

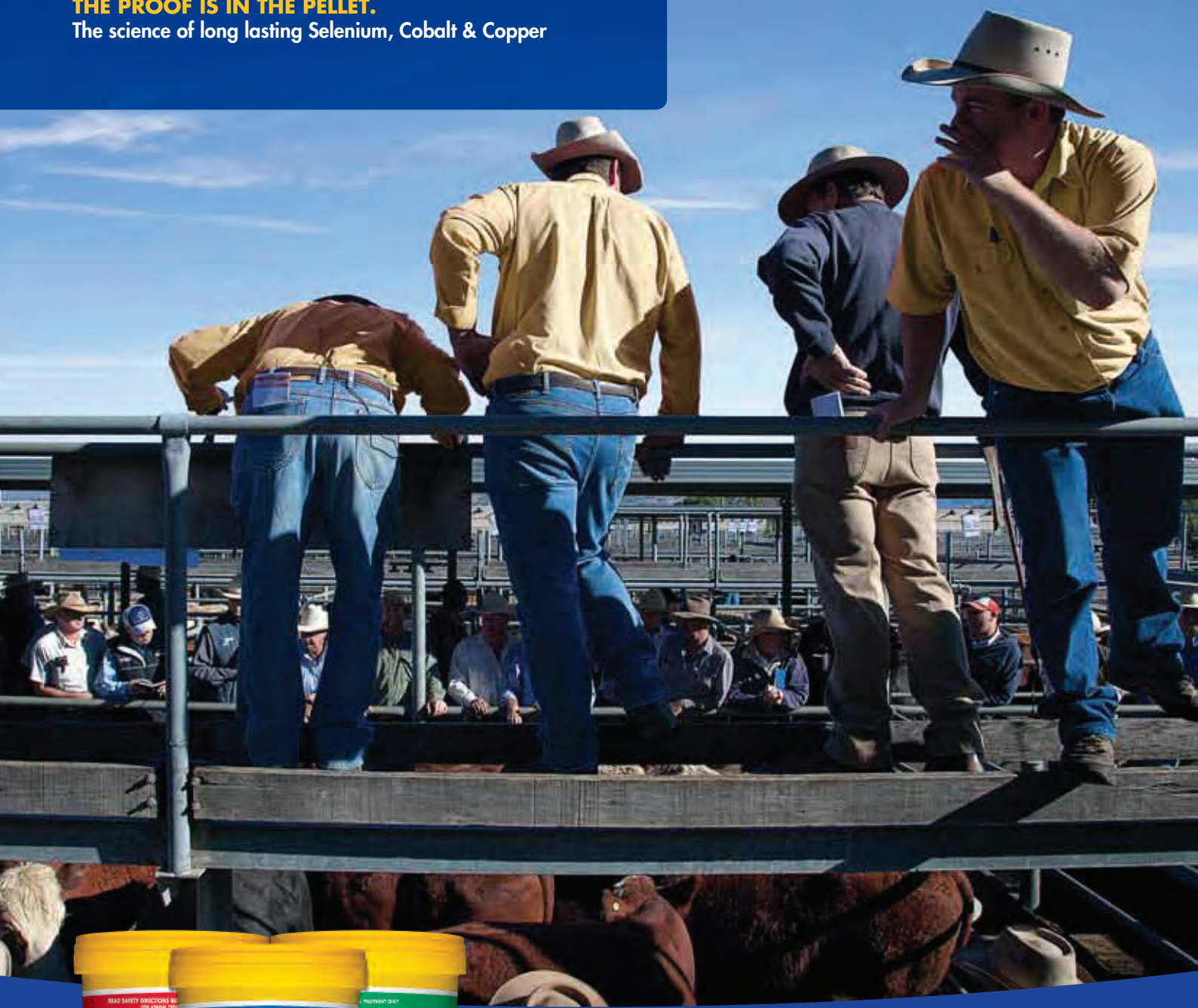
COOPERS®
PERMATRACE®

Cattle

TECHNICAL MANUAL

THE PROOF IS IN THE PELLET.

