



FACTSHEET

TRACE ELEMENT NUTRITION OF SHEEP

The four important trace elements to consider in New Zealand flocks are selenium (Se), copper (Cu), iodine (I), and cobalt (Co).

Assessing the trace element status of a flock should be part of your animal health programme (check out the “Sheep and Beef Cattle Health Review workbook” linked at the end of this fact sheet for more information on animal health planning).

A trace element deficiency will impact on ewe (and ram) fertility, as well as the health and growth of lambs.

Trace element research in New Zealand has provided some of the best data in the world on the diagnosis and prevention of deficiencies.

In some situations, a trace element deficiency may be subclinical or marginal and, therefore, can only be detected by collecting the appropriate blood and liver samples for trace element and/or enzyme determinations.

As most trace element deficiencies occur in lambs, prevention is the best approach. To prevent white muscle disease (Se), swayback (Cu) and goitre (I), treat the ewe in early gestation with Se, Cu and I. Preventing Co deficiency is the exception – lambs are best treated with vitamin B12 at docking.

TRACE ELEMENT – SELENIUM

SELENIUM DEFICIENCY

About 30 percent of the pastures in New Zealand will not provide an adequate selenium intake for grazing livestock.

Function of selenium

The main role of Se is as an antioxidant to protect the integrity of the cell membranes. It also maintains the integrity of the immune system.

Clinical signs of selenium deficiency

- Poor lamb growth rates
- Infertility in ewes as a result of embryonic mortality which occurs three to four weeks after conception. This results in a higher percent of barren ewes and a low lambing percentage
- Poorer motility and increased morphological defects in ram sperm
- White muscle disease in lambs, characterised by a non-inflammatory degeneration or necrosis of the skeletal and cardiac muscles. Lambs are born dead or die suddenly within few days of birth. Some deaths occur three to six weeks after birth (delayed white muscle disease).

Selenium deficiency diagnosis

Sheep grazing pastures with <0.03 mg/kg DM are at risk of becoming selenium deficient. Testing of animals is necessary to confirm the need for Se supplementation.

Blood or liver selenium concentrations from five to eight samples per flock, and the levels compared to selenium tissue reference ranges which have been determined from selenium supplementation animal performance trials. Ewes should be sampled four to five weeks before mating, and lambs prior to weaning.

Serum concentrations of <50, 50-100, >100 nmol/L reflect deficient, marginal and adequate selenium status, respectively. Some vets use blood glutathione peroxidase activity, and the respective values for deficiency and adequacy are <1.0 and >3.0 kU/L @25 degrees C.

Liver selenium concentrations of <250, 250-450 and >450 nmol/kg fresh tissue reflect deficient, marginal and adequate Se status, respectively.

PREVENTING SELENIUM DEFICIENCY

Warning: Use only one of the following approaches to prevent selenium deficiency, otherwise selenium toxicity could become a serious problem.

Inject ewes and rams subcutaneously in the neck region with a long-acting product containing barium selenate four weeks before mating. The dose is 1mg Se/kg LW (i.e. 60 mg Se for a 60 kg ewe or 90 mg for 90 kg ram), with the volume given depending on the product used. In ewes this will increase their selenium status during gestation and lactation, thereby increasing the selenium status of their lambs at birth. This increase will protect the lamb from selenium deficiency (especially white muscle disease) until at least weaning. If ewes have not been treated and their lambs are selenium deficient, then the lambs can be treated at around 3-4 weeks of age (around docking time). The dose is again 1mg Se/kg LW (i.e. 12 mg for a 12 kg lamb); this dose will prevent selenium deficiency for at least 10 months.

Oral dosing of 5mg of selenium (0.1mg Se/kg LW) as sodium selenate to ewes and rams at four weeks before mating, the ewes again at four weeks before lambing, and a further 2mg Se to their lambs at docking. Lambs will require further drenching at six to eight week intervals to maintain selenium status.

Topdress in the autumn with 0.5 or 1kg of selenium prills to provide 10g Se/ha annually. The ewes (and rams) must graze a selenium-treated pasture for a minimum of eight weeks; namely four weeks pre-mating and the following four weeks during mating. Their lambs are likely to need a further 2mg selenium at docking. Preferably, ewes should be grazed on selenium-treated pasture for at least 16 weeks. From a management point of view, after applying the selenium-amended fertiliser, the pastures must not be grazed for at least four weeks, to allow the Se to be 'washed' into the soil and taken up by the pasture.

Dose ewes with one 10g Se bolus (iron) pellet, four weeks before mating.

SELENIUM TREATMENT DECISION TREE

1 Test

📅 February

- Blood test or liver biopsy ewes

2 Results

	LOW	MARGINAL	ADEQUATE
Serum (nmol/l)	<50	50 - 100	>100
Liver (nmol/kg)	<250	250 - 450	>450
Glutathione peroxidase (kU/L @25)	<1.0	1.0 - 3.0	>3.0

3 Treatment if low or marginal

Options

- Inject ewes and rams or
- Dose ewes with Se/Fe (iron) pellet or
- Topdress with Se prills or
- Oral dose ewes and rams
 - 📅 1st dose February
 - 📅 2nd dose 4 weeks pre-lamb
 - 📅 3rd dose tailing/docking
 - 📅 Then every 6-8 weeks until February

TRACE ELEMENT - IODINE

IODINE DEFICIENCY

In New Zealand iodine deficiency is usually associated with feeding pregnant ewes on brassica crops. More rarely iodine deficiency can be observed in sheep grazing only on pasture.

