AGRITOPIC

April 2022

COPPER

1. INTRODUCTION

Copper (Cu) is one of the micronutrients or trace elements that are essential for the healthy growth of plants and animals.

In Australia, deficiency occurs less commonly in crops than does zinc, but more often than iron or manganese. Deficiency most commonly occurs on sandy soils, particularly if low in organic matter. Crops differ in their sensitivity to copper deficiency. Copper responsive crops include oats, wheat and lucerne, whilst potatoes and soybeans are less likely to respond. Pastures on sandy soils, and animals grazing these pastures, may also suffer from copper deficiency.

2. COPPER IN SOILS

Copper is present in relatively small quantities in the earth's crust, except in areas where it is concentrated as an ore, usually with other metals such as silver, zinc and lead. Soil minerals decompose slowly to release copper into the soil, where it is usually present as a divalent cation (Cu^{2+}), combined with organic complexes, or as copper oxides, hydroxides, sulfides, sulfates or carbonates.

Copper is held very tightly on inorganic exchange sites in the soil. Copper is also strongly bound to organic matter, more so than are other micronutrient cations e.g. zinc and manganese. Consequently, copper is very immobile in the soil. The copper concentration of the soil solution is also very low, and it is not easily lost by leaching.

As the soil pH increases above 7.0, copper availability declines due to stronger copper adsorption. As the soil becomes more acid, copper is held less securely and so becomes more available to plants.

3. COPPER IN PLANTS

3.1 Uptake and Function in Plants

Copper is taken up by plants in very small quantities. Iron and zinc (ions of similar size and charge) inhibit the uptake of copper and vice versa. Copper plays important roles in metabolic processes, e.g. enzyme and chlorophyll formation, photosynthesis, respiration, and the metabolism of carbohydrate and some proteins. An adequate supply of copper is essential at pollination in wheat. A deficiency may result in barren heads. There also appears to be a specific requirement for copper in symbiotic nitrogen fixation.

Copper is not readily mobile in the plant although it can be translocated from older to younger leaves. The movement of copper appears to be strongly dependent on the copper status of the plant. In wheat plants well supplied with copper, movement readily occurs from leaves to the grain, but in deficient plants, copper is relatively immobile.

3.2 Deficiency Symptoms in Plants

As copper is relatively immobile in plants, deficiency symptoms first develop on the growing points and the leaves. The main general symptoms are chlorosis or yellowing, first developing on the leaf edges. In winter cereals, the leaf tips wither and drop, turn from yellow to grey and die. The leaves curl and twist and fail to unroll. “Die-back” occurs in tree crops.

Specific symptoms in various crops include:

- In cereal crops, the deficiency is indicated at tillering by white leaf tips and narrow, twisted leaves. The growth of internodes is depressed and in extreme cases ear or panicle formation is absent. In less severe cases, ears may form but not fill due to the effect low copper has in reducing pollen grain viability.
- Die-back in younger leaves in citrus, pome-fruit, lucerne, grasses, stone-fruit, pea and sunflower.
- Stunted growth and poor development of edible parts of onion and vegetable crops.
- “Droopy-top” in sugar cane.
- Severe wilting in tobacco, potato, pea and cereals.
- Chlorosis in celery, lettuce, cabbage, clovers.

3.3 Toxicity Symptoms in Plants

The range between deficiency and toxicity is quite narrow, but varies for the different plant types. Legumes are particularly susceptible to high copper while grape vines are reported to be the most tolerant. The inhibition of root and shoot growth is one of the first symptoms of copper toxicity, especially in bean, citrus and maize.

Copper can displace metal ions (particularly iron) from their centres of activity within the plant. Therefore, the leaves are often chlorotic due to an induced iron deficiency.

4. CRITICAL LEVELS OF COPPER

4.1 Soil Analysis

The total copper content in soils ranges from 2 - 20 mg/kg Cu. Sands tend to have the lowest levels. Total copper is not, however, a good measure of plant available copper. The amount of water soluble and exchangeable copper in the soil is a better measure. This can be estimated by chemical extraction with a chelating agent, e.g. DTPA. Some general guidelines are:

- Soils with levels less than 0.3 mg/kg Cu are likely to be deficient for many of the highly productive crops, while levels of 0.1 mg/kg Cu or less will severely limit the growth of many field crops and pastures.

- Soils with copper levels of 20 mg/kg Cu or more are likely to be toxic to many plants. Soils with levels between 10 and 20 mg/kg Cu may be toxic to some plants, under stress conditions.

