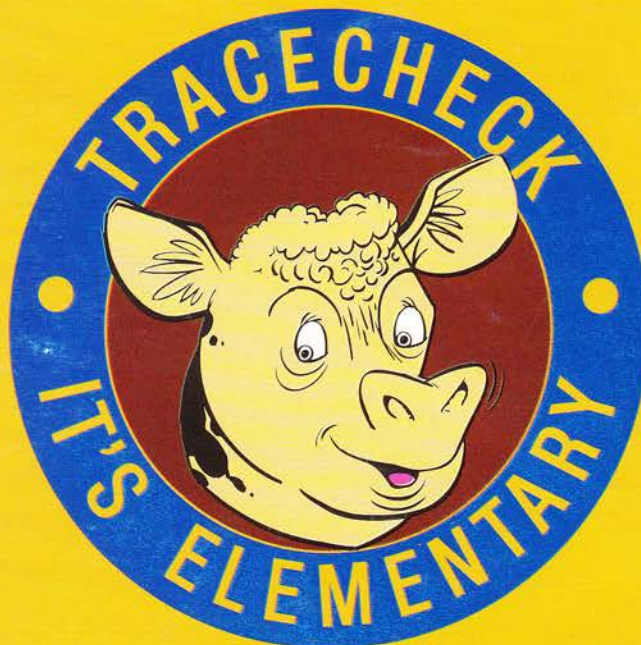


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PRIMARY INDUSTRIES
SOUTH AUSTRALIA

TRACE ELEMENTS FOR BEEF AND DAIRY CATTLE



Prepared by the TraceCheck Committee with funding from the
South Australian Cattle Compensation Trust Fund

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***With funding from the
South Australian Cattle Compensation Trust Fund.***



**PRIMARY INDUSTRIES
SOUTH AUSTRALIA**

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TRACE ELEMENTS FOR BEEF AND DAIRY CATTLE – BACKGROUND

Agricultural development in South Australia has involved the widespread use of trace elements for improved animal, pasture and crop production. The requirements of pasture for some trace elements are greater than for livestock and so normal pasture nutrition provides for those elements in the animal. The requirements of cattle for copper, cobalt and selenium are, however, higher than the requirement for pasture. In fact, plants do not require selenium or iodine at all. Animals and pastures have a similar requirement for zinc which, because of changes in the sources and formulations of fertilisers, has become a limiting factor to production on some soil types.

Severe deficiencies

Historically, severe trace element deficiencies often caused characteristic signs followed by death. In recent years there has been a disappearance of clinical signs in animals grazing developed pastures. This has been due to the adoption of preventative practices such as routine treatment of animals with trace element bullets, drenches or vaccines, or addition of trace elements to feed rations and fertilisers.

Marginal deficiencies

Deficiencies are now often associated with seasonal variations of trace element intake, just above and below an “adequate” level. This shows up as a marginal deficiency affecting a variable percentage of stock from year to year.

The result is lowered production without obvious signs of ill-health. The transient nature of these deficiencies means that, after a period of poor growth, the problem may “cure” itself. It is vital that problems are recognised and treated early so that no production losses occur. A routine treatment

can be incorporated into the annual management plan for the property.

Marginal trace element deficiencies have also been shown to weaken animals resistance to disease.

This bulletin summarises the effects the significant trace elements have on beef and dairy production and the clinical signs which help diagnosis of a deficiency.

Remember, however, that trace elements are only part of the total management package. Too often trace elements are thought to be the problem, when other basic aspects of management, such as availability of feed or parasites are overlooked.

TRACE ELEMENT AVAILABILITY

A number of environmental and management factors affect the availability of trace elements to livestock.

Soil type

The relationship between trace element deficiencies and soil type has long been recognised. Local experience is invaluable in assessing the risk of deficiency on particular soil types.

Problem soil types recognised in South Australia are peats, calcareous sands, red gum soils, black alkaline clays, deep acid sands, soils containing ironstone and shallow sand over clay soils.

Soil type relates to the chemistry and the physical characteristics of the soils which impact on trace element availability.

Soil fertility and acidity determine the availability of all nutrients, including trace elements. In addition, soil depth and texture and waterlogging are the important physical characteristics that relate to the leaching of nutrients.

Where different soil types are present on farms, rotational grazing can be a useful method of supplementing intake of trace elements, due to the variation of trace element availability with soil type.

Pasture composition

Different pasture species vary in their uptake of specific trace elements.

Management issues such as the amount and type of fertiliser, the balance of sheep and/or cattle, stocking rate and the use of herbicides which alter pasture composition may increase or decrease the intake of trace elements by livestock. On dryland pasture the seasonal break can be all important in determining clover, weed or grass dominance.

Clovers are generally higher in copper and cobalt than grasses. Grasses are generally higher in selenium and molybdenum than clovers.

Some key soil type issues are:

- Sandy soils are inherently deficient in phosphorus and sulphur and require annual applications. Appropriate applications of copper and zinc, however, have prolonged residual values. Reapplication of copper and zinc should only occur after plant tissue analysis indicates low or marginal concentrations.
- Peats are high in molybdenum. The high organic matter of peat locks up available copper, requiring 1 kg/ha of copper/year for plant/legume growth.
- Red gum soils which have low pH (acidic) have unusually high molybdenum levels. High molybdenum levels tie-up the copper in the rumen making it unavailable to the animal. This requires regular blood and plant tissue testing to establish when another copper application is required.
- High pH (alkaline) soils, such as coastal calcareous sands and the black clays (rendzina), are inherently cobalt deficient and are also often low in zinc.
- Low pH (acidic) soils, and especially those in high rainfall areas with high iron content, are likely to be selenium deficient.
- Soils with a high iron content can induce low copper status in livestock when soil intake into the animal rises over the dusty conditions of summer or winter with soil splash and low feed availability.