Function of iodine

- Constituent of the thyroid hormones
- Thyroid hormones control basal metabolism and heat production, cell differential and the growth of tissues such as brain, central nervous system and lungs
- Important for foetal development

Clinical signs of iodine deficiency

- Enlarged thyroid (goitre) in lambs
- Increased perinatal mortality, particularly in cold weather because iodine deficient lambs have less control over body temperature
- Low birth weights and hairless lambs
- Decreased fecundity

Iodine deficiency diagnosis

The presence of goitre in lambs. Measure the ratio of thyroid weight to liveweight in 10 or more lambs. Any lambs with a ratio >0.8 g/kg confirms iodine deficiency. Most lambs <0.4 g/kg suggests iodine deficiency not a problem.

For prevention measure serum inorganic iodine (SII) concentrations in 5 - 10 ewes. SII concentrations $>20\mu\text{g/L}$ are associated with healthy lambs.

Care needs to be taken when interpreting results from ewes treated with iodised oil products.

Sheep grazing pastures with iodine concentrations of <0.5 mg/kg DM are at risk of becoming iodine deficient. However if goitrogens are present then iodine requirements can be much higher (>1 mg/kg DM). Goitrogens include thiocyanates in brassicas and cyanogenetic glucosides in white clover. For this reason it is not possible to recommend a dietary iodine requirement with any confidence.

PREVENTING IODINE DEFICIENCY

Untreated pregnant ewes fed brassicas are at a very high risk of giving birth to lambs with goitre.

Inject ewes intramuscularly, in the anterior neck region, with 1.5 ml iodised oil to provide 390mg iodine four weeks before mating.

Drench ewes with 200mg iodine as potassium iodide or iodate at eight and four weeks before lambing.

IODINE TREATMENT DECISION TREE

1 Test



At lambing

- Conduct post-mortems on 10-20 dead newly born lambs for thyroid removal and weighing

2 Results

	IODINE LOW	IODINE ADEQUATE
Ratio g/kgLW	Any lamb >0.8 or most >0.4	Most lambs <0.4

- Thyroid: Body weight ratio (g/kgLW) of 10-20 autopsied lambs
- Example: 5 gram thyroid, 6 kg lamb = Ratio of 0.83
- Aim for most lambs below 0.4

3 Treatment if low



Inject ewes 4 weeks before mating

- Intramuscularly 1.5ml iodised oil (390mg iodine)

or



Drench ewes 8 weeks and 4 weeks before lambing

- Each drench 200mg Iodine (potassium iodide or iodate)

TRACE ELEMENT – COPPER

COPPER DEFICIENCY

In New Zealand copper deficiency is usually associated with increased pasture molybdenum (Mo) concentrations. The metabolism of copper is complex as the Mo influences copper absorption and liver copper storage, thereby increasing dietary copper requirements. Other trace elements such as iron (Fe) and zinc (Zn) have also been observed to influence copper metabolism. Cattle and deer are more prone to copper deficiency than sheep.

Functions of copper

- Development of the nervous system and maintenance of myelin sheath around nerve fibres
- Bone growth and development
- Maintains the integrity of the immune system
- Role in iron metabolism
- Development of the fleece and skin pigmentation

Clinical signs of copper deficiency

The lamb is the most sensitive to Cu deficiency.

- Nerve disorder termed swayback or enzootic ataxia
- Bone disorder described as osteoporosis
- Poorer growth might occur when pasture Mo >3mg/kg DM

Copper deficiency diagnosis

Biochemical criteria associated with the presence of clinical signs such as swayback.

Liver is the tissue of choice for determining the need for supplementation as it reflects body copper stores. Collect five to eight liver samples using a biopsy technique from ewes in the early autumn. Livers can also be collected from the meat processing plants when cull ewes and lambs are slaughtered, but biopsies allow samples to be collected from the groups of interest at the appropriate time. There is a seasonal decline in liver copper concentrations, with the lowest value being observed in late winter/early spring. Sheep with a barely adequate copper status in the autumn may be supplemented with copper.

Serum copper concentrations of <4.5, 4.5-8 and >8 umol/L reflect a deficient, marginal and adequate copper status, respectively.

Liver copper concentrations <65, 65-100 and >100 umol/kg fresh tissue reflect a deficient, marginal and adequate copper status, respectively.

Pasture with copper concentrations <4mg Cu/kg DM are associated with a simple copper deficiency, while pastures with 5-6mg Cu/kg DM, in the presence of low Mo (<1 mg/kg DM) are adequate. Increasing Mo to >3 mg/kg DM at pasture copper concentration of 5-6 mg/kg DM will not maintain an adequate copper status in sheep. The pasture analyses must include Mo as well as copper.