The science of long lasting Selenium, Cobalt & Copper

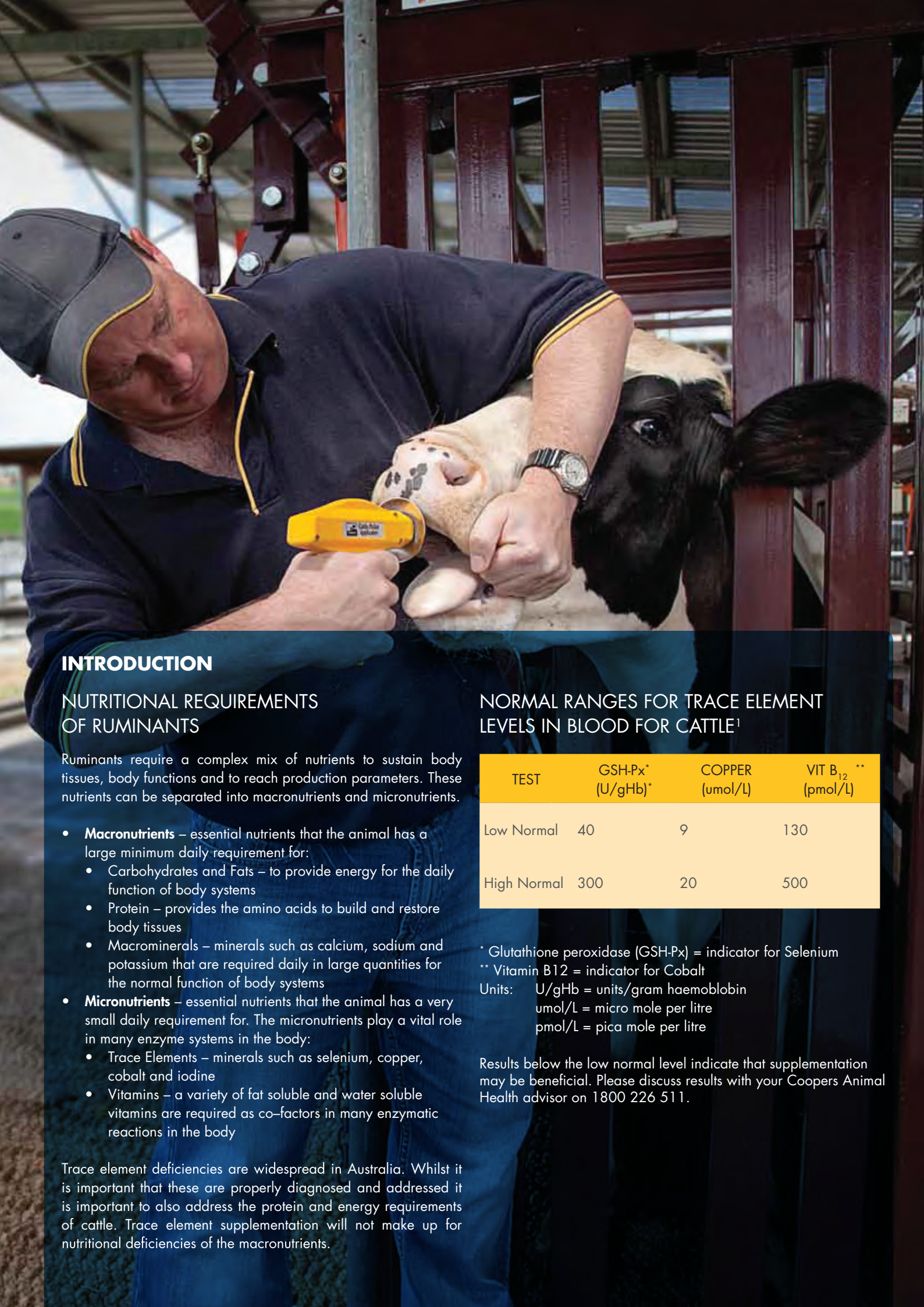




THE PROOF IS IN THE PELLET.

Selenium, Cobalt & Copper

Trace Elements	2
Selenium deficiency in cattle	3
Copper deficiency in cattle	6
Cobalt deficiency in cattle	8
Dosage and administration	10
References	13



INTRODUCTION

NUTRITIONAL REQUIREMENTS OF RUMINANTS

Ruminants require a complex mix of nutrients to sustain body tissues, body functions and to reach production parameters. These nutrients can be separated into macronutrients and micronutrients.

- **Macronutrients** – essential nutrients that the animal has a large minimum daily requirement for:
 - Carbohydrates and Fats – to provide energy for the daily function of body systems
 - Protein – provides the amino acids to build and restore body tissues
 - Macrominerals – minerals such as calcium, sodium and potassium that are required daily in large quantities for the normal function of body systems
- **Micronutrients** – essential nutrients that the animal has a very small daily requirement for. The micronutrients play a vital role in many enzyme systems in the body:
 - Trace Elements – minerals such as selenium, copper, cobalt and iodine
 - Vitamins – a variety of fat soluble and water soluble vitamins are required as co-factors in many enzymatic reactions in the body

Trace element deficiencies are widespread in Australia. Whilst it is important that these are properly diagnosed and addressed it is important to also address the protein and energy requirements of cattle. Trace element supplementation will not make up for nutritional deficiencies of the macronutrients.

NORMAL RANGES FOR TRACE ELEMENT LEVELS IN BLOOD FOR CATTLE¹

TEST	GSH-Px* (U/gHb)*	COPPER (umol/L)	VIT B ₁₂ ** (pmol/L)
Low Normal	40	9	130
High Normal	300	20	500

* Glutathione peroxidase (GSH-Px) = indicator for Selenium

** Vitamin B12 = indicator for Cobalt

Units: U/gHb = units/gram haemoglobin

umol/L = micro mole per litre

pmol/L = pica mole per litre

Results below the low normal level indicate that supplementation may be beneficial. Please discuss results with your Coopers Animal Health advisor on 1800 226 511.

TRACE ELEMENTS

WHAT ARE TRACE ELEMENTS?

