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What do the elements do?

Copper (Cu)

In plants:

- Copper in plants is important for:
  - chlorophyll production;
  - seed development;
  - increased sugar content in fruits and vegetables;
  - contributes to produce colour and flavour, plus storage and shipping qualities.
- Along with potassium and magnesium, assists with stalk strength.
- Assists with nitrogen metabolism.
- Nitrogen overuse leads to copper deficiency shown by:
  - stunted growth
  - wilting
  - death of leaf tips.
- Excess phosphorous also ties up copper.
- Cu is an expensive element, but builds well in the soil.

In animals:

- Associated with biochemical processes of proteins, so is important for milk and wool production, bone development and for reproduction.
- Lack of copper can cause a reduction in wool strength. The wool loses its crimp and takes on a 'steely' appearance.
- Black sheep need copper to create black (not grey) wool.
- Where there is adequate calcium and phosphate but a lack of copper, the process of laying calcium in the bone structure can be interrupted leading to softened bone and possible bone fractures.
- Copper and manganese deficiencies can lead to sterility.
- Adequate dietary copper can help animals build resistance to intestinal parasitic worms; copper will loosen their attachment to the intestine walls causing them to be expelled from the body.
- Plays a major role in liver function, synthesis of haemoglobin and in the body's defence against microbes. It also prevents the degeneration of the spinal cord.

Magnesium (Mg)

In plants:

- Is the central atom of chlorophyll; makes plants green.
- Essential to a plants' very existence due to its major role in photosynthesis.
- Enhances enzyme activity and facilitates biochemical reactions.
- Together with calcium, forms the glue that holds cell walls together.
- Pulls soil particles together. Excess Mg will make soil sticky when wet and hard when dry.
- Aids in metabolism of phosphorus (P).

  Yellowing pastures are not always caused by a lack of nitrogen, but may be due to not enough or too much magnesium in the soil affecting chlorophyll and interrupting photosynthesis. Magnesium acts as a coenzyme for nitrogen regulation, so a magnesium deficiency will interrupt the transfer of N into the plant and more nitrogen will be required.

In animals:

- Although Mg only makes up 0.05% of the animal body, it is an essential component of catalysts which enable biochemical reactions such as the metabolism of calcium and phosphorus.
- Shortage of Mg can lead to protein deficiencies affecting growth, the immune system and reproduction.
- Essential for bones and teeth, in the nervous system and as buffers to maintain the correct body pH.
- Inadequate digestion of Mg from the digestive system is the cause of grass staggers, nervousness, restlessness and loss of appetite.

Boron (B)

In plants:

- Increases nitrogen availability to plants.
- Assists with cell division, plant pollination, fruit set and seed development:
  - carries the starch from leaf to the grain or fruit.
- Assists nodulation (for nitrogen fixation) in legumes, e.g. clover and lucerne.
- Crops require a continuous supply of boron – several applications through the season are ideal.
- Essential for lucerne crops.

In animals:

- In young animals boron deficiency can cause the blood supply to the growth plate of the bone to be interrupted, leading to localised bone cell death.

Iron (Fe)

In plants:

- Essential in the synthesis of chlorophyll so Fe is necessary for photosynthesis.
- Required for nitrogen fixation.

Lack of iron will show up via yellowing of leaves and stunted plant growth with leaf tip die-back. When yellow leaves are cut off the new ones grown will be yellow.

Excess iron isn't a problem in terms of production. However, iron level should always be greater than the level of manganese in the soil.

In animals:

- An important part of the haemoglobin molecule – prevents anaemia.

Calcium (Ca)

In plants:

- Cell division/elongation, i.e. growth.
- Increases disease and parasite resistance.
- Moves other nutrients into the plant root.
- When calcium levels are corrected, three times more phosphorus is moved into the plant.
- Ensures efficient use of nitrogen thereby increasing the protein in the plant.
- Regulation of acids and bases in the cell, and potassium and sodium in cell membranes.
- In the soil, calcium will open up the soil and cause the clay particles to flocculate and create space; hence it's commonly referred to as a 'soil conditioner'.

In animals:

- Increased calcium and phosphate in the soil improves protein levels in feed, leading to increased bodyweights and better reproductive outputs.
- Required for all processes involving protein.
- Creates bone and wool strength.
- Bones act as a calcium reservoir for the body with Ca moving in and out of the bone as required, e.g. for milk production.
- Low calcium can lead to milk fever.
- Ca, P and H combined act as buffers maintaining the correct pH and protecting the body against sudden changes in acidity.

Sulphur (S)

In plants:

- Essential for protein, chlorophyll and seed production, and to fabricate enzymes and vitamins.
- Improves palatability (sweetness and taste), yield and keeping qualities.
- Important for early root development.
- Proteins in lucerne require (in order of importance) calcium, sulphur and phosphorous.
- Leaches easily, so repeated applications are required.
- If Ca, Mg, N, P and K are all present in the right amounts then will get a good response when correct S.

The major source of S is humus or organic matter so the more organic matter present, the less dependent you'll be on sulphur applications. This is why it is so important not to burn out your organic matter by applying excess nitrogen!

In animals:

- The sulphur containing amino acids (methionine and cystine) are essential building blocks of protein.
- Required for cell division and growth, the immune system and reproduction.
- The sulphate forms of many elements are more effective at preventing animal and human health problems than the chloride or nitrate forms.