Season

Season affects feed availability in both quantity and quality. In areas of marginal deficiency the livestock status generally improves over summer until autumn.

In spring, the legume component of the pasture increases, feed becomes abundant and this leads to a dilution effect of some trace elements in pasture. Further, the drying out of the soil reduces the uptake of some elements.



Seasons of risk

Winter	Spring	Summer	Autumn
Copper			
Vitamin B ₁₂			
Selenium			
Vitamin E			
Green pasture		Dry pasture	

Over the summer period, the availability to animals of copper present in pastures increases as pastures dry off. This is due to a number of factors including the forms of copper becoming more readily absorbed and the decrease of molybdenum in pasture as soils dry out in late spring. Therefore copper deficiency is more common in winter - early spring. Similarly cobalt and selenium deficiencies are less severe in summer.

Irrigation

Underground water supplies in SA are often alkaline. This raises the pH of irrigated soil increasing molybdenum availability, and therefore decreasing copper availability in livestock. More molybdenum is available in wet soil.

Nitrogen applications on irrigated pasture increase grass component of pasture which improves molybdenum intake and so decreases copper intake.

Soil fertility

Running down soil fertility generally results in lower phosphorus levels. This usually results in lower legume content which affects the trace element status of livestock.

With high fertiliser input systems the extra quantity of feed produced may require higher inputs of soil applied trace elements. In addition, if nitrogen fertiliser is applied the pasture may become more grass dominant and soil pH decrease both of which affect trace element availability.

Acidity

Increasing acidity in our soils has lowered selenium availability.

Liming raises the pH making selenium more available to pasture. The increase in legume content may, however, partially offset the increase. Molybdenum availability can also increase with lime application, reducing copper availability to livestock.

Supplementary feeding

The feeding of purchased hay, silage or grain in periods of feed shortages may provide extra trace elements. Grain from dryer areas usually has good levels of selenium.

TRACE ELEMENT REQUIREMENTS OF CATTLE

The amounts of trace element required by cattle depends on their stage of growth, sex and production pressures place upon them.

Calves and weaners have a higher nutritional requirement to match their higher growth rates. Young bulls and steers have a higher requirement for trace elements than their heifer herd mates.

Pregnant and lactating cows have a significantly higher requirement than dry stock.

Dairy cows

Milk production is the top priority in dairy cows and the nutritional management of the dry period plays a major role in the smooth transition through late pregnancy to the lactation cycle. Cows which calve at higher body condition scores partition more energy to milk production and less energy towards maintaining body condition. Therefore, in addition to supplying supplements during lactation, it is most important that the trace element status and feed availability are maintained during pregnancy.

Beef cows

Autumn calvers

The trace element status of autumn calvers in marginally deficient areas should naturally be near the seasonal maximum when they calve. With the winter stresses on trace element availability strategic treatments should be given to maintain their status. However, the most important time to ensure trace element status is adequate is prior to spring so that cows and calves can best benefit from the spring flush of pasture growth.

Spring calvers

During winter the trace element status of cows is likely to decrease so that it is important to address trace element requirements prior to calving. As a result both cow and calf are best placed to make maximum weight gains when feed availability is at the maximum.

Animal health

The incidence of some diseases have been linked with subclinical trace element deficiencies. For instance marginal selenium status has been associated with mastitis, and low copper with lowered resistance to disease and parasite burdens.

GRAZING

Rotational grazing through different soil types can overcome a deficiency that might otherwise occur on one particular soil type.

Increased stocking rates usually increase clover content of pasture. This improves cobalt and copper intake, but if pasture is extremely short then soil intake is increased. This can increase cobalt intake and, if combined with high molybdenum or iron, can reduce copper availability.

Weeds and some fodder crops including Yorkshire Fog Grass (a molybdenum accumulator) and cruciferous weeds such as Radish, Ward's weed, Lincoln weed, Turnip, Fodder Rape (sulphur accumulators) can reduce the availability of copper in the diet.

DIAGNOSIS OF DEFICIENCIES

Laboratory tests using blood, milk or other animal tissues are available as aids for assessing livestock nutritional status. The tests should be interpreted in conjunction with clinical signs, feed availability, parasitism, district experience, etc to identify possible responses to trace element supplementation.

Because trace element levels vary between years, soil type and stock class, it is recommended that you routinely check the status of your herd. This will enable you to determine specific trace element requirements.

The best time to test stock is when they have been on green feed for at least 2 months. This usually means late winter-early spring.

It is best to test the stock that are most at risk to trace element deficiency. These include young, rapidly growing calves, animals in their first pregnancy and high producing dairy cows.

Plant analysis can only be used as a rough guide for determining the availability of supply of trace elements to grazing livestock. However, following the diagnosis of copper deficiency in livestock, plant analysis is recommended to assess the effectiveness of alternative treatments. Interpretation of the plant analysis is required to determine

whether an indirect method of supplementation (e.g. copper enriched fertiliser) is suitable or whether a direct animal supplement is required (e.g. injection or pellets).

Soil analysis is of no value in assessing the availability of trace elements to animals.

It is also very difficult to interpret how soil analysis relates to pasture concentrations.

COPPER

Cattle are more susceptible than sheep to copper deficiency.

