

Copper

Test before you supplement

Deer health and farm profitability can both be affected if body copper levels are too low (deficiency) or too high (toxicity). Many areas of New Zealand are deficient or low in available copper and deer industry survey results suggest about 80% of deer farmers supplement their herds with copper. However there is evidence that many farmed deer are being given these supplements unnecessarily.

Copper supplementation can be costly if it is inadequate, incorrectly timed or not needed in the first place. So it is important to test copper levels before and after supplementation. The test results will enable you to make an informed decision about the need for copper supplementation and the form it should take.

Supplementation is likely to be economic if it prevents clinical disease occurring, even in a small number of animals. Bear in mind that wapiti have a higher requirement for copper and a greater susceptibility to deficiency than red deer.

On farms where copper levels are marginal or deficient for all or part of the year, the decision whether to supply more copper needs to take into account less obvious benefits.

The benefits of copper are not all tangible. For example, on farms with vaccination programmes it is wise to have adequate copper levels in the herd. This is because of the important role copper plays in maintaining a strong immune system and the ability of animals to mount a strong response to a vaccine or a disease challenge.

What are the signs?

In affected deer herds – even those with low blood copper status – typically only a handful of animals show clinical signs of deficiency.

The main clinical signs are enzootic ataxia (swayback) in older deer, and osteochondrosis (abnormal bone development, deformities and fractures) in young deer.

Key points

- Both too little and too much copper can cause health issues in deer.
- While many areas of New Zealand are copper-deficient, there is evidence that some farmed deer are being given copper supplements unnecessarily.
- Have the copper status of your herd checked before you use copper supplements.
- Seasonal changes in copper levels dictate the best time to monitor copper levels in deer.
- Consider the copper content of forages and supplements when formulating a copper plan for your herd.
- Make trace element monitoring and any supplementation part of your deer health risk review and plan.

Swayback (enzootic ataxia) is generally seen as a lack of co-ordination in the hindquarters. Affected animals often stumble when turning and lose balance on slopes.

Fawns and yearlings can have weak bones which are prone to fractures – especially in the humerus.

Copper is involved in the formation of melanin, which is responsible for a dark coat colour. Faded-looking coats can be a sign of low copper.

Copper deficiency is not reflected in deer body condition or growth rates unless the deficiency is extreme. In the few trials where a growth response to copper supplementation was seen in rising 1-yr old deer, blood copper levels were extremely low.

The long-term effects of copper deficiency on hind productivity or velvet antler growth are not well understood.



Photo: Trevor Walton

A stag showing the classic signs of copper deficiency at the end of winter
In herds with low blood copper only a handful of animals are likely to show clinical signs of deficiency

Photos: Laurent Audigé, The Deer Farmer magazine



Two photos of a fawn showing signs of copper deficiency
Note the swollen hocks and the back leg posture

Seasonality and copper

The season has a marked effect on the copper status of deer.

The lowest serum and liver copper levels occur in late winter/early spring, in part because low soil temperatures reduce the copper content of pastures.

Other suggested reasons for this decline include seasonal changes in deer metabolism, feeding management, and increased winter soil intake, however this decline is still poorly understood.

Seasonal highs in copper levels occur in late summer/autumn, due to rebuilding of copper stores from pasture (especially legumes).

Why deer need copper

Copper is a trace element that is essential for plant, animal, and human health.

It is critical in the formation of the collagen matrix that keeps bones strong, which is why animals that experience copper deficiency in early life can have bones that are weak and prone to fractures.

It is involved in the formation of red and white blood cells and the synthesis and release of life-sustaining proteins and enzymes. These enzymes in turn produce cellular energy and regulate nerve transmission, blood clotting, and oxygen transport.

White blood cells play a pivotal role in the immune system, potentially making copper deficient animals more susceptible to infectious diseases such as yersiniosis.

Copper deficiency also causes defects in the insulating layer of nerves, leading to the weakness and wobbly gait associated with swayback.

Copper in the diet

Research indicates that the minimum dietary copper requirement for deer is 11-12 mg copper per kilogram of dry matter, however this can be affected by the presence of

factors in the diet that can interfere with copper absorption (see below).

Legumes such as red clover, and herbs such as chicory are excellent summer/autumn feeds for fast-growing fawns and weaners. In addition they have up to three times the copper levels of conventional ryegrass/white clover pasture.

There are two causes of copper deficiency, primary and secondary.

Primary deficiency

Primary deficiency occurs when there is insufficient copper in the diet. With a pasture-based diet, this will normally be because the pasture is growing on soils that are deficient in copper. Many NZ soils – especially sand, pumice and peat-based soils – are low in copper.

Soil copper needs to be at least 1.5 ppm (parts per million) to allow uptake by plants, with an ideal level being 3.5 ppm. High soil alkalinity (pH greater than 7) and the application of high rates of lime will reduce copper availability to plants and hence to grazing stock.

The copper content of palm kernel extract (PKE) is highly variable, and is not a reliable source of copper. It is important to discuss the use of supplements like PKE when reviewing your deer health plan with your vet.

Secondary deficiency

Secondary copper deficiency occurs when other factors in the diet – known as antagonists – reduce the ability of an animal to absorb copper.