Manganese (Mn)

In plants:

- Accelerates germination, fruiting and ripening of crops.
- Has major roles in chlorophyll synthesis, enzyme system construction and operation, and in photosynthesis.
- Vital for seed quality, yield and vitality.
- Along with potassium and copper leads to greater stalk strength.
- Involved in uptake of iron, carotene, ascorbic acid and glutathione in plants.

  When a plant is under stress it produces more glutathione which, in turn, attracts insects who eat the plants to obtain the glutathione.

  As the soil pH increases, the availability of manganese decreases. The level of manganese in soil should always be less than the iron present.

  Optimal soil level of manganese is still being debated, but an excellent level is around 250kg/ha. Research in Germany has shown levels as high as 500kg/ha can lead to very high yielding crops; but only when your base saturation levels of Ca, Mg, K and Na are balanced.

In animals:

- Lack of manganese can cause bone distortion disease, e.g. calves born with crooked necks and legs.
- Is part of many enzyme systems so is necessary for growth, bone structure and reproduction.
- Mn deficiency can cause reproductive defects in cattle, often causing abortions.

Phosphorous (P)

In plants:

- The 'reluctant nutrient' as it gets attracted to Ca and becomes locked up.
- An energy provider vital for photosynthesis, cell division and growth, respiration and energy storage.
- An 'usher' of nutrients into the plant.
- Phosphorous will be suppressed by high zinc, and vice versa.

In animals:

- Component of catalysts which enable biochemical reactions of carbohydrate and proteins; so any P deficiency has serious implications.
- P (along with Ca and Mg) is important for 'hidden' processes within the body – in bones, teeth and the soft tissues.
- Phosphate can be mobilised from bone reserves when P is deficient in the diet and this can mask any deficiencies in animals. Problems with crop growth may be the earliest indicator of a P deficiency.
- Lack of P can cause fragile bones, decreased milk production and reduced egg production in poultry.
- Is a component of RNA and DNA, so is required for protein synthesis.
- Important for energy metabolism.
- Has a role in the absorption of fats and sugars from the intestine and in the release of glycogen from muscles.
- Phosphorous is a component of cell membranes.

Molybdenum (Mo)

In plants:

- Vital for nitrogen fixing bacteria in legumes.
- Below 2 kg/ha molybdenum will become a limiting factor.
- However, too much molybdenum can cause toxicity; we only recommend application levels below 4 kg/ha.

In animals:

- Aids digestion giving more rapid growth.
- Excess Mo binds Cu in the intestine and causes scouring disease.

Sodium (Na)

In plants:

- Can have a marked effect on pH.
- Regulates osmotic pressure (the water pressure) in cell tissues and fluids.
- If the level of sodium is higher than the level of potassium, it can be mistaken by the plant for potassium and be taken up, causing cell rupture and death when conditions are hot or humid.

In animals:

- Helps maintain osmotic pressure in body cells.
- Important in manufacture of bile to digest fats and carbohydrates.

Potassium (K)

In plants:

- Essential mineral for plants:
  - activates some enzymes involved with photosynthesis and protein synthesis;
  - is required in high quantities.
- Transport and storage of carbohydrates, getting reserves into plant roots, aiding winter hardiness, cell development, cell wall construction and cell wall strength.
- Improves stalk strength and crop bulk.
- Increases protein concentrations and other nutrients in forage.
- Key nutrient that improves water efficiency increasing crop quality and reducing disease.

  Potassium deficiency in plants will show up in the oldest leaves first; the leaf dies from the outside edge and proceeds towards the leaf centre.

In animals:

- Regulates water pressure, pH, and the nerve and muscle activity in the body. Needed for carbohydrate metabolism and for microbiological activity in the rumen.
- Lack of K causes loss of appetite, slow growth, poor hair and skin condition, decreased feed efficiency and cardiac impairment.

Cobalt (Co)

In plants:

- A well known deficiency in New Zealand soils.
- A constituent of vitamin B-12, essential for hemoglobin formation and preventing the degeneration of nerves.
- Cobalt and iron are essential for:
  - legume nodule formation and nitrogen fixation;
  - seeds planted without cobalt and iron will not grow into a viable plant.
- Cobalt is needed by microorganisms including Rhizobium, the nitrogen fixing bacteria associated with legume plants.

In animals:

- Lack of cobalt and copper can cause loss of appetite, emaciation, scaly skin, rough hair coat, listlessness and lack of thrift.

Selenium (Se)

In plants:

- Se is essential for livestock and humans, but is not necessary for plants.

In animals:

- Many New Zealand soils are Se deficient.
- Lack of Se and vitamin E causes white muscle disease with symptoms ranging from mild stiffness to sudden death; infertility in ewes; and ill-thrift in sheep and cattle.
- Yet excessive selenium can be extremely toxic in animals and humans – care must be taken with any form of selenium treatment.
- Topdressing with selenium-containing prills at a rate of as little as 10g Se/ha-1 can be a safe and effective way of overcoming selenium deficiency for a period of up to one year.

  Soil acidity results in decreased Se availability to crops. Brassicas and legumes contain higher Se than other crops.

Zinc (Zn)

In plants:

- A growth regulator.
- Increases water absorption.
- Regulates plant sugar usage. Helps convert simple carbohydrates to complex forms.
- An enzyme activator.
- Necessary for protein synthesis.
- Excess nitrogen, calcium and phosphorous can lead to zinc deficiency.
- Like copper, is held well in the soil once levels built-up.

In animals:

- Zn is essential in skin, hair and bone development.

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