Copper applied with fertiliser has a prolonged residual value. Any copper deficiency that occurs in livestock grazing treated pasture is likely to be the result of either dietary copper interacting with molybdenum, iron and sulphur, or waterlogging reducing copper availability. Further applications of copper fertiliser should only be considered following the interpretation of a pasture analysis. When deciding the best method of supplying copper the relative proportions of the interactive elements compared to the copper concentration in available pasture need to be considered. If the copper concentration is relatively low in pasture (< 8 mg/kg (ppm) of dry matter), 2 kg copper/ha, (8 kg copper sulphate/ha), may redress the balance in the interactions. However, if the copper concentration is > 10 mg/kg (ppm) of dry matter, a direct animal supplement is required.

Seasonal effects

Copper deficiency is often seasonal, being most evident in winter and spring.

Waterlogging increases molybdenum availability while decreasing copper.

Where pasture grows on acid soil, plant analysis should be done before molybdenum is applied to pasture

Areas of copper deficiency

In a recent study at least 20% of the state's cattle were shown to be at risk. The regions where cattle are most at risk to copper deficiency, however, are the South East, the Murraylands and the Lower Eyre Peninsula.

Soils responsive to copper treatment used to be extensive in the agricultural areas of South Australia. The problem has been largely overcome by a single application of copper sulphate in fertiliser. This form of application is likely to last for many years in

these areas and should be checked with plant tissue analysis.

The severity of copper deficiency varies within a soil type depending on seasonal conditions, fertiliser application, irrigation, pasture composition and weed species.

Signs of copper deficiency

- Pale, harsh, dry coats
- Loss of condition and poor growth rates
- Scouring
- Lowered milk production
- Reduced fertility
- Delayed puberty in heifers
- Pale membranes of eye and mouth
- Easily broken bones

Diagnosis of deficiency

Any early signs of copper deficiency should be considered in conjunction with a blood test.

Blood tests should be taken as soon as signs appear or when stock are at most risk in winter, spring period (August- September).

Interpretation

If a copper deficiency is diagnosed, a pasture analysis should then be undertaken.

Plant analysis results identify the cause of the deficiency i.e. if it is low copper or alternatively interactions with molybdenum, iron or sulphur.

If low copper is the cause then the most economic treatment is likely to be the application of copper enriched fertiliser.

If copper pasture levels are high (>10 mg/kg of dry matter) then the animals will require a direct supplement.

Treatment and prevention

Once a deficiency has been diagnosed it should immediately be treated to reduce production losses. After this, an ongoing strategy should be developed.

Treatments include:

Copper fertiliser

Top dressing pastures with copper is the usual way of increasing pasture levels of copper. Traditionally, in copper deficient areas, 2 kg copper/ha (equivalent to 8 kg/ha of copper sulphate) has been applied in the pasture development phase.

On most soils, copper fertiliser has a long residual value and maintains adequate copper concentrations in pasture for livestock for many years.

Pasture copper levels can be monitored with plant tissue analysis. This should be a top priority after copper deficiency has been diagnosed in livestock so that the potential efficiency of copper fertiliser applications can be assessed.

On soils with high molybdenum, iron or sulphur, such as peats and some red gum soils, copper fertiliser is not an efficient method of supplementing livestock with copper.

Copper pellets

Intraruminal capsules containing copper oxide are a most efficient method of quickly raising the copper status of livestock.

Capsules quickly dissolve in the rumen and copper oxide particles are released. They are gradually passed from the rumen through to the abomasum (4th stomach) where they dissolve and release copper which is then absorbed and stored in the liver. The liver store increases significantly and acts as a copper reservoir which supplies the copper requirements of the animal for up to a year depending on the demand for copper in relation to that supplied in the diet.

Copper injections

Copper injections are the most cost effective method of treating copper deficiency in marginal deficient areas. They can be used strategically to maintain the copper status of animals where seasonal copper deficiency is a problem.

A copper injection is effective for about 3 months. The severity and the period of the deficiency will determine how long the

injection is effective and how often treatment is required.

Prior to and during use, copper injection products need to be well shaken so that the copper is evenly distributed in the solution.

To reduce the damage caused by site reactions, copper injections should be given under the skin high on the neck or behind the ear. Site reactions can be reduced by addressing hygiene issues i.e. changing to clean needles regularly and not injecting when cattle are wet.

Copper drench

Oral drenching with copper sulphate solution is not recommended. It is a short term method of supplementing stock with copper. The maximum dose for cattle is 4 g copper sulphate with any increase in dose representing a high risk of causing copper toxicity. A single drench with copper does not build up any liver store and is passed through through the digestive system relatively quickly.

The compatibility of copper sulphate or any other copper compound should be checked before mixing it with oral worm drenches.

Copper lick blocks

Salt blocks containing copper may be used where individual animals are hard to treat or on pasture where there is a marginal consistent copper deficiency.

The problems with salt licks are:

- Only a certain percentage of animals may lick the supplement.
- In most marginal copper areas licks are only fed in summer when copper deficiency is not present.
- Generally the concentration of copper in salt licks is too low to build liver reserves to useful levels to guard against periods of low copper later on in winter-spring.

Copper in water

Metering devices which deliver measured amounts of copper are not readily available. The dose rates with current methods of administering copper to drinking water are

unreliable. This is a potential problem for toxicity, especially in sheep which graze with cattle.

In marginal copper deficient areas water intake is generally confined to the months of the year when copper deficiency is least likely.

Where underground water or water from dams sealed with alkaline dispersible clays are the source of stock water, the water is likely to be alkaline. The alkalinity causes the copper to settle out of solution and form an insoluble blue-grey sediment in the base of the trough.

