rates. Scouring is often associated with copper deficiency caused by high levels of dietary molybdenum but not when a deficiency is due mainly to low dietary copper. Sudden death (falling disease) may occur in adults.

Cobalt

A wasting syndrome develops similar to that seen in sheep. There is a greater susceptibility to other diseases such as mucosal disease, ostertagiasis and mange.

Selenium

Suckling calves may develop nutritional myopathy, which usually affects heart muscle and consequently causes sudden death. Ill-thrift may occur in young cattle. Limited evidence suggests that a marginal deficiency reduces milk volume, fat yield and conception rates, and increases the occurrence of retained foetal membranes and mastitis.

Differences between sheep and cattle in susceptibility to a deficiency

The *copper* requirement for cattle is slightly higher than for sheep. Falling disease has been seen in cattle when there were no signs in sheep.

Cattle are less at risk from *cobalt* and *selenium* deficiencies than sheep.

Diagnostic aids

Soil tests

To assess the likelihood of deficiencies, results of soil tests for trace minerals must be adjusted for soil type, the presence of competing minerals, the plant species growing in the area and seasonal conditions. Consequently, soil testing is an indirect measure of the trace mineral status of grazing livestock and is of limited diagnostic value.

Plant tests

Plant testing may be useful in the diagnosis of copper deficiency, particularly to determine the likely role of molybdenum and sulphur. However, take great care when interpreting pasture levels of cobalt and selenium, especially when results are at marginal levels.

Animal tests

Animal tissue levels are a better guide than results from soil and plant tests but animal tissue results must be considered together with the case history and the clinical signs. Part of the history will include the time of year when the suspected deficiency started and the prevailing seasonal conditions. Animal tests may be useful for detecting an emerging trace element problem.

Response to treatment remains the most effective test for trace mineral deficiencies. It is also the most effective method for determining the presence of a marginal deficiency.

Responses to supplementation — trial summaries

Responses to trace mineral supplementation in deficient areas are unlikely to occur in successive years and local information suggests that responses are likely once in every three years. An example of between year variation comes from a study where sheep were monitored on one severely cobalt deficient property over 14 consecutive years. The sheep showed a response to cobalt supplementation in nine of those years.

Sheep trials

Copper

Three trials in the Albany region and one at Newdegate showed no production response but clinical copper deficiency continues to be diagnosed as a cause of production loss. In the past two years cases have been diagnosed in association with ill-thrift in near coastal areas from Geraldton to Mt Barker.

Cobalt

Four of 34 trials conducted from Dongara to Esperance showed a response to cobalt supplementation. These responses occurred on grass dominant pastures in spring after above average winter rainfall.

Table 1. Cost of different methods of trace element supplementation, based on average retail prices (excluding GST) at Albany in February 2004.

	Basic Cost	Rate	Cost/ha/y	Cost/head/y*
Copper				
Copper/Zinc/Molybdenum with superphosphate	$85/T extra	100 kg/ha (every 10 y)	$0.85	$0.09 sheep $0.85 cattle
Sheep pellets	$520/500	1/y		$1.04
Cattle pellets	$550/100	1/y (calves) 2/y (adults)		$5.50 $11.00
Injection - cattle	$25/200 mL	1 mL (calves) 2 mL (adults)		$0.25 (2 doses) $0.50 (2 doses)
Cobalt				
Cobalt sulphate with superphosphate	$19/kg	300 g/ha/2y	$2.85	$0.29 sheep $2.85 cattle
Cobalt sulphate sprayed	$19/kg	20 g/ha/y	$0.38	$0.04 sheep $0.38 cattle
Sheep pellets	$400/500	1 for life (5 y)		$0.16
Cattle pellets	$300/100	1/y		$3.00
Vitamin B_{12} injection without selenium	$39/500 mL	1 mL/3 months (lambs) 1 mL/y (adult sheep) 2 mL/2 months (cattle)		$0.16 (2 doses) $0.08 (1 dose) $0.47 (3 doses)
Vitamin B_{12} injection with selenium#	$50/500 mL	1 mL/3 months (lambs) 1 mL/y (adult sheep) 2 mL/2 months (cattle)		$0.20 (2 doses) $0.10 (1 dose) $0.60 (3 doses)
Selenium				
Selenium Chips (applied with fertiliser)	$2.65/kg	0.30 kg/ha/y	$0.80	$0.08 (sheep) $0.80 (cattle)
Sheep pellets	$173/500	1 for life (5 y)		$0.07
Cattle pellets	$200/100	1/y		$2.00
Selenium Drench#	$28/5 L	5 mL (lambs) 20 mL (ewes)		$0.14 (5 doses) $0.11 (pre-lambing)
Selenium with vaccine#				
3S (sheep)	$5/500 mL	2 mL (lambs) 2 mL (sheep)		$0.04 (2 doses) $0.02 (booster dose)
5 in 1 (cattle)	$5/100 mL	2 mL (calves) 2 mL (cattle)		$0.10 (2 doses) $0.05 (booster dose)