4.2 Plant Tissue Analysis

The copper content of most plants is generally between 2 - 20 mg/kg Cu. For a wide variety of plants, copper deficiency occurs where copper levels are less than 5 mg/kg Cu in the leaf dry matter. Copper deficiency may also occur in grazing animals if the copper concentration in the pasture is below this concentration.

The ranges for optimum plant growth vary for different plant species from 5 - 10 mg/kg Cu to 5 - 20 mg/kg Cu. When copper exceeds 20 mg/kg Cu in the leaves of many plants, growth is adversely affected and copper is considered toxic.

Where copper fungicides are applied, elevated copper levels will be found, but much of the copper will be on the leaves rather than within the leaves. Some plant species are capable of accumulating copper to levels 2 to 50 times the normal value of copper in leaf dry matter, but the toxicity is in some way prevented.

Ingestion of copper by grazing animals may be harmful to stock, while the pasture itself is unaffected. Copper poisoning has occurred in Australia in sheep grazing young pasture of high sub clover content, the clover containing 10 - 15 mg/kg Cu and < 0.2 mg/kg Mo.

5. COPPER FERTILISERS

Copper can be applied to the soil or foliage, either on its own or in combination with other nutrients. Straight copper fertilisers include:

Copper sulfate

Copper sulfate is soluble in water. There are two salts:

- **Copper sulfate monohydrate** ($CuSO_4.H_20$), containing 35 % Cu. Granular grades of this product have been used in the past, for dry application to the soil. Little use is made of it in Australia at the present time. The fully hydrated copper sulfate pentahydrate salt (discussed below) is used where copper is to be applied in solution.

- **Copper sulfate pentahydrate** ($CuS0_4.5H_20$) or **Bluestone**, containing 25 % Cu. Bluestone may be purchased in different ways:

    - As a coarse crystalline product for dry application to the soil;

    - As a fine solution grade product, with a small particle size, for use where copper is to be applied in solution (dissolved in water), e.g. as a soil spray, in fertigation programs (with the irrigation water), or as a foliar spray.

    - Or in ready prepared copper sulfate solutions.

Bluestone (copper sulfate) solutions are corrosive. Insoluble suspension grade copper products, such as copper oxide and copper hydroxide, which do not dissociate in water to produce copper ions, are potentially abrasive, but are less corrosive to equipment than Bluestone.

As well as its use as a fertiliser, Bluestone has other uses in agriculture including the preparation of Bordeaux mixture (for disease control in plants); as an algacide; to control slime in seedling rice; and for foot-rot in sheep.

Copper chelate

Copper chelate can be applied to the soil or as a foliar spray. Chelated trace elements have wider compatibility in fertiliser solutions, and are less subject to fixation in the soil, than is sulfate, but are more costly.

Copper oxide

A fine particle size is essential if copper oxide (or other insoluble copper compounds) are applied to the soil, for them to react and release copper for plant root uptake. The need to apply them as a dust makes application difficult, given the low application rates that are required.

Some form of carrier is necessary:

- Copper, for example, can be added to other fertilisers during the manufacturing process, e.g. superphosphate, for use on pasture.

- Water can also be used as a carrier, with microfine suspensions (wettable powders and flowable concentrates) being applied through a boom spray, to the soil or foliage. An extremely fine particle size is essential, firstly, for the product to remain in suspension, and secondly, for the copper to be absorbed though the leaf pores (stomata) if foliar applied.

- Copper dusts may also be used as seed dressings, though the amount of copper than can be applied in this way is limited.

Copper Fungicides

Fungicidal products such as copper oxychloride and copper hydroxide are insoluble. A fine particle size is required for them to be effective in disease control. This means they also have nutritive value. Where copper fungicides are used routinely in crop protection programs, it will not be necessary to apply additional copper in fertiliser programs. Unless also labelled for use as a fertiliser, copper fungicides should only be used for the intended purpose, i.e. as a fungicide. To use them otherwise, i.e. as a fertiliser, would constitute an off label use.

Copper oxysulfate

Copper oxysulfate contains copper in the soluble sulfate and insoluble oxide forms. It is manufactured by partially acidulating copper oxide with sulfuric acid. On wetting of the granules after application, the copper sulfate dissolves, releasing fine particles of copper oxide.