The corrosive nature of copper means it cannot be used in systems with galvanised fittings, pipes or troughs.

Copper misting of pasture

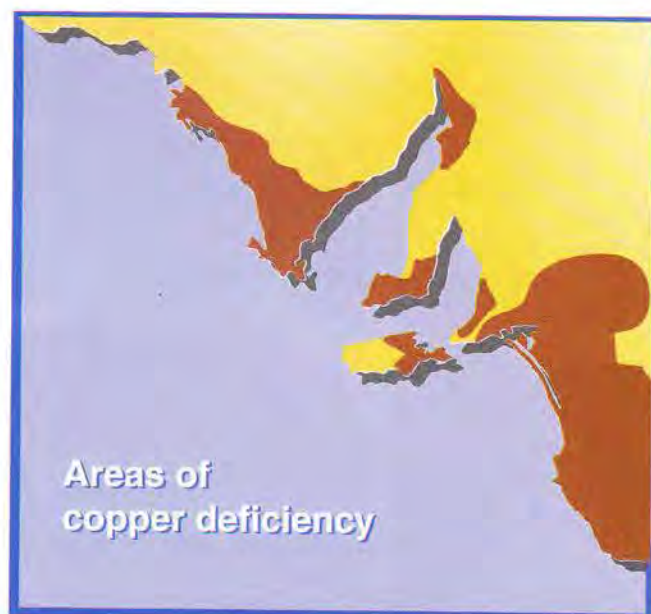
Misting copper on pasture is a very efficient method of raising plant tissue concentrations. The risk of causing toxicity is therefore also very high.

Misting copper on pasture does have an application on hay paddocks prior to mowing or raking. The yield of the paddock needs to be estimated prior to spraying and copper sprayed at a rate of 20 g copper/tonne of hay, i.e. 80 g of copper sulphate/tonne of hay.

The advantage of supplementing copper with this method is that hay is generally fed out in autumn-winter when the copper reserves stored in the liver of grazing animals are depleted in marginal copper deficient areas.

Copper additives in feed mixes

Copper additives to feed mixes - as prescribed - are a most effective method. High producing dairy cows require about 200 mg Cu daily.



Trace element deficiencies can vary markedly within a small area. These maps are a guide to potential risk areas for all stock. Copper deficient areas shown in brown. Pastoral areas north and east of Lake Eyre are also at risk, especially to copper deficiency.

Caution:

Copper treatments are dangerous when stock are grazing pasture containing salvation jane or potato weed and lupin stubbles infected with phomopsis.

Residues from the sulphonurea class of herbicides, which include Logran[®], Glean[®] and Alley[®], may induce copper and zinc deficiency in pasture.



The two animals on the left are copper deficient. Note the coat colour and appearance compared to the copper sufficient animal on the right.

COBALT

Cobalt's only role in plants is in legumes/clovers where trace amounts are required by the nitrogen fixing rhizobia. In stock the main requirement for cobalt is for the synthesis of vitamin B₁₂ in the rumen. It is vitamin B₁₂ the animal requires not cobalt.

A second important role of cobalt in animals is the prevention of phalaris staggers. It is believed the cobalt modifies the rumen bacteria which detoxify the alkaloids that cause the staggers.

Areas of deficiency

Historically cobalt deficiency has had most impact in the coastal areas of South Australia. It is now standard practice to supplement all animals at risk. Defining other areas especially where cobalt deficiency is marginal is more of a challenge, with many livestock producers administering vitamin B₁₂ at marking.

Clinical signs of vitamin B₁₂ deficiency

- Loss of appetite and, therefore, illthrift.
- Pale coats, similar to copper.
- Eye discharge encrusting the eyelid.
- Anaemia in severe cases.

Diagnosis of cobalt/vitamin B₁₂ deficiency

Cobalt deficiency is best diagnosed in cattle by vitamin B₁₂ analysis of the liver. As liver can only be sampled with a minor surgical method or from slaughtered animals, analysis of vitamin B₁₂ in blood samples is the usual method. However, results of blood vitamin B₁₂ in cattle have proven to be unreliable in diagnosing a deficiency. Blood vitamin B₁₂ levels reflect the dietary cobalt rather than the animals status or liver reserves of vitamin B₁₂.

In dairy cattle, milk vitamin B₁₂ rather than blood vitamin B₁₂ may be a more useful indicator of vitamin B₁₂ status.

However if the blood vitamin B₁₂ is adequate, experience has shown that the vitamin B₁₂ status of the animal is also adequate.

In marginal deficiency areas, vitamin B₁₂ is most likely to be limiting during spring. Therefore sampling for diagnosis of vitamin B₁₂ deficiency should be done in the spring.

Cattle are not as susceptible as sheep to cobalt deficiency. So, if sheep grazing with cattle have an adequate status, then the cattle are almost certain to be adequate.

Cobalt treatment and prevention

Cobalt pellets

For weaned animals grazing deficient pasture, cobalt pellets are the most efficient method of ensuring a continuous supply of cobalt.

In suckling calves, milk is likely to cause coating of the pellet with calcium salts. Similarly there are areas in South Australia where the high calcium content of the livestock water and pasture can cause coating on the pellet. A grinder or a second pellet can help prevent this problem.

The dose rate for beef or dry dairy cattle is 1 pellet/year and for milking dairy cattle is 1 pellet every 6 months.