A high level of the element molybdenum in the soil and pasture is the most common example of an antagonist. In combination with a form of sulphur, the molybdenum ties up copper in the feed, reducing its availability to the animal. Sandy and pumice soils are often high in molybdenum.

Copper levels in new-born fawns

Copper is transported across the placenta, particularly in the last two months of pregnancy. Hinds with high liver

copper will give birth to fawns with a high copper store. Indeed, copper levels in the liver of the foetus are much greater than that of the hind.

Supplementation of hinds in mid-to late pregnancy (late spring, in advance of set stocking) is the most cost-effective way to prevent deficiency in young fawns.

Testing as a basis for decision-making

If deer show clinical signs of copper deficiency on a farm, the decision to include copper supplementation in the overall animal health plan is easy. Preventing the loss of only a few animals is economic whether it be adults with swayback or young deer with broken limbs.

At the other extreme, testing enables copper to be eliminated as a possible factor in poor performance if levels are shown to be adequate. This will save on supplementation costs. Also unnecessary copper supplementation of deer with adequate copper levels has been shown to cause liver damage.

Decision-making where copper is marginal

On farms where there are no obvious signs of deficiency it is important to test copper levels before deciding whether active copper management is needed and the form it should take.

If test results show the copper status of some of the herd at certain times of the year is deficient or marginal, decisions on supplementation may need to be made on grounds of insurance.



Legumes such as red clover (pictured) and herbs such as chicory are not only excellent summer/autumn feeds for fast-growing fawns and weaners. They also contain up to three times as much copper as conventional ryegrass/white clover pasture



In these situations copper supplementation will raise the copper status of the herd and remove the animals in the 'at risk' category. Although there is no hard data confirming that this will result in increased production, it is important to think of all the roles copper plays within the body, particularly in immune function. For example, having adequate copper levels will help ensure good immune responses to vaccinations and disease challenge.

There will also be cases where animals with low copper levels are not doing well. If all other likely causes have been eliminated, copper supplementation may well be deemed to be a sensible precaution.

TESTING TIMES

The liver acts as a store of copper, buffering minor fluctuations in dietary copper levels. It releases sufficient copper into the bloodstream to maintain health and function until its stores are depleted.

Liver samples give the best indication of an animal's copper status and can be taken either by biopsy or from a sample taken at the DSP (called an Optigrow profile).

Due to the strong effect of the season on levels of copper in the liver and blood the timing of sampling is important for the interpretation of results. In practice, of course, sampling has to fit in to an individual farm's management, which means compromises in timing may sometimes be needed.

Autumn

Hinds: A good starting point when assessing the copper status of a farm is to take liver samples from 5-8 mixed-age hinds immediately before mating. At this time liver copper stores should be at their seasonal high.

If copper levels prove to be marginal or deficient, then further investigation is needed. Discuss a supplementation plan with your vet.

Weaners: Your vet will take blood samples from 8-10 young deer at weaning if this can be done without causing undue stress.

Spring

Because copper levels fall over winter, adequate copper levels in autumn are no guarantee they will be sustained until spring.

Your vet may advise sampling the liver and/or blood again in July-September when levels will be at their lowest.

Guideline copper levels

	Units	Deficient	Marginal	Adequate
Serum copper	µmol/L	<5	5-8	>8
Liver copper	µmol/kg	<60	60-100	>100

What form of supplement?

Copper supplements can be either indirect or direct.

Indirect methods involve adding copper sulphate to fertiliser or drinking water.

These methods aren't always effective. They are unsuitable for farms where antagonist levels are high. Trough treatment in winter and spring – when supplementation is most needed – tends to be ineffective because of low seasonal water intakes.

Direct copper supplements (injection, bullets or boluses) allow all animals to reliably be given the same amount of copper. They also bypass the negative effect of antagonists (like molybdenum) in the rumen and gut. They also avoid the variability of supplementation from trough water.

With copper bullets, care needs to be taken when dosing, because of the risk of soft tissue damage to the throat. This can cause infection and abscesses, which can result in pneumonia and systemic infections.

Copper bullets

Copper wire particles in a slow release capsule:

- Slowly absorbed, reduced risk of toxicity
- Care needs to be taken when dosing
- High labour input
- Risk of spitting out
- Elevates liver copper for 6-9 months.

Copper injections

Two main forms: Copper Ca EDTA and aqueous solution (water-based):

- Certain direct delivery to each animal
- Risk of toxicity in animals with adequate copper levels
- May cause a reaction, including raised body temperature
- Some formulations can't be used immediately before and during mating.

Mineralised anthelmintic (drench)

- Very low dose, and short-acting
- Not an adequate supplement on its own.

Copper in fertiliser

Copper sulphate:

- Easy
- Variable uptake into plants
- Competing trace elements can limit absorption.



Copper bulleting hinds

Copper bullets allow all animals to reliably be given the same amount of copper. But they are expensive, labour intensive and some deer spit them out

Seek advice

Copper has been a topical issue since the earliest days of deer farming. On some farms copper supplementation is part of the annual routine.

Because there are significant costs involved in giving supplements (and potentially the cost of lost production from not giving supplements when they are needed), it pays to seek advice about the copper policy that's best for your farm.

Discuss copper with your vet when you review your animal health plan.