- Minerals (sometimes called microminerals) that are required by the body in very small amounts
- Present in the soil and are taken up by plants and then absorbed by animals when feeding
- A large number of trace elements play an essential role in many body systems but the most important ones that Australian cattle producers face deficiency problems with are SELENIUM, COPPER and COBALT

WHY ARE TRACE ELEMENTS IMPORTANT?

- They are required within the body for the function and manufacture of many enzymes or enzyme co-factors as well as some vitamins
- These enzymes, enzyme co-factors and vitamins are vital to many body systems and that is why trace element deficiency in cattle can be expressed in such a wide variety of clinical signs or production parameters

REASONS FOR TRACE ELEMENT DEFICIENCY

- Rainfall, soil type, pasture species and pasture growth rates all affect the amount of trace elements available to grazing animals
- Fertiliser usage is important when assessing trace element requirements as type, rates and frequency of fertiliser used can all have an influence on trace element availability, as can other elements in the feed or soil
- Individual animal factors such as age and stage of lactation can also affect trace element requirements

SIGNS OF TRACE ELEMENT DEFICIENCY

Due to the wide variety of body systems reliant on trace elements, deficiencies can manifest in a variety of ways. These will be dealt with in the individual sections on selenium, copper and cobalt but can be summarised into the following groups:

- **Lowered production** – of milk and meat
- **Lowered fertility** – lower conception rates, decreased calving rates, increased abortion
- **Depression of immune system** – increasing susceptibility to diseases such as mastitis (clinical and subclinical) and metritis (often associated with retained foetal membranes)
- **Developmental problems** – white muscle disease, poor growth rates and ill-thrift

TRACE ELEMENT DEFICIENT AREAS IN AUSTRALIA

- Trace element deficiencies are widespread throughout Australia
- Deficiencies are known to occur in coastal and southeastern Queensland, northern and southern tablelands of New South Wales, the eastern half of Tasmania, parts of Western Australia, South Australia and Victoria
- Deficiencies also occur in other areas and responses to supplementation have been known to occur on soils not known to be deficient

LEVELS OF DEFICIENCY

There are different levels of deficiency of trace elements:

- **Marginal (subclinical) deficiency** – doesn't necessarily result in visible signs of deficiency. Very common to have subclinical trace element deficiencies which can develop into clinical deficiencies given changing factors such as feed intake.
- **Clinical deficiency** – when visible signs occur. It is important to remember that an area (or property) can have a marginal deficiency for one class of stock (e.g. steers) and a clinical deficiency for other classes (e.g. pregnant or lactating cows). This is due to differing trace element requirements by different classes of stock.

TRACE ELEMENT SUPPLEMENTATION

A VARIETY OF OPTIONS EXIST FOR TRACE ELEMENT SUPPLEMENTATION

- **Sustained release intra-ruminal pellets** – PERMATRACE – provides a constant supply of trace elements over an extended period with a single annual treatment
- **Top dressing pasture** – good at addressing selenium deficiency
- **Clostridial vaccines containing selenium** – generally only raise selenium blood levels for 8-12 weeks
- **Mineralised drenches** – offer only a short term benefit
- **Pour on supplements** – only a short term benefit gained
- **Short acting injections** – need frequent retreatment and associated risk of carcass damage
- **Depot selenium injections** – risk of site reactions and degrading of carcass
- **In feed supplementation** – useful for some dairies and feedlots



SELENIUM DEFICIENCY IN CATTLE

THE ROLE OF SELENIUM IN CATTLE

- Selenium is required by the body for the production of a number of selenium dependant proteins, or seleno-proteins
- These seleno-proteins act primarily as anti-oxidants in the body, scavenging free radicals (products of normal metabolism in the body, which can cause cellular damage)
- The activity of selenium in the body is closely linked with the activity of Vitamin E

WHY SELENIUM IS IMPORTANT

Selenium is required for:

- Growth and production
- Foetal development
- Normal ovarian function
- Immune function

SELENIUM DEFICIENCY IN AUSTRALIA

- In Australia, selenium deficiency is widespread and often occurs in the most heavily stocked and cultivated areas
- Deficiency is known to occur in coastal and southeastern Queensland, the northern and southern tablelands of New

South Wales, the eastern half of Tasmania, parts of Western Australia, South Australia and Victoria

- Deficiencies also occur in other areas in Australia and responses to supplementation have occurred in areas or soils not known to be selenium deficient

FACTORS AFFECTING SELENIUM AVAILABILITY TO CATTLE

- **Soil Type** – acidic or sandy soils are more likely to be selenium deficient
- **Climate** – high rainfall areas (>450mm) are more likely to be low in selenium as the trace element is leached out of the soil
- **Plant Types** – clover and other legumes are low in selenium
- **Pasture Growth** – rapidly growing pastures are often deficient in selenium
- **Fertilisers** – superphosphate application can lower selenium uptake in plants as sulphur is taken up preferentially by the plant
- **Interaction with other minerals** – copper supplementation can increase the uptake of selenium by the liver
- **Animal age** – young, growing animals have a higher requirement for dietary selenium than older animals



DAILY REQUIREMENTS OF SELENIUM

- Dietary selenium requirements for beef cattle are 0.1 mg/kg²

TOXICITY

Selenium is a potentially toxic and hazardous element. However recommended ratios of supplementation are at least 5-10 times lower than those found to be toxic and are without risk to animals that have an adequate selenium status.

