Trace Element Deficiencies in Heifers

This Infosheet covers

- The trace elements (minerals) most likely to be deficient in New Zealand heifers i.e. selenium and copper, and those which may sometimes be deficient, cobalt and iodine.
- The signs of, and testing for, deficiency.

Key points

- Subclinical deficiencies in heifers still occur despite the widespread use of trace element supplements.
- Copper uptake is particularly affected by competition with other elements. Liver samples give the best indication of copper levels.
- About 30 % of farmed land in New Zealand is considered selenium-deficient. Whole blood selenium levels will indicate the selenium status of youngstock.
- No recent published information is available on any benefits of vitamin B12 supplementation. Liver vitamin B12 concentration should be used if testing is required.
- Most cases of iodine deficiency are seen in animals that have grazed winter forage brassica crops for prolonged periods.

Why are trace elements important?

Trace element deficiencies are common in New Zealand heifers because their major, or sole, feed source is pasture, and the forage reflects soil composition. Although severe forms of deficiencies have become less common, subclinical deficiencies still occur despite the widespread use of trace element supplements.

Selenium and copper are the trace elements in which New Zealand heifers are most likely to be deficient, although in certain situations they may have insufficient cobalt and iodine. Manganese, zinc, chromium, molybdenum and iron deficiencies are rare and so are not covered in this infosheet.

In heifers, the efficiency of trace element uptake from pasture changes as the rumen develops. It is also affected by pasture species, soil type and competition with other elements in the diet.

Farmer Viewpoint

With the soil type at our contract grazier’s property, we know that our heifers need long acting selenium to address deficiencies.

Dairy farmer, 850 cows, Leeston, Canterbury
Trace element testing

Reasons for testing trace element levels include:

1. Animals are performing poorly.
2. To determine if animals are likely to suffer from a mineral deficiency in the future (test prior to spring).
3. Animals are going into a situation or property where deficiency might occur (test prior to spring).
4. To assess adequacy of supplement programme.

Many farmers buy expensive products and treat animals without justification, or purposefully over-supplement without diagnosis; others try to assess trace element levels from soil, plant and ration analysis, rather than the animal, resulting in unidentified deficiencies. Monitoring helps to determine the most cost-effective supplement, and the required administration frequency.

The reason for testing will determine the timing of testing. For example:

- Poor animal performance - test at the time of the problem.
- Assessing effectiveness of supplementation - test at the halfway point between treatments.

The aim of testing and developing and applying a trace element plan is to set up a robust strategy so that all stock have sufficient trace elements for their health and production throughout the year. Once a plan is actioned, testing will gradually become less frequent and will only need to become more frequent again if a problem arises.

Animals selected for testing should be:

- representative of the group,
- randomly selected e.g. every nth heifer running through the race,
- representative ages, and
- representative breeds.

A group’s test results are compared with reference values to identify if stock require supplementation, e.g. increase growth rate, resist or recover from a disease, or improve their fertility.

The results should be interpreted alongside the history of the farm, e.g. fertilisers, renovation, animal species on farm, supplementation history and soil type.
An example process for trace element testing is given in Figure 1.

**Figure 1.** Decision tree diagram for supplementation of copper and selenium

Test copper and selenium status of weaner heifers in early summer.

Supplement required?

Yes

Re-test same weaner heifers to check supplement has worked. Timing will depend on the supplement used.

Supplement worked?

No

Supplement required?

Yes

Re-test same heifers 1-2 months pre-mating to check selenium and copper levels.

No

Supplement required?

Yes

Change supplement plan and re-test to check it has worked.

No

Continue supplement plan.

Test weaner heifers next season to check yearly variation.

Once supplement plan works, re-test if heifer performance drops or supplement/feed/fertiliser inputs change.
**Copper (Cu)**

Growing animals can become low in copper because:

1. The copper content of the pasture is low.
2. Molybdenum, sulphur, iron and zinc in the diet have tied up or bound the copper, making it unavailable for absorption (see Figure 2).

**Figure 2.** Factors affecting uptake of molybdenum, sulphur, iron and zinc.

<table>
<thead>
<tr>
<th>Molybdenum</th>
<th>Sulphur</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molybdenum increases during winter and spring. More of a problem in heavier, less free draining soil groups. Molybdenum forms a three way interaction with sulphur and copper to limit the absorption of copper from the small intestine.</td>
<td>Dietary sulphur changes vary little during seasons. Sulphur in combination with molybdenum can form a three way interaction with copper to limit the absorption of copper from the small intestine.</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Iron</th>
<th>Zinc</th>
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<tr>
<td>High iron intake is usually the result of a high intake of soil. This happens with short muddy pastures, silage with lots of soil, high water table, grazing soil with high iron levels. Iron will reduce the update of copper by the hepatic cells.</td>
<td>Zinc is a potent antagonist of copper absorption, but there needs to be 20 times more zinc than is recommended for nutritional purposes for this to happen. This level of dosing happens during facial eczema seasons.</td>
</tr>
</tbody>
</table>

**Signs of deficiency**

- poor weight gain,
- poor mating results,
- lighter coat colour,
- broken bones, and
- scouring.
**Testing**

**Sampling options**

- Preferably, 5 liver samples, or
- 10 blood samples.