Vitamin B₁₂ injections

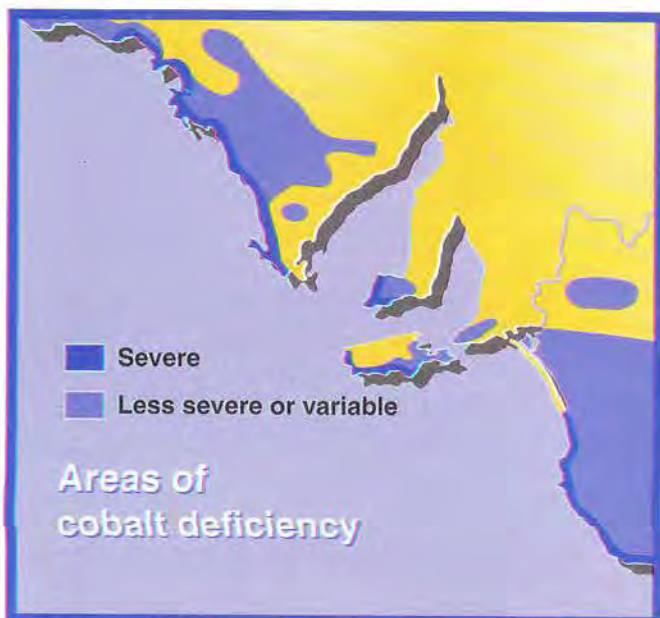
Vitamin B₁₂ injections are a most effective short term method for supplementing all classes of cattle. A single injection will be effective for up to 3 months.

Injections are most suitable for calves, weaners sold soon after weaning, or any class of cattle in marginally deficient areas.

Injections should be given well under the skin. To prevent the supplement leaking to the skin surface use a long needle.

Cobalt misting pasture

Cobalt misting pasture is a most effective method of raising the vitamin B₁₂ status of



cattle. It is especially valuable in minimising the risk of phalaris staggers. The misting can be in strips across the paddock rather than to the whole area.

For phalaris staggers, early in the autumn season where phalaris begins shooting and is potentially most toxic, a cobalt spray of 5-10 g of cobalt sulphate/ha every 2 weeks, over a quarter of the paddock. This should be applied in strips. When there is adequate leaf cover to intercept all the spray a single spray of 35 g cobalt sulphate/ha can be applied. Once again this can be applied in strips across the paddock with an adjustment to the application rate. For example, if a quarter of the area is sprayed

then the rate required is 140 g cobalt sulphate/ha sprayed.

For cobalt/vitamin B₁₂ deficiency, the requirement for cobalt is not as high as for phalaris staggers and a rate of 20 g cobalt sulphate/ha may be used.

For hay paddocks 35 g cobalt sulphate/ha can be sprayed over the whole area prior to mowing or raking.

Cobalt lick blocks

Cobalt licks are of limited value for the same reasons that copper licks are inefficient.

Cobalt in drinking water

Similar to copper, cobalt added to drinking water usually lacks control of the dose rate, is supplied at a time of the year when it is least likely required and due to the alkalinity of many water supplies, the cobalt becomes unavailable as an insoluble sediment at the bottom of the trough.

Cobalt in rations as a feed additive

As with other nutrients, a minimal amount of cobalt included in a daily ration as required is a most effective method of maintaining cobalt/vitamin B₁₂ status.

It has obvious applications in the dairy and feedlot industries but can also have an application in broadacre enterprises where hay or grain are fed on a regular basis.

The daily cobalt requirement for beef cattle is 1-2 mg and dairy cattle 3-5 mg



Vitamin B₁₂ trial conducted at Robe.

SELENIUM

Selenium has no known role in plant nutrition.

Due to the acidification of the majority of high rainfall grazing areas in South Australia, selenium is emerging as a nutrient which limits livestock productivity. In addition, selenium excreted in faeces and urine is of low availability for pasture uptake and therefore is not efficiently recycled and the reserve of available selenium is in decline.

Sheep have a higher requirement than cattle for selenium. This is also affected by the difference in dietary preference of cattle and sheep. Cattle tend to graze grasses which are higher in selenium than clovers which are preferred by sheep.

Selenium is very toxic and careful diagnosis needs to be made before animals are treated. Only recommended methods and dose rates should be used.

Areas of selenium deficiency

Selenium deficiency is confined to the high rainfall areas of South Australia. It is more serious on acid soil types but also occurs on calcareous sands.

A PISA survey showed that 80% of cattle in the Lower South East and 20% across the state as a whole were at risk to deficiency. Other high risk regions were Kangaroo Island, the Adelaide Hills and the Mid South East.

By contrast, in the Lower South East, selenium also occurs in very high

concentrations on ground water rendzinas (black alkaline clays). So high, that if livestock receive selenium drenches or injections while grazing these rendzinas they would be at risk of toxicity. The small amounts released by the pellets do not present the same risk.

Diagnosis of selenium deficiency

Selenium deficiency is diagnosed by blood or milk testing.

Selenium treatment and prevention

Selenium pellets

Selenium pellets are the most effective method of raising the selenium status of grazing cattle especially at lower stocking rates.

The recommended dose rate is 2/yr for dairy and beef cattle.

Selenium in fertiliser

Selenium as a additive to fertiliser is a more expensive method of supplementation and therefore relies on higher stocking rates to be cost effective. In broadacre livestock systems it can be used in areas where the most susceptible classes of livestock such as weaners, young cows are grazed.

Selenium fertiliser can also be spread on hay paddocks. The supplemented hay fed out in autumn-winter when the selenium status of cows is generally declining.

Selenium in drenches and vaccines

Additions of selenium to drenches and vaccines are a most effective method of supplementing sheep in marginal selenium deficient areas. As lambs and weaners are the most susceptible classes of livestock the regularity of drenches and vaccinations can effectively overcome marginal selenium deficiency.