- **Acute poisoning** – usually due to an excess of readily absorbable supplements or consumption of a large amount of highly seleniferous plants (e.g. *Neptunia amplexicaulis* in some parts of Queensland)
- **Chronic poisoning** – “Blind Staggers” (occurs when animals ingest water soluble selenium compounds naturally found in accumulator plants), or “Alkali Disease” (caused by ingesting protein bound, insoluble selenium in grains or forage grasses over a period of several weeks to months)

CLINICAL SIGNS OF SELENIUM DEFICIENCY^{3,4,5,6}

In cattle, selenium deficiency is manifest in a variety of ways including:

- Reduced production
- White muscle disease
- Ill-thrift and reduced growth rate
- Lowered milk production
- Decreased fertility
- Increased susceptibility to disease
- Reduced immune system function
- Retained foetal membranes
- Metritis
- Subclinical mastitis

WHITE MUSCLE DISEASE

- In calves born to selenium deficient cows
- Selenium deficiency causes degeneration of skeletal and cardiac muscles – calves may die within 6-12 hours of the onset of disease
- If deficiency is less severe the calf may be weak or have an irregular heartbeat
- Irreversible once calf is affected and the only way to prevent in selenium deficient areas is by supplementing pregnant cows

ILL-THRIFT AND REDUCED GROWTH RATE

- Common in heifers and steers
- Adversely affects the body weight at calving and milk production, delays age to puberty
- New Zealand researchers have found up to a 15% increase in liveweight gain when heifers grazing selenium deficient pasture were supplemented with Permatrace selenium pellets⁴

LOWERED MILK PRODUCTION

- Related to poor growth rates and selenium also appears to have a direct relationship to milk production
- Many researchers have described a link between selenium supplementation and improved milk yield. Canadian researchers found a 7.6% increase in milk yield in selenium supplemented herds, compared to selenium deficient herds⁷.
- New Zealand researchers have found up to an 8% increase in milk volume in Friesian cows grazing selenium deficient pasture that were supplemented with Permatrace selenium pellets³
- Research has also shown reductions in somatic cell counts in selenium supplemented cows³

DECREASED FERTILITY

- Thought to be due to the role of selenium in the synthesis of prostaglandins⁸
- Improvement in conception rates have been seen after selenium supplementation⁹

REDUCED IMMUNE SYSTEM FUNCTION^{4,10}

- Studies have confirmed that white blood cells from selenium deficient cattle have decreased microbicidal activity
- This means that selenium deficient cattle are less able to fight infectious diseases than cattle with adequate blood selenium levels
- Major infectious diseases that selenium may have a role in are mastitis, metritis, diarrhoea and pneumonia
- Researchers have found that the duration of clinical signs of mastitis can be reduced by up to 27% in selenium supplemented cattle¹¹

EVALUATING SELENIUM STATUS IN CATTLE

- **Blood Tests** – testing a small percentage of the herd is the preferred method for measuring the selenium status of animals. Most laboratories measure the seleno-protein glutathione peroxidase (GSH-Px). This test is cheaper than measuring selenium directly and has been shown to provide an accurate reflection of the levels of selenium in the blood.
- **Soil testing** – can provide an indication of deficiency problem in an area but there are so many factors relating to selenium uptake by plants and animals that blood tests are a more reliable indicator of animal deficiency problems
- **Supplementation trials** – often preferred by many people, especially if animals are showing typical signs of deficiency in an endemically deficient area

See table on page 1 for normal selenium levels in livestock.

METHODS OF SELENIUM SUPPLEMENTATION FOR CATTLE

- **Intra-ruminal pellets** – Coopers® Permatrace® Selenium Pellets for Cattle. Slow release pellets, easily administered orally with a pellet gun and provide a sustained release of a constant supply of selenium for 12 months in cattle. Coopers® Permatrace® selenium pellets can safely and easily be given with copper and cobalt pellets.
- **Top dressing pasture** – is effective at raising soil selenium levels in deficient paddocks. The limitation of topdressing paddocks however is that unless the paddocks are highly productive and there is a very high stocking rate this may not be the most effective form of supplementation.
- **Selenium injections** – can be either short acting (sodium selenate) or long acting (barium selenate)
- **Premixes** – applicable in many feedlot situations but animals can have variable intake due to variable feed intake
- **Pour-on selenium** – only maintains blood levels for up to 3 months
- **In water supplementation** – can be effective in some situations but animals can have a variable intake
- **Mineralised drenches** – only increase blood selenium levels for a short period of time
- **Oral selenium drenches** – need to be used every 6 weeks

COOPERS PERMATRACE SELENIUM PELLETS

- 30g pellets containing 3g of elemental selenium compressed into an iron oxide matrix
- Used for prevention of selenium deficiency and treatment of selenium responsive disorders
- Can be used in cattle from 3 months of age
- Formulated in conjunction with CSIRO
- The particle size of the selenium in Permatrace pellets is the most important factor in determining the life of the pellet and the rate of supply of selenium to the animal. CSIRO determined the optimum particle size and Coopers Permatrace Selenium pellets are manufactured to these strict specifications.
- Two pellets provide adequate selenium levels for 12 months
- On average, 16.44mg of selenium is released each day in the rumen
- Administered via the Coopers Cattle Pellet Gun (easy to administer with studies showing a retention rate of 99% or higher)