COPPER DEFICIENCY PREVENTION

Sheep are very susceptible to copper toxicity, so should not be supplemented unless copper deficiency has been proven. Check dose rates and instructions for each product. Never use multiple methods of copper supplementation in sheep.

Dose ewes with 5g CuO (Copper oxide) needles (bolus) early in gestation. This will increase the copper status of the ewe, the foetus and her lamb from birth to at least nine to 10 weeks of age. The copper concentration of ewe's milk is not greatly changed.

Inject ewes with copper (0.5-1.0mg/kg LW; 25-50mg Cu) during early to mid- gestation. The copper status of the foetus and lamb will be increased.

Topdress pasture annually with 5kg copper sulphate (1.25kg Cu/ha) in the autumn. From a management point of view, pasture must not be grazed for at least four weeks to allow the copper to be 'washed' into the soil and taken up by the pasture.

Drenching with copper is **not recommended** as it is only effective for a short period of two to three weeks.

COPPER TREATMENT DECISION TREE

This decision tree is to aid management of copper deficiency. It should be used in conjunction with the technical notes on Trace element nutrition of sheep – Copper

1 Test

- 📅 Sample ewes in February/March
 - Blood test or liver biopsy

2 Results

	LOW	MARGINAL	ADEQUATE
Blood (nmol/l)	<4.5	4.5 - 8.0	8.0
Liver (nmol/kg)	<65	65 - 100	>100

3 Treatment if low or marginal

- Topdress pasture
 - or
- 📅 Dose with bolus in May
 - or
- 📅 Inject in May



TRACE ELEMENT – COBALT

COBALT DEFICIENCY

About 13% of pastures in New Zealand will not provide an adequate cobalt intake for lambs which are the most sensitive to cobalt deficiency.

Function of cobalt

- Cobalt is essential for the synthesis of vitamin B12 by rumen micro-organisms
- Vitamin B12 is important for energy and protein metabolism
- Maintains the integrity of the immune system

Clinical signs of cobalt deficiency

- Poor growth rates
- Loss of appetite
- Watery eye discharge
- Increased lamb death rates at lambing time

Cobalt deficiency diagnosis

Vitamin B12 concentrations from 10 blood (serum) or five liver samples per group of lambs, and the vitamin B12 tissue reference ranges determined from Co/vitamin B12 supplementation lamb growth trials.

Serum vitamin B12 concentrations of <250, 250-450 and >450 pmol/L reflect deficient, marginal and adequate cobalt status, respectively.

Liver vitamin B12 concentrations of <200, 200-375 and >375 nmol/kg fresh tissue reflect deficient, marginal and adequate cobalt status, respectively.

Sheep grazing pasture with cobalt concentrations <0.1 mg/kg DM may become cobalt deficient. Note that soil contamination can increase “pasture” cobalt concentrations and, therefore, tissue vitamin B12 concentrations give a more reliable assessment of lamb vitamin B12 status.

Cobalt deficiency prevention

Treat with 3mg of microencapsulated vitamin B12 as a long-acting injection given subcutaneously in the neck region once at docking or weaning. Preference should be given to injecting at docking, because lambs should be treated as early as possible. Treating the ewes (12mg vitamin B12) during gestation only gives a limited period of three to four weeks protection to their lambs.

Inject with 2mg of water soluble vitamin B12 subcutaneously every four to six weeks from docking to weaning.

Dose with one 10g cobalt pellet at weaning.




Topdress with 350g/ha cobalt sulphate (70g Co/ha) annually in the spring. This approach is unsatisfactory on some soils because high manganese (Mn) levels can interfere with Co uptake by plants. From a management point of view, pasture must not be grazed for at least four weeks to allow the Co to be ‘washed’ into the soil and taken up by the pasture.



COBALT TREATMENT DECISION TREE

This decision tree is to aid management of cobalt deficiency. It should be used in conjunction with the technical notes on Trace element nutrition of sheep – Cobalt.

1 Test

-  Pasture sample in November
-  Sample lambs in November - blood test or liver biopsy
-  Sample lambs at slaughter later in summer/autumn (Optigrow)

2 Results

- Pasture

	LOW	MARGINAL	ADEQUATE
(ppm)	<0.1	0.1 - 0.15	>0.15


- Blood test or liver biopsy - lambs

	LOW	MARGINAL	ADEQUATE
Serum B12 (blood) (p mol/l)	<250	250 - 450	>450
Liver B12 (nmol/kg)	<200	200 - 375	>375

3 Treatment if low

- Treat lambs or pasture or soil
- Sample lambs at slaughter (Optigrow)
- Repeat treatment and testing if still low

3 Treatment if marginal

-  Pasture sample 2-3 paddocks in December
- Sample lambs at slaughter (Optigrow)
- If still marginal or low, treat lambs or pasture or soil
- Repeat treatment and testing if required

ACKNOWLEDGEMENTS

Further reading: Grace N, Knowles S, Sykes A - Managing Mineral Deficiencies in Grazing Livestock, NZ Society of Animal Production, Hamilton.

B+LNZ RESOURCES

www.knowledgehub.co.nz

- Resource book - [Sheep & Beef Cattle Health Review workbook](#)

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