As cattle are less regularly vaccinated or drenched this method is less easily incorporated in routine management strategies. However, selenium drenches and injectables are both very effective and inexpensive methods of preventing selenium deficiency.

Signs of selenium deficiency

- Ill-thrift
- White muscle disease
- Retained afterbirth
- Lowered fertility
- Mastitis



Cattle dose rates for injectable selenium are as recommended for the relevant proprietary preparation. Usually 0.1 mg selenium/kg liveweight is safe but in practice the dose for young cattle (under 200 kg) is 10 mg selenium while for adult cattle (over 200 kg) the dose is 20-30 mg selenium.

Selenium in stock licks

As with copper and cobalt, selenium in stock licks is not usually an effective treatment.

Selenium added to rations

A minimal amount of selenium included in the daily ration as required is a most effective method of maintaining selenium status. The suggested dose rate is 1mg selenium daily for beef cattle and 3-5 mg selenium daily for dairy.



Tim Heysen, (Kalangadoo, Lower South East) pelleting a calf.



Bale feeding.

ZINC

Zinc has not been a significant problem in livestock production until recently. This was due to the widespread use of zinc enriched fertilisers at pasture development and the regular applications of single superphosphate which contained significant quantities of zinc as an impurity. In recent years there has been a reduction in the amount of fertiliser used and also in the amount of "impurity" zinc in fertilisers.

Areas of zinc deficiency

Areas of potential zinc deficiency include most of the livestock productive parts of the state. The risk is highest on pastures on alkaline soils, especially those that have not received zinc for over 10 years.

Clinical signs of zinc deficiency

Because there are only small reserves of zinc in the body, signs of deficiency can occur within a couple of weeks of stock grazing low zinc pastures. Deficiency can occur on dry or green pasture.

Signs of deficiency include:

- Reduced feed intake and growth rate.
- Illthrift.
- Cracking skin on the bare areas (nose, ears, above the hooves etc.).
- Salivation, bowing of the hind legs, elongated hooves.

Diagnosis

Blood testing and faecal testing can confirm a deficiency exists. In a marginal situation blood testing can be unreliable.

Treatment and prevention

Because cattle cannot store zinc, a continuous supply is required. Without doubt the best way to treat and/or prevent zinc deficiency is by pasture top-dressing or

spraying. A rate of 1.5 to 2.0 kg of zinc (as zinc sulphate) per hectare is required. If animals are deficient there is a good chance that pasture plants will also respond to the treatment.

Other treatments include:

- Oral drenching with zinc sulphate. Weekly treatment is required.
- Bail supplementation is a reliable way of supplementing lactating dairy cows.
- There is a large ruminal pellet containing 7 trace elements that can be used to treat zinc deficiency. The pellets are expensive and only provide about half the animals needs.
- Licks, water supplementation are again of limited value.

Treatment option table

COBALT/VITAMIN B ₁₂ SUPPLEMENTS		
Product name <i>Manufacturer</i>	Product information	Comments
Cobalt pellets		
Permatrace cobalt for cattle and sheep <i>Mallinckrodt Veterinary (Coopers)</i>	Beef/ dairy heifers: 1 pellet/yr. Milking dairy: 1 pellet/6 months. Available in containers of 100 Sheep: 1 pellet/3 yr. Available in containers of 500 Cost: cattle \$2.30/pellet sheep \$0.70/pellet	Pellets require a special gun to be administered. Not recommended for calves younger than 3 months. In areas where pellet coating is a problem a steel grinder should also be administered. If administering to suckling calves also give one or two grinders to prevent calcium build-up on the pellet. From: rural merchandise outlets.
Sire Sine cobalt pellets <i>Ridley Agriproducts (Cheetham Rural)</i>	Beef/dairy heifers: 1 pellet/yr. Milking dairy: 1 pellet/6 months. Available in containers of 25 and 150 Sheep: 1 pellet/yr. Available in containers of 100, 500 and 1000 Cost: cattle \$1.90/pellet sheep \$0.55/pellet	
Vitamin B ₁₂ Injection		
Vitamin B ₁₂ for sheep and cattle <i>Troys Laboratories</i>	Dose rate: adult cattle: 2 mL calves, sheep: 1 mL Available in a 500 mL flexipack Cost: \$35 for 500 mL	Treat every 2-3 months in extremely deficiency areas and every 5-6 months in less deficient areas. Vitamin B ₁₂ should be given under the skin with a long, thin needle so that the dose does not leak out to the skin surface when the needle is removed. From: rural merchandise outlets.
Vitamin B ₁₂ <i>Young's Animal Health</i>	Similar treatment regime and price to above	
Cobalt drench		
Cobalt sulphate <i>Consolidated Chemicals</i>	Mix 35 g/5 L water sheep 5 mL/week Cattle 25 mL/week	Labour intensive. Larger doses at less frequent intervals will not prevent deficiency. Not recommended.
Cobalt pasture misting		
Cobalt sulphate <i>Consolidated Chemicals</i>	Spraying pasture with cobalt is also valuable in the prevention of phalaris staggers. The involves spraying 5-10 g cobalt sulphate/ha every 2 weeks, over a quarter of the paddock, applied in strips. Cobalt sulphate can also be added to hay before it is cut or before bailing. Usually 35 g of cobalt sulphate/ha.	