COPPER DEFICIENCY IN CATTLE

THE ROLE OF COPPER IN CATTLE

- Copper is involved in the uptake of iron from the diet and is vital for the manufacture of haemoglobin, which is responsible for carrying oxygen in the red blood cells. It is involved in many other enzyme systems in the body and has a role in the production of many pigments in the body and hair.
- Copper is required for body and bone growth as well as nervous system and immune system function in cattle



SIGNS OF COPPER DEFICIENCY IN CATTLE^{4,6}

- Fading coat colour and loss of hair condition – facial hair is often affected first with a classic spectacled appearance where hair around the eyes loses its pigmentation. General loss of coat condition with the hair appearing thin and dry and colour fading.
- Poor growth rates – due to interference with metabolism. More noticeable in spring when copper content of pasture is known to be lower than in summer. Poor growth rates can have an adverse effect on age at puberty and subsequent fertility and milk production.
- Lameness/bone fragility – due to osteoporosis. Particularly apparent in the long bones and the ribs.
- Anaemia and falling disease – due to the importance of copper in the production of haemoglobin
- Intermittent scouring – usually only when there is a concurrent excess of molybdenum

DAILY REQUIREMENTS OF COPPER

- 10mg/kg of dry matter²
- Higher level for young, growing and heavily pregnant animals, lower levels for mature cattle at maintenance

COPPER POISONING

- **Primary copper poisoning** – more common in sheep but can appear in cattle, generally as a result of over-supplementation. Heavy mortalities have been seen in calves when soluble copper injections have been given at twice the recommended dose levels¹¹
- **Secondary copper poisoning** – can occur in animals that have liver damage

COPPER DEFICIENCY IN AUSTRALIA

Copper deficiency can be primary (where there is an absolute lack of copper in the soil) or secondary (where soil or plant factors inhibit the availability of copper to the animal).

- In Australia many of the sandy coastal soils are copper deficient but responses due to copper supplementation have also been noted in areas not known to be deficient, due to secondary deficiency

FACTORS AFFECTING THE AVAILABILITY OF COPPER TO CATTLE

- **Climate** – in wet periods (or areas) the copper concentration in plants can be lower and is in a less available form
- **Soil type** – known deficient regions include sandy coastal soils and some granite soils or peat swamps
- **Plant type** – clovers have a higher content than grasses. Grasses and clovers can however both be low in copper during the wetter months.
- **Fertilisers** – fertilisers containing molybdenum can decrease the availability of copper in pasture and also interfere with metabolism of copper in the body. Copper metabolism can also be inhibited by heavy treatment of pasture with lime that can lead to secondary copper deficiency.
- **Other minerals** – excess consumption of sulphur, cadmium, iron and zinc in the diet can decrease the availability of dietary copper
- Genetic differences between animals

EVALUATING COPPER LEVELS

- Definitive diagnosis of a copper deficiency can be quite difficult
- Blood tests – can be of limited value in marginal deficiencies as copper is removed from the blood when the blood clot forms
- Liver biopsies/examination at slaughter – copper is stored in the liver and drawn on when the animal is in a deficient state so copper liver measurements can give an accurate picture of the animals overall copper status. Liver biopsies are more invasive than blood tests but if abattoir samples are available liver measurement can be a good indicator of deficiency.

See table on page 1 for normal copper levels in livestock.

- **Soil testing** – may provide an indication that an area is copper deficient
- **Supplementation trial** – in deficient areas in animals showing clinical signs attributable to copper deficiency great value can often be gained from supplementing part or all of the herd

METHODS OF COPPER SUPPLEMENTATION

- Permatrace slow release formulation oral capsules – slow release formulation, for all classes of cattle over 3 months of age
- Copper licks or in water supplements – intake is variable
- Injectable formulations – important that copper deficiency is diagnosed before treatment as copper poisoning is possible. Copper injections also need to be repeated every 3-9 months depending on the formulation and the class of animal.
- Copper in feed supplements – for feedlot cattle or dairies

COOPERS PERMATRACE COPPER CAPSULES FOR CATTLE

- Formulated in conjunction with CSIRO
- 10g and 20g capsules containing fine copper needles in a polyethylene glycol capsule. The needles contain 390g/kg copper oxide.
- Administered with a pelleting gun
- Capsule lodges in the rumen where it then dissolves, the fine copper needles are released and they travel to the abomasum where they gradually break down
- Released copper is stored in the liver and available when required
- Permatrace copper capsules provide a convenient and long lasting form of copper supplementation for your cattle
- Blood levels start to increase immediately and are often back to normal in deficient animals within 4 weeks