Copper oxysulfate can only be applied dry to the soil. It is unsuitable for application in solution. The analyses (% Cu) of these products vary with the manufacturer.

Incitec Pivot Copper Fertilisers

Incitec Pivot Fertilisers does not market a complete range of copper fertilisers. Incitec Pivot Fertilisers adds copper to dry granular fertilisers in two ways:

- **As a spray on coating** – fertiliser products are treated with a copper oxide based suspension which provides a coating on every granule. Depending on the nature of the product being treated, this approach is typically limited to an analysis of around 0.6% Cu. Typically used in the grains industry and for extensive pasture applications.

- **Incitec Pivot Copper Granules** – A dry granular copper oxysulfate product containing 25% Cu. Copper Granules is commonly used in NPK Blends for horticulture, e.g. tree crops, and sugarcane.

Incitec Pivot Copper Granules can also be purchased on its own.

6. PREVENTION OF COPPER DEFICIENCY IN PLANTS

Seek local and industry advice on the need for copper and appropriate application rates. In the absence of more specific information, advice is provided herein on typical copper (Cu) application rates, and for commonly used products such as Incitec Pivot Copper Granules and Bluestone. Both these products contain 25% Cu, so their application rates are similar.

Incitec Pivot Copper Granules can be applied dry to the soil, either on its own or in fertiliser blends. Bluestone can be applied as a soil or foliar spray. Incitec Pivot Fertilisers does not market Bluestone.

6.1 Soil Application

Soil application rates for copper are influenced by such factors as the soil type (texture and pH), whether it is applied annually or on a less frequent basis several years apart, and how and where the fertiliser is applied.

Lower rates will be required in pasture where the copper fertiliser is applied to the soil surface, than where it is placed into the soil and subject to regular cultivation, which exposes the copper to more fixation sites in the soil.

Surface applications are effective in pasture and tree crops, where plant roots proliferate. In annual crops, where the seed or planting material are placed at depth in the soil, and the roots at first grow deeper into the soil profile, copper needs to be placed into the soil to ensure access is adequate in the critical early growth stages. Copper applied to the soil surface is positionally unavailable to young plants, and can be left stranded if the soil dries out.

Soil application rates for copper range from 2 kg/ha Cu in pastures and on light sandy soils up to 10 kg/ha on heavy clay soils and in high value crops (horticulture and sugarcane). Repeat applications are generally required at 5 – 10 year intervals. Annual application rates in crops are typically in the order of 0.5 – 1.5 kg/ha Cu.

Pasture

Apply 2 kg/ha Cu, e.g. 8 kg/ha of Copper Granules or Bluestone, every 3 – 10 years. If Bluestone is applied through a boom-spray to established pasture, do so when the pasture is short, i.e. after grazing, so that the maximum amount of spray reaches the soil (and the foliage intercepts the least amount possible). Withhold stock from the paddock until after rain is received or irrigation is applied to minimise ingestion by stock.

Grain

On light sandy soil, 2 kg/ha Cu (8 kg/ha of Copper Granules or Bluestone) may suffice. Copper deficiency is less likely to occur on heavy textured clay soils, but if diagnosed, higher rates are required as copper is more likely to be fixed on heavy soils, particularly if they are

alkaline (have a high pH). Apply 5 – 10 kg/ha Cu, e.g. 20 – 35 kg/ha of Copper Granules or Bluestone. Such applications may last up to 5 years or more.

The copper should be applied pre-plant and incorporated into the soil. If left on the soil surface, the copper will be inaccessible to crop roots.

NOTE. An adequate supply of copper is essential in wheat and other winter cereals at flowering, as copper plays an important role in pollen formation. A shortage of copper may result in barren heads.

In northern NSW and Qld, flowering coincides with the spring, which is the driest time of the year. Winter grain crops in these summer-dominant rainfall areas are very dependent on conserved fallow moisture. If the winter and early spring has been dry and the topsoil has dried out, the crop roots will be left to draw water and nutrients from the sub-soil. Copper in the topsoil, including that applied as fertiliser, can be left stranded and positionally unavailable to the crop.

Strategic 2% w/v sprays of Bluestone (or other less corrosive copper fertilisers) may be required at mid-tillering and just before booting in those districts and soil types in which copper deficiency is known to occur, particularly where little in season rainfall has fallen, irrespective of whether copper has been applied to the soil.