Copper is stored in the liver, so blood copper levels will only decrease once this stored copper is depleted. Blood testing will indicate a copper deficiency on the day of testing but adequate blood test levels do not mean copper levels will be sufficient in the future. If all the blood sample results are low, then most likely the liver stores are low. However, if blood levels are normal, liver stores could be close to being depleted, or alternatively, there may be close to toxic levels of copper. In both these scenarios the blood copper level will be the same.

Liver samples give the best indication of the copper storage status of youngstock.

Even though the initial outlay is higher, resampling the same un-supplemented animals over two seasons is recommended. It will give the best indication of what is happening to animals over time and whether they need supplementing. The liver copper levels of R2 heifers will give a good indication of the R1 heifer levels if they are grazing on the same block.

If liver copper levels are lower than expected, or lower than required in the autumn to adequately supply animals with copper throughout the winter and spring, consider taking a pasture sample to find out why, e.g. copper may be low or molybdenum/sulphur high in the pasture.

**Selenium (Se)**

The selenium intake of grazing animals is largely determined by the selenium content of the soils growing or grew the forage being fed. About 30 % of farmed land in New Zealand is considered selenium-deficient. The most deficient soils are in the central volcanic plateau of the North Island, followed by peat soils in the Waikato. Much of the South Island is marginally deficient.

Animal selenium levels tend to be lowest during rapid pasture growth i.e. spring. This is most important as the mating season approaches.

Several selenium-responsive conditions occur in New Zealand.

**Signs of deficiency**

- poor weight gain, and
- poor mating results.

**Testing**

**Sampling options**

- 3-10 blood samples.
- More if checking a supplementation programme, less if are checking for poor performance or farm deficiencies.

Whole blood selenium levels will indicate the selenium status of youngstock.

Blood selenium levels can vary between farms and seasons. The recommended mean selenium concentration in autumn is >350 nmol/l; however, the fertiliser protocol will affect this. Your veterinarian can help determine the level which is right for your situation.
Cobalt (Co)

Rumen microbes incorporate cobalt when making vitamin B12, which is released when the microbes are digested in the abomasum.

Historically, some regions were associated with “bush sickness” in ruminants. This illness was subsequently identified as being due to low soil cobalt levels, and was remedied by cobalt or vitamin B12 supplementation. Despite many anecdotal reports of positive responses to vitamin B12 supplementation in cattle, there are no recent published New Zealand trials that demonstrate any beneficial response.

In general, cobalt levels are lower in spring and summer, and higher in autumn and winter.

The soil-plant-animal cobalt relationship is moderately strong. This means that the soil cobalt content will give an indication of the cobalt content of the pasture and the animals grazing that pasture.

Signs of deficiency

- Ill-thrift (rare in NZ).

Testing

Sampling options

- Preferably, 3 liver samples, or
- 10 serum samples.

Serum samples can be used to test vitamin B12 levels but the reliability of the test results and interpretation is questionable. Liver vitamin B12 is a more reliable indicator and should always be used if testing is required.

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Iodine (I)

Iodine is needed for the manufacture of thyroid hormones, which regulate energy metabolism. Demand for these hormones (and thus iodine) increases in cold weather, when heifer energy demands increase. Soil ingestion is an important iodine source for grazing stock, e.g. when grazing conditions are muddy or dusty. Iodine deficiency can be caused by:

- low feed iodine levels, or
- the presence of goitrogens in the diet which cause a reduction in iodine uptake.

Brassicas contain goitrogenic compounds, substances that interfere with the action of thyroid hormones. Most cases of iodine deficiency occur in animals that have grazed winter forage brassica crops for prolonged periods.

Signs of deficiency

- Goitre (a swelling in the neck due to the enlargement of the thyroid gland).
- Calf still births.

Testing

Serum and urine iodine levels are good indicators of iodine deficiency but testing these is expensive. Measuring the thyroid weight of dead calves, together with histology carried out by a laboratory, is probably the most reliable method for diagnosis. However, the information available is scarce and sourced from international literature.

Supplementation

The results of research to test if iodine supplementation is beneficial are inconclusive. Care is needed when supplementing iodine as it is cumulative, and can be a chronic poison at high levels. However, anecdotally many veterinarians believe that supplementation it is beneficial. Figure 3 indicates a method which can be used to decide if supplementation is warranted.

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**Figure 3.** Iodine supplementation decision process.

- Brassicas fed?
  - **Yes**: Supplement while being fed
  - **No**: Goitre diagnosed previously?
    - **Yes**: Supplement cows in last trimester
    - **No**: Still births > 6%?
      - **Yes**: Test dead calves for deficiency (weigh goitre)
      - **No**: Vague calving problems - still borns, RFMs, longer gestations?
        - **Yes**: Test calves, trial injecting half the herd and record differences
        - **No**: Don’t supplement

**More information**

- For more, see Heifer Infosheet: Heifer Trace Element Supplementation Options