DOSE RATES FOR CATTLE

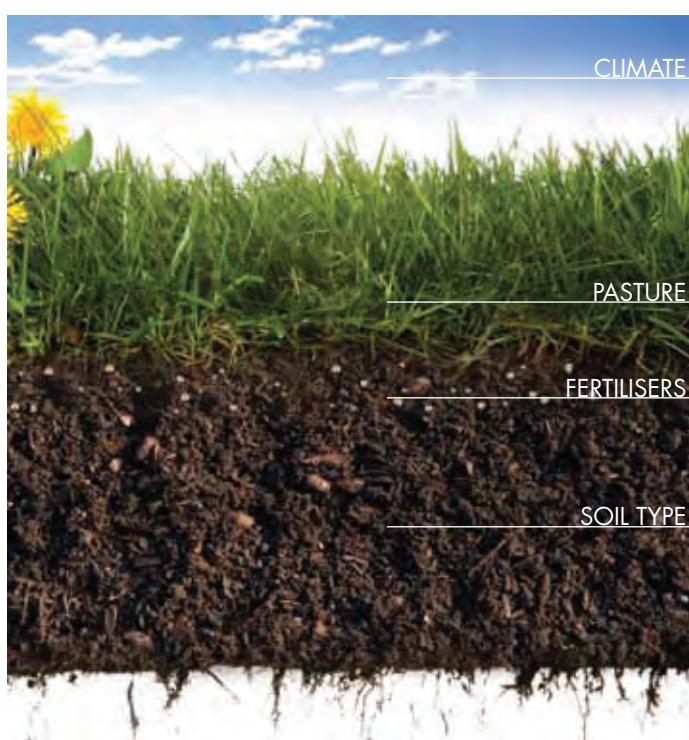
Calves from 3 months of age (<200 kg): 1 x 10g capsule
All cattle over 200 kg: 2 x 10g capsule or 1 x 20g capsule annually



COBALT DEFICIENCY IN CATTLE

FACTORS AFFECTING THE AVAILABILITY OF COBALT TO CATTLE

- **Climate** – cobalt is more likely to be deficient in very wet seasons due to leeching from the topsoil
- **Pasture** – deficiency can occur even in cattle grazing good quality pasture
- **Fertilisers** – heavy, long term superphosphate usage can result in cobalt deficiency
- **Soil type** – soil ingested while grazing is an important source of cobalt. Soils with reduced cobalt levels include coastal, calcareous and sandy soils. Soils high in manganese (such as red basalt) can result in a secondary cobalt deficiency as manganese binds cobalt.



THE ROLE OF COBALT IN CATTLE

- Cobalt is an essential trace element as it is required by rumen microbes to synthesise Vitamin B₁₂, and this is the only source of Vitamin B₁₂ to the animal
- Vitamin B₁₂ is required by enzymes involved in a variety of metabolic processes
- Cobalt is not stored for any significant length of time in the body but Vitamin B₁₂ is able to be stored in the liver

THE IMPORTANCE OF COBALT AND VITAMIN B₁₂ TO CATTLE

Cobalt is required for:

- Vitamin B₁₂ synthesis
- Healthy rumen function

Vitamin B₁₂:

- Produced in the rumen
- Required by ruminants in much greater amounts than other animals
- Deficient animals are unable to metabolise the Volatile Fatty Acid (VFA) propionic acid which is required for the production of glucose for energy. Clinical deficiency is often accompanied by inappetence and death from starvation.

SIGNS OF COBALT DEFICIENCY IN CATTLE

- The primary effect of a cobalt deficiency in cattle is a loss of appetite and then many other effects are felt as a result:
 - Poor coat condition, reduced growth rates, delayed onset of puberty, reduced milk production
 - Malnutrition – weepy eyes, poor growth, anaemia (pale mucous membranes), depression of the immune system, death
- Marginal cobalt deficiency can lead to ketosis in lactating cattle and also decreased fertility
- Affected calves and calves born from affected cows have decreased survival rates

DAILY REQUIREMENTS OF COBALT

- The recommended safe level of cobalt in the diet for cattle is 0.10mg-0.15mg cobalt kg/dry matter²
- If this dietary cobalt is not available, supplementation is necessary

EVALUATING COBALT STATUS IN CATTLE

- **As Vitamin B₁₂ levels are directly linked to an animal's cobalt status, measurements of Vitamin B₁₂ are used to determine the need for cobalt supplementation**
- **Liver tests** – biopsies or at slaughter. Very effective as the liver is the principal storage organ for Vitamin B₁₂.
- **Blood tests** – can be quite accurate for diagnosing cobalt deficiency but may not indicate that liver reserves of Vitamin B₁₂ are getting low

- **Supplementation trials** – in animals showing clinical signs typical of cobalt deficiency this may be one of the most effective methods of diagnosing a deficiency problem
- See table on page 1 for normal Vitamin B₁₂ levels in livestock.