Vegetables

Apply 5 – 10 kg/ha Cu, e.g. 25 – 35 kg/ha of Copper Granules or Bluestone, at intervals of up to 5 years. Lower rates may be required on light-textured (sandy) or acid soils.

Apply pre-plant, and incorporate into the soil. Soil-applied copper will not be required where copper fungicide sprays are routinely used.

Sugarcane

In areas where copper deficiency is known to occur, e.g. blocks with a history of copper deficiency (Droopy Top), apply 10 kg/ha Cu (40 kg/ha Copper Granules) in the row at planting, i.e. with the basal NPK planting mixture. This should last for the entire crop cycle (plant crop plus ratoons).

If copper deficiency is diagnosed early in a crop cycle, apply 10 kg/ha Cu (40 kg/ha of Copper Granules or Bluestone) over, into or adjacent to the rows, e.g. into the drill in plant cane, or after harvest. In ratoons, results are likely to be better if applied into the soil to a depth of 10 cm rather than to the soil surface.

Where copper is thought to be marginal, e.g. soil analysis results are low but deficiency has not been observed in past crops, apply 5 kg/ha Cu (20 kg/ha Copper Granules) at planting as an insurance against deficiency, or test strip at 10 kg/ha Cu (40 kg/ha Copper Granules).

Tree and Vine Crops

Apply 5 -10 kg/ha Cu (25 – 35 kg/ha of Copper Granules or Bluestone) at up to 5 year intervals. Lower rates may be required on light-textured (sandy) or acid soils.

In tree crops, copper can be applied in one of the following ways:

- to the whole floor area of the orchard
- uniformly over the entire root zone of the trees, i.e. under the whole canopy and just beyond the canopy but not within 30 cm of the trunk
- concentrated in a band at least 30 cm wide around the drip line, i.e. where the roots are most active, or
- concentrated in a band along the canopy edge of the hedgerow if the canopies have met.

For young trees, treat the area that the roots will be growing into as well as the area where most roots are now present.

Trees may be slow to respond to soil applied copper. Where copper deficiency is evident in the foliage, it is recommended that foliar sprays of copper be applied as well in the first year after applying copper to the soil, or until such time that deficiency symptoms are no longer apparent.

Soil-applied copper will not be required where copper fungicide sprays are routinely used.

6.2 Foliar Application

The following guidelines are for Bluestone (25% Cu). They should only be used if more specific district and crop advice is not available, and read in conjunction with the Incitec Pivot Agritopic on "Foliar Fertilisers".

Bluestone solutions are corrosive to metals. Seek advice from the equipment's manufacturer before use. Spray equipment should be thoroughly flushed afterwards. Alternatively, suspension grade copper fertilisers may be used. These products cost more, but are less corrosive to spray equipment.

The copper concentration in these products may vary from that in Bluestone, and rates may need to be adjusted. Seek advice from the supplier on appropriate rates of use. Some authorities recommend the use of higher copper rates on account of the low solubility of these products.

Application Rates and Time of Application

Copper should be applied before the onset of deficiency as prevention is better than cure. If deficiency symptoms are allowed to develop, yield reductions will have already occurred.

Typically around 1 kg/ha of Bluestone is applied per foliar application, with one or two sprays being made early in the growing season in annual crops, or to a new flush of growth in tree crops.

In grain crops, apply 0.5 - 2 kg/ha of Bluestone in sufficient water to wet the foliage 3 – 5 weeks after emergence. A second spray just prior to booting is recommended in northern NSW and Qld.

In tree crops, spring is normally the best time to spray copper.

Late season sprays, e.g. approaching harvest, are usually ineffective, and may result in elevated concentrations of copper in farm produce.

Spray Volumes

Typical spray volumes for early season copper sprays are:

- 50 L/ha in field (grain) crops,
- 250 - 500 L/ha in vegetables, and
- 1 000 L/ha in tree crops.

Spray Concentrations

Typical spray concentrations for Bluestone in foliar sprays are:

- in vegetables, a 0.05 % high volume spray 1 – 2 weeks after emergence or transplanting, with additional sprays being applied if the deficiency is severe; and
- in tree crops, a 0.1 % high volume spray in the spring.