* Assuming a stocking rate of 10 DSE/ha
# Selenium supplementation by this treatment method is effective for approximately 8–12 weeks

Selenium

Responses in liveweight and wool growth have been seen in zones with annual rainfall above 410 mm. Trials from 1960 to 1982 conducted in the Albany region, with rainfall over 500 mm, showed significant production responses at nine of 27 sites. Only one significant increase (10 per cent) in lambing percentage was recorded from 26 other trials.

Cattle trials

Copper

In 25 trials on farms with suspected copper deficiency, only one produced a growth response after copper supplementation. Studies conducted elsewhere suggest that responses to supplementation are more likely when the copper deficiency is due to excessive dietary molybdenum.

Cobalt

One small response to cobalt supplementation was seen in cattle liveweights in one of four years (1973–1976) at Denmark.

In a subsequent trial in 1977, growth rates were greater in supplemented cattle. Trials on 13 other properties from Bunbury to Esperance showed no response.

Selenium

Four trials were conducted in the Albany region in 1976 and 1977 in calves less than six months old. Liveweight changes were not significant.

Four trials on 11 farms in the Bunbury region did not produce significant liveweight changes. A more recent study in dairy cattle indicated that selenium supplementation reduced the incidence of new udder infections. Nutritional myopathy has been recorded in cattle, mostly suckled calves, from Moora to Esperance.

Recommendations

The decision to implement a trace element supplementation program is relatively simple for properties that have a known history of clinical disease. If a deficiency is identified, then it is likely to occur again in future years unless preventive measures are taken.

On properties that have no record of clinical disease but which are in areas that are known to be deficient, the decision whether to use trace elements is more difficult. The best approach is to conduct a production response trial. Regrettably, it is the nature of trace element deficiencies that a response may only be seen once every few years, so trials must be run over several years. If a response is found, the selection of a supplementation option should be based on economics.

There are several methods for supplementing with trace elements. A guide to the cost of different methods is given in Table 1. One way to reduce costs is to include an assessment of the risk for each season. For example, in a season with a good break, heavy winter rains and a good spring flush, there is a greater probability that cobalt will be deficient. In this situation, cobalt sulphate could be sprayed onto pastures being grazed by young stock.

Copper

The cause of a copper deficiency should be determined. Check the pasture levels of copper and molybdenum and correct them as necessary. Animal treatment may be required in the short term, before pasture copper and molybdenum levels can be corrected. In the case of excessive pasture molybdenum, animal treatment may be required over several seasons. In the latter situation, slow release copper supplements given orally may be more effective than injectable copper formulations.

Cobalt

Pasture treatment by foliar spray is the cheapest method of supplementation. Reduce costs further by treating the parts of paddocks that will carry young stock at a proportionately higher concentration.

Selenium

Pellets are a cheap method for sheep but the life of the pellet may be only one to two years, which may be inadequate for lambs suckling mature ewes.

Pasture treatment may be a better option. Areas that carry young sheep or cattle may be targeted for treatment, or part of the farm could be treated and stock rotated through the treated areas. Recent studies indicate that slow release selenium fertiliser may provide adequate selenium for grazing stock for three years.

Care should be taken to avoid over supplementing with selenium. The use of selenium pellets and treatment of the pasture at the same time can lead to excessive tissue levels in sheep.

Further reading

Farmnote No. 25/88 “Copper, zinc and molybdenum fertilisers for new land”

Farmnote No. 80/89 “Avoiding cobalt deficiency in livestock”

Farmnote No. 7/92 “Mineral requirements of the lactating dairy cow”

Farmnote No. 15/94 “Copper deficiency in sheep and cattle”

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