Treatment option table

SELENIUM SUPPLEMENTS		
Product name Manufacturer	Product information	Comments
Selenium pellets		
Permatrace selenium for sheep and cattle. Mallinckrodt Veterinary (Coopers)	Cattle: 2 pellets/yr. Available in containers of 100. Sheep: 1 pellet/3yrs. Available in containers of 500. Cost: cattle \$1.60/pellet sheep \$0.28/pellet.	Pellets require a special gun to be administered. Not recommended for calves younger than 3 months and lambs younger than 2 months. If only one pellet is administered a grinder should also be given to help keep the surface of the pellet clean. From: rural merchandise outlets.
Tri-Sel selenium pellets. Arthur Webster	Sheep/lambs: 1 pellet/2 yrs. Available in containers of 500 and 1000. Cost: sheep \$0.30/pellet.	
Sire Sine selenium pellets for cattle and sheep. Ridley Agriproducts (Cheetham Rural)	Cattle: 2 pellets/yr. Available in containers of 25 and 100. Sheep: 1 pellet/yr. Available in containers of 100, 500 and 1000 Cost: cattle \$1.50/pellet sheep \$0.25/pellet	
Selenium drench concentrates		
Selenium concentrated stock. Drench. Nufarm Animal Health	Requires dilution 1:9. Dose rate of diluted drench: adult cattle 5 mL/45 kg bodyweight calves 10 mL ewes/wethers 5-10 mL lambs 2 mL Available in a 500 mL and 5L container. Cost: \$8.30 for 500 mL.	Drenches generally give 2-3 months protection against deficiency problems. The frequency of dosing will depend on how long and severe the period of deficiency. Drenching a cow/ewe a month before calving/lambing will give some protection against deficiency to the new born until it is old enough to be treated. Most selenium drench concentrates can be mixed with oral worm drenches, but the label should be checked before mixing. From: veterinarians and some rural merchandise outlets.
Selovet-5. Bomac Laboratories	Used undiluted in cattle. cattle 6 mL calves 2-4 mL. Requires a 1:4 dilution of sheep. Dose rate of diluted drench: lambs 2 mL every 6-8 weeks ewes 5 mL one month prelambing. Available in 500 mL containers Cost: \$6-7/ 500 mL container	
Selenium drench Virbac Australia	No dilution required. Dose rate: ewes 20 mL lambs 5 mL. Available in 5 L containers Cost: \$12.50 for 5 litres	

Worm drench with added Selenium		
Valbazen plus selenium <i>Pfizer Animal Health</i>	Sheep: 1 mL/4-5 kg depending on which worms are present Withholding period: meat 10 days Available in a 20 L container Cost: \$180/20 L container	When using drenches with added trace elements it is important to consider the drench type and how it fits into your drenching program. Your livestock adviser/vet can assist you with this.
Selenium injections		
Vitamin-E-Selen <i>Boehringer Ingelheim Pty Ltd</i>	Dose rate: cattle 10 mL calves/sheep 3-5 mL lambs 1-3 mL Withholding period: meat 7 days Available in 100 mL glass vials Cost: \$26/100 mL glass vial	Injections generally give about 3 months protection against deficiency problems. The frequency of dosing will depend on how long and severe the period of deficiency is. From: veterinarians and some rural merchandise outlets.
Selovin-5 <i>Bomac Laboratories</i>	Dose rate: cattle 4-5 mL sheep 1 mL calves 1-2 mL lambs 0.5 mL No withholding period A available in 500 mL flexipack Cost: \$30/500 mL flexipack	
Selenium fertiliser		
Agssel <i>Mallinckrodt Veterinary (Coopers)</i>	Application rate: 1 kg/hectare Applied every second year with super Cost approximately \$3.20/ha/yr	Cost of application can be reduced by targeting lambing/calving paddocks or forage crop/hay paddocks.
Vaccinations with added selenium for sheep		
Glanvac 3S and 6S <i>CSL Limited</i>	2 mg selenium/dose	Most vaccines with added selenium provide a small amount of selenium to protect against deficiency problems before animals are old enough to be given pellets, usually at weaning. From: rural merchandise outlets in a 500 mL flexipack.
Vaxall 3 (5 or 6) in 1 Vaccine with selenium <i>Arthur Webster</i>	1 mg selenium/dose	
Cheesyvax 3 (6) plus selenium <i>Pfizer Animal Health</i>	1 mg selenium/dose	
Tasvax 5 in 1 plus selenium Guardian 3 (6) in 1 plus selenium <i>Mallinckrodt Veterinary (Coopers)</i>	1 mg selenium/dose	
Selenium pour-on		
Selpor <i>Virbac Australia</i>	Cattle: 2 mL/50 kg up to 20 mL Available in 2.5 L container Cost: \$140/2.5 L	Requires a pour-on applicator. Effective for about 3 months, less if cattle are wet or it rains within 2 hours of treatment. Not to be used concurrently with other pour-on products. From: rural merchandise outlets.