Suggested Spray Programs for Foliar Applications of Bluestone in Various Crops

Crop	Concentration		Comments
	g/100 L	% w/v	
Winter cereals			(wheat, barley, oats)
Northern NSW & Queensland	2 000 (2 kg)	2	Apply two sprays at 30 to 50 L/ha so as to apply 0.5 to 1 kg/ha of Bluestone, the first at the commencement of stem elongation, the second just prior to booting (Feeke's stage 9.5 to 10.0, Zadok's stage 41 to 45).
Southern Australia	-	-	Apply a single spray of Bluestone at 400 g/ha in sufficient water for plant coverage.
Western Australia	-	-	Apply Bluestone at 1 – 2 kg/ha. Spraying at the 6 leaf stage gives better results than at late booting. Foliar sprays are not effective once the crop has flowered.
Summer cereals (sorghum, maize, millet, panicum)	2 000 (2 kg)	2	Apply at 3 to 5 weeks after emergence. A second spray may be required at the time of pollen formation.
Legume grains and oilseeds (sunflower, soybean, peanut)	2 000 (2 kg)	2	Apply at 3 to 5 weeks after emergence. In navy bean, which has a shorter growing season, the spray should be applied earlier (1 to 2 weeks).
Cotton	500	0.5	Little information is available as deficiency is not likely to occur on most soils used to grow cotton in Australia.
Tree crops	100	0.1	Apply to an expanding flush of growth. Late spring is often the best time to spray. Later applications can be made if deficiency occurs.
Vegetables (French bean, pea, cucurbits)	50	0.05	Apply at 1 to 2 weeks. Additional sprays may be required if deficiency is severe.

Add Urea (1 kg/100 L in field crops, 500 g/100 L in vegetables, 100 g/100 L in tree crops); plus a wetting agent at label-recommended rates.

Nutrient sprays may burn plant foliage. Please refer to the Incitec Pivot Agritopic on "Foliar Fertilisers" for further information on this and related topics.

Bluestone Compatibility in Solution

Bluestone is compatible with urea, ammonium nitrate, potassium fertilisers, magnesium sulfate and other metallic trace elements. Do not mix Bluestone with calcium nitrate, calcium chloride, MAP, MKP or boron fertilisers. Metallic sulfate fertilisers such as Bluestone are considered to be incompatible with glyphosate, paraquat, diquat and phenoxy herbicides, e.g. 2,4D.

Before mixing Bluestone with other crop protectants, refer to the product labels for compatibility advice.

6.3 Crop Protection Sprays

Sprays such as copper oxychloride, copper hydroxide and Bordeaux mixture contain copper. Where copper fungicides are used on a routine basis, e.g. in some horticultural crops, there will be no need to apply additional copper as a fertiliser to the soil and/or foliage. Where copper sprays have been used over a long time it is possible that soil concentrations of copper may increase to the extent that copper toxicity may occur.

It is also possible that the copper may be of environmental importance if lost off-site into waterways or estuarine environments, e.g. in surface run-off when heavy rain falls, and soil erosion occurs. If alternative fungicides are available, they should be used in these circumstances.

If there are no alternatives, check the label recommendations for the various copper products that are available. If some of these apply less copper than others, choose them.

7. CORRECTION OF COPPER TOXICITY IN PLANTS

As copper is most available for plant uptake at low pH levels, copper toxicity is most likely to occur on acid soils, and / or where excessive copper has been applied to the soil or plants, e.g. as a fungicide. On acid soils, the best corrective measure is to raise the pH to 6.5 by liming the soil.

Where copper toxicity occurs or is suspected, non-copper fungicides should be chosen whenever possible in plant protection programs.

8. COPPER IN ANIMALS

8.1 Function in Animals

In animals copper aids in haemoglobin formation and has a role in bone and joint development. It is also important in the effective functioning of the digestive tract, the development of a protective sheath around nerves and for the pigmentation of hair.

8.2 Deficiency Symptoms in Animals

In eastern Australia, copper deficiency in cattle and sheep most commonly occurs on acid sandy soils, particularly in areas of high rainfall. In South Australia, deficiency is more widespread, occurring on acidic and alkaline soils, and on sands, loams, clays and peats. It commonly occurs on calcareous sands.

When dietary copper levels in forage and pasture are less than 5 mg/kg Cu, copper deficiency is likely to occur. Cattle are more susceptible to copper deficiency than sheep. Common symptoms of deficiency are:

- retardation of growth;
- failure to fatten;
- coarsening and depigmentation of hair (pale, harsh dry coats);
- steely wool in sheep;
- nervous disorder (swayback) and muscular incoordination (ataxia);
- scouring (diarrhoea);
- abnormal bone formation (bones fracture easily);
- anaemia (low haemoglobin in blood).