COBALT/VITAMIN B₁₂ TOXICITY

- Overdosing with cobalt is unlikely as cattle readily convert the element to Vitamin B₁₂, and they can tolerate approximately 100 times the dietary requirement for cobalt. However, if toxicity does occur, signs include weight loss, rough hair coat, listlessness, anorexia and muscle inco-ordination.²

METHODS OF COBALT/VITAMIN B₁₂ SUPPLEMENTATION

- **Slow release pellets** - Coopers Permatrace Cobalt pellets are convenient and very effective form of cobalt supplementation and provide a sustained release of cobalt to the rumenal bacteria over a period of 12 months
- **Vitamin B₁₂ injections** – provide rapid elevation of serum B₁₂ levels and may be effective in treating clinical signs of cobalt deficiency but need to be repeated every 3 months
- **Vitamin B₁₂ drenches** – need to be given fortnightly
- **Salt blocks/mineral mixes/in water supplementation** – may assist in marginal deficiencies but ineffective if animals don't consume them (cobalt deficient animals are often inappetent)

COOPERS PERMATRACE COBALT PELLETS

- 9 gram of cobalt oxide in a 30 gram pellet
- Easily administered orally with the specially designed Coopers Cattle Pellet Gun
- Developed by the CSIRO to be of the correct weight, density and specific gravity to stay in the rumen
- Continually releases small amounts of cobalt over a 12 month period (the "pay out period"), to be converted into Vitamin B₁₂ in the rumen
- Can be used in cattle from 2 months of age
- Can be used with Coopers Permatrace Selenium Pellets and Copper Capsules

PARTNERSHIP, PRODUCTIVITY AND PROFIT

Coopers Animal Health, collaborated with the CSIRO Livestock Industries to develop PERMATRACE trace elements specifically to enhance the health, productivity and profitability of Australian livestock.

PERMATRACE DOSAGE AND ADMINISTRATION

PRODUCT	DOSE RATE	MINIMUM AGE/WEIGHT	PACK SIZE AVAILABLE
Permatrace Selenium Pellets • Beef and Dairy Cattle	2 pellets annually as a single dose	> 3 months of age	100 Pellets/tub
Permatrace Cobalt Pellets • Beef Cattle • Growing Dairy Cattle • Milking Cows	1 pellet annually 1 pellet annually 1 pellet twice yearly: one at dry off and one 3 months after calving. First calf heifers: one three months prior to calving and thereafter as for cows	> 8 weeks of age	100 Pellets/tub
Permatrace Copper 10 Capsules • Calves • Adult Beef and Dairy Cattle	1 capsule annually 2 capsules annually as a single dose	> 3 months of age up to 200kg LW > 200 kg LW	100 Capsules/tub
Permatrace Copper 20 Capsules • Beef and Dairy Cattle	1 capsule annually	>200 kg LW and over 12 months of age	100 Capsules/tub

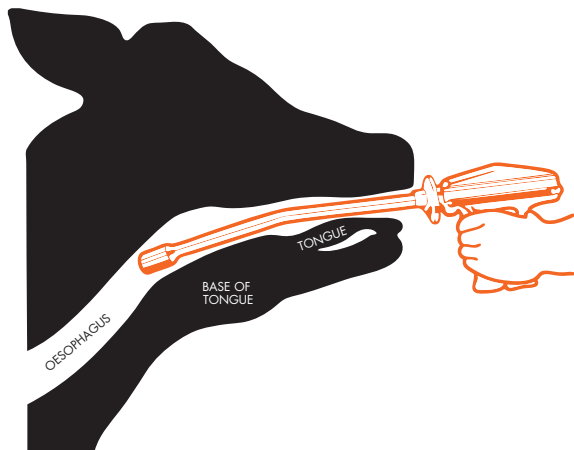
In some situations it may be required to also administer a steel grinder (grooved metal pellet) to keep the surface of the cobalt pellet clean and active. This will prevent a coating building up on the surface of the pellet. The following table highlights the situations in which a grinder would be recommended.

Caution: Selenium and copper deficiencies in cattle should be confirmed prior to administering Selenium pellets and/or Copper capsules. Veterinary consultation is recommended