COPPER SUPPLEMENTS		
Product name Manufacturer	Product information	Comments
Copper Pellets		
Permatrace copper for cattle and sheep <i>Mallinckrodt Veterinary (Coopers)</i>	Cattle:(over 200 kg): 1 Permatrace copper 20 capsule/yr or 2 Permatrace copper 10 capsules/yr as a single dose. Calves (under 200 kg): 1 Permatrace copper 10 capsule/yr. Both available in containers of 100. Sheep: 1 Permatrace copper capsule/yr. Available in containers of 500. Cost: adult cattle \$4/yr calves \$2/yr sheep \$0.70/yr	Pellets require a special gun to be administered. In areas of severe copper deficiency due to high molybdenum content, copper pellets may have to be given every 6 months. Not recommended for calves/ lambs younger than 3 months. From: rural merchandise outlets.
Copper Injection		
Coppernate <i>Troy Laboratories</i>	Dose rate: adult cattle 2 mL calves 1 mL Available in a 100 mL glass or 250ml flexipack	A copper injection is effective for about 3 months. The severity and length of the deficiency period will determine how often treatment is required. The copper suspension needs to be shaken well before use and should be checked during use to ensure the suspension is not settling out. The injection should be given under the skin high in the neck or behind the ear. Swelling can occur at the injection site. This can be reduced by not dosing during wet weather.
Copper injection <i>Young's Animal Health</i>	Dose rate: adult cattle (over 200kg) 2 mL calves (under 200kg) 1 mL Available in a 200 mL flexipack Cost: \$26.50 /200 mL pack	
Copper drench		
Copper sulphate <i>Consolidated Chemicals</i>	Cattle over 4 months can be given an oral dose of 4 g of copper sulphate. Sheep an oral dose of 10-15 mg/kg body weight.	Short term (about 2 weeks), labour intensive and high risk of copper toxicity if an incorrect dose is given. Not recommended.
Copper fertiliser		
Copper sulphate <i>Consolidated Chemicals</i>	Copper sulphate can be added to pasture with or without fertiliser. It is usually spread at the rate of 8 kg copper sulphate/ha. Available in 5 kg and 25 kg bags. Costs: \$2.70/kg.	Copper fertiliser is long lasting on virgin soil, but is not recommended for soil types high in molybdenum. Benefits from adding copper in the fertiliser to correct a deficiency will only be seen if copper pasture levels are less than 10 ppm.
Copper pasture misting		
Copper sulphate <i>Consolidated Chemicals</i>	Copper sulphate can be added to hay before it is cut or before bailing. Usually 80 g of copper sulphate/ tonne of hay.	

PRODUCTS CONTAINING A COMBINATION OF TRACE ELEMENTS		
Product name <i>Manufacturer</i>	Product information	Comment
Boluses		
Agrimin All-Trace Boluses <i>Young's Animal Health</i>	Dose rate: Cattle: 2 boluses Should not be given to calves younger than 5 months or weighing less than 150 kg. Contains copper, cobalt, selenium, manganese, zinc, iodine, sulphur and vitamins A, D ₃ and E. Cost: \$12-13 /head	The boluses are effective for up to 8 months. They are suitable for all cattle over 150 kg. The boluses require a special applicator to be administered. After the 8 months there are no residues in the reticulum/rumen. All-Trace boluses are packed 20 to a box (10 cattle doses).
Combination injections		
Young's Vitamin B ₁₂ Injection with Selenium <i>Young's Animal Health</i>	Dose rate: lamb 1 mL weaners and adults 2ml Available in 500 mL container Cost: \$40 /500 mL (compared to \$35/ 500ml for the Young's Vitamin B ₁₂ injection)	The frequency of dosing is related to severity of the deficiency. In extremely deficient areas, inject every 2-3 months. In less deficient areas, every 5-6 months. Dose by subcutaneous injection with frequent needle changes. Avoid using in wet conditions. Once pack is opened it should only be stored for 2 months.
Drenches		
Mineralised Fencare <i>Virbac Australia</i>	Dose rate: cattle 15 mL/50 kg body weight sheep 1 mL/5 kg body weight Trace elements contained: Cobalt 0.2 g/L Copper 2.1 g/L Selenium 0.5 g/L Zinc 0.6 g/L Withholding period: meat 21 days Available in a 20 L container Cost:\$70/20 L	In areas where trace element deficiency is a problem in livestock, mineralised drenches alone generally do not provide sufficient trace elements and additional supplementation will probably be required. Note also that zinc is not stored well in the body and the effect will be short lived, as will the effect of the cobalt. When using mineralised drenches it is important to consider the drench type and how it fits into your drenching program.
Mineralised Levamisole <i>Virbac Australia</i>	Dose rate: cattle 5 mL/50 kg body weight sheep 1 mL/10 kg body weight Trace elements contained: Cobalt 0.5 g/L Copper 4.94g/L Selenium 1.25 g/L Zinc 1.4 g/L Withholding period: meat 3 days, do not use in animals producing milk for human consumption Available in a 10 L container Cost; \$100/10 L	Your livestock adviser/vet can assist you with this.

Treatment option table (*products containing a combination of trace elements cont.*)

Mineral lick blocks		
<p>There are a number of companies that produce lick blocks containing various amounts of trace elements and minerals. Blocks don't always provide trace elements when they are required and some blocks don't have enough trace elements to meet the animals requirements, particularly for copper and selenium. Effectiveness of blocks tends to be limited by animal intake which can be highly variable. Some animals may consume enough to meet their trace element requirements while others won't. Your livestock advisor/vet can assist you with which block may suit your situation.</p>		
Water trough additives		
<p>Cobalt sulphate and copper sulphate in drinking water <i>Consolidated Chemicals</i></p>	<p>1 g cobalt sulphate in 1,500 L of water</p>	<p>A concern with adding cobalt and copper sulphate to drinking troughs is that animals are usually deficient during late winter and spring when they aren't drinking a lot of water from the trough and the availability of the trace elements is decreased in alkaline water. If the float jams water evaporation can increase the concentration of copper and cause copper toxicity problems.</p>
In-bail supplements		
<p>There is a wide range of supplements available that are used in the bail for dairy cows. These mixes can be tailored to individual farms and can be an effective way of supplementing the herds trace element requirements.</p>		