As with most nutrient disorders, livestock production can be affected before deficiency symptoms become apparent. Wool growth is reduced before steely wool is evident, while growth rates in young cattle may be reduced with clinically silent hypocuprosis.

Anaemia occurs as a result of severe copper deficiency and may not be evident where the deficiency is marginal.

Blood plasma copper levels are routinely used by veterinarians to help diagnose copper deficiency. It is usually recommended that ten animals be bled from the suspect group for plasma assays.

8.3 Toxicity Symptoms in Animals

As in plants there is a narrow range between copper deficiency and toxicity in animals. Copper poisoning is basically caused by an accumulation of copper in the liver of animals, which develops quickly into a toxaemic jaundice. Symptoms of copper toxicity in animals include:

- jaundice (yellow colouration of fatty tissues, skin and mucous membranes);
- yellow or muddy eye membrane;
- photosensitisation;
- dark urine;
- liver damage through copper accumulation;
- enlarged kidneys of a gun metal colour..

High blood copper levels only occur at the time of haemolytic crises and so is not always a reliable guide to the copper loading in stock.

8.4 Interactions

An imbalance in dietary copper, molybdenum and sulfur may induce nutritional problems in livestock, particularly if animals are stressed, or suffering liver damage.

High concentrations of molybdenum and/or sulfur in forage can induce copper deficiency in grazing animals. If dietary intake of sulfur is high, it can directly affect copper availability by causing insoluble copper sulfide to form in the gut. Conversely, high dietary copper, low molybdenum and low sulfur are the major direct causes of copper poisoning.

Seasonal or soil conditions (low pH) can affect nutrient availability in the soil, plant uptake and growth and contribute to nutritional disorders.

When plants are growing quickly, sulfur concentrations, both as inorganic sulfate sulfur and in protein may be diluted and low, causing copper to accumulate in the liver even though dietary intake of copper and molybdenum are at levels which would normally be regarded as satisfactory.

Ingestion of plants containing toxic chemicals such as alkaloids may also induce excessive accumulation of copper in the liver.

8.5 Correction of Copper Deficiency in Animals

When copper deficiency occurs, it is important to determine whether the deficiency is simple or induced. If both the soil and pasture are low in copper, copper fertiliser should be applied to the soil. Heavy textured clay and alkaline soils and those high in molybdenum may require

heavier and/or more frequent applications of copper. Where molybdenum fertiliser is also required, the rate at which it is applied may need to be reduced.

If copper deficiency in animals is induced, e.g. where copper concentrations in the pasture are 8 - 10 mg/kg Cu, direct treatment of animals may be the only option.

Copper can be administered to cattle by injection (which remains effective for about 3 months) or oral bullets (which provide protection against copper deficiency for up to 12 months). Where the pasture has a high molybdenum content, the effective life of bullets may be as short as 6 months. Veterinary advice should be sought as to the most appropriate treatment.

For sheep, copper bullets can be used. As of 1997, an injectable copper preparation was not available for sheep in Australia, but "may be released in the near future". Copper drenches are not recommended because of the short effective life and risk of copper toxicity if too much is given.

In some circumstances, copper may need to be applied to the soil, and administered to animals.

8.6 Correction of Copper Toxicity in Animals

On acid soils, liming will reduce the availability of copper in the soil, and uptake by the pasture. This in turn will help reduce copper toxicity in animals.

Where molybdenum is low, it should also be applied to the soil. Molybdenum licks may also be of use. Providing access to forage or feed with lower copper and/or higher molybdenum and / or higher sulfate sulfur levels will help reduce accumulation and storage of copper in the liver.

Where animals have grazed plants containing damaging alkaloids (e.g. Heliotrope, Patterson’s curse and some varieties of clover), they should be removed from these paddocks, and not returned for two years. Veterinary advice should be sought as to the most appropriate management practices.

WARNING

The information contained in this publication is for use as a guide only. The use of fertilisers is not the only factor involved in producing a top yielding pasture or crop. Local soil, climatic and other conditions should also be taken into account, as these could affect pasture or crop responses to applied fertiliser.

Before using fertiliser seek appropriate agronomic advice. Fertiliser may burn and/or damage plant roots or foliage.

Foliar burn to the leaves, fruit or other plant parts is most likely to occur when different products are mixed and sprayed together, the water is of poor quality, or the spray is applied under hot dry conditions, eg. in the heat of the day.

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