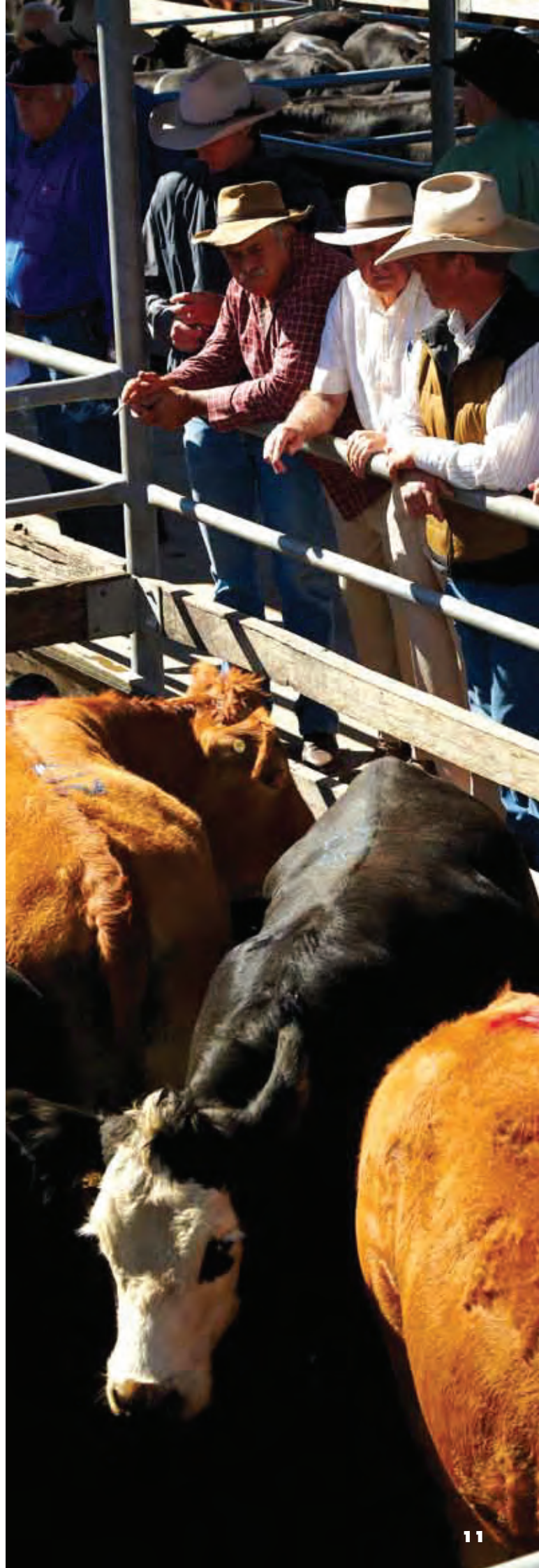
SITUATION	STEEL GRINDER RECOMMENDED
Permatrace Cobalt Only	Y
Permatrace Selenium Only	N
Permatrace Copper 10/20 Only	N
Permatrace Cobalt and Copper 10/20 Only	Y
Permatrace Selenium and Copper 10/20 Only	N
Permatrace Selenium and Cobalt Only	N
Permatrace Selenium, Cobalt and Copper 10/20	N



PERMATRACE CATTLE APPLICATION INSTRUCTIONS



1. It is recommended that Permatrace Cattle pellets be administered using the COOPERS® CATTLE PELLET APPLICATOR.
2. To load the applicator it is important to insert either the selenium or cobalt pellet first. The copper capsule should always be inserted into the gun last. The Copper 20 pellet should be inserted into the applicator with the narrower end pointing out.
3. Immobilise the head of the animal. This is best carried out in a crush with a head bail at the end.
4. Stretch the animal's head forward, open the animal's mouth and PASS THE GUN BARREL ALONG THE MIDDLE OF THE ROOF OF THE MOUTH AND OVER THE BASE OF THE TONGUE. The tongue may have to be pulled aside if it obstructs the applicator.
5. When the applicator is in the correct position (see picture) completely squeeze the trigger to release the pellets. The cattle should swallow these easily without distress. Holding the mouth closed, after the applicator has been withdrawn, may assist with swallowing.
Under no circumstances should undue force be applied if any obstruction to ejection of the pellets or capsules is encountered. Withdrawing the applicator slightly and re-positioning it correctly will ensure easy and safe pellet administration.





THE PROOF IS IN THE PELLET.

Selenium, Cobalt & Copper

REFERENCES

1. Regional Laboratory Services, Benalla VIC 3672
2. Nutrient Requirements of Beef Cattle. National Research Council, The National Academies Press, 1984, pgs 1-249
3. Wichtel, J.J., et al (1994). The effect of intraruminal selenium pellets on growth rate, lactation and reproductive efficiency in dairy cattle. New Zealand Veterinary Journal 42:205-210.
4. Suttle, N.F., Mineral Nutrition of Livestock, 4th Edition, CABI, Cambridge 2010, pgs 1-579 Smith,...Effect of Vitamin E and Selenium Supplementation on Incidence of Clinical Mastitis and Duration of...
5. Ammerman, C.B and Miller, S.M., Selenium in Ruminant Nutrition: A Review, Journal of Dairy Science, Vol 58, 10: 1561-1577
6. Corah, L. Trace Mineral requirements of grazing cattle, Animal Feed Science Technology, 1996, 59:...
7. Witchel, J.J., et al (2004). The selenium status of dairy herds in Prince Edward Island. Canadian Veterinary Journal, 45:124-132
8. Hong JS et al. The role of selenium-dependant and selenium-independant glutathione peroxidases in the formation of prostaglandin F2_. Journal of Biological Chemistry 246, 13793-800, 1989
9. Tasker, J.B. et al, Selenium response in dairy cattle, New Zealand Veterinary Journal, 35:8, 139-140
10. Smith, K.L., et al (1984). Effect of Vitamin E and Selenium Supplementation on Incidence of Clinical Mastitis and Duration of Clinical Symptoms. Journal of Dairy Science 67:1293-1300
11. Galey F.D., et al (1991). Copper toxicosis in two herds of beef calves following injection with copper disodium edetate. Journal of Veterinary Diagnostic and Investigation 3, pp. 260-263

Copyright © 2024 Merck & Co., Inc., Rahway, NJ, USA and its affiliates. All rights reserved.
The information contained herein is subject to change without notice.

For further information on Coopers Permatrace products please
contact MSD Customer Care Team on:

1800 226 511

or visit our website:

www.coopersanimalhealth.com.au

