



Nutrient Deficiencies

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In agriculture and horticulture plant nutrition has been relatively well studied and in forestry there is a large amount of information on nutrition in conifers. However, there is a distinct lack of knowledge on nutrition and nutrient requirements of Australian native plants and in particular, eucalypts. The problem is compounded by the fact that different species (and even different provenances) of eucalypts seem to react differently to mineral deficiencies. Many deficiencies produce similar symptoms. Low levels of a particular element may also produce symptoms and these may vary depending on just how low the levels are. Multiple deficiencies may occur. Factors such as site, seasonal and climatic effects and chemicals may also be involved. It is a very complex matter and means that nutrient deficiencies are extremely difficult to diagnose. Deficiency problems may not show up for some time after planting, (possibly years), as at first there may be sufficient nutrients in the soil to meet the requirements of the trees.

The following are general descriptions of nutrient deficiencies in eucalypts based on the limited information available. Specific information is given about *Eucalyptus globulus* where possible.

Boron

Boron is important in actively growing areas such as shoots and root tips. It is particularly important when trees are growing in marginal areas or on shallow, rocky soils that are poorly drained or at times, waterlogged. Only small amounts are needed by the trees. Symptoms of deficiency vary depending on the species involved but the most common symptom is dieback of the young shoots. New leaves may have yellowish edges.

Calcium

Calcium is important for healthy root development. Deficiencies are most likely to occur in very acid soils. Deficiency symptoms show up first on new leaves and include necrosis (dead patches) and dieback. Plants may be stunted and generally have poor root development. In *E. globulus* there are few recognisable symptoms but growth is poor and there is very little branching.

Copper

Copper is concentrated in green leaves. Copper deficiency is commonly associated with Zinc deficiency and occurs mainly in sandy soils. In soils high in nitrogen and phosphorus, copper is often tied up so it becomes unavailable for plant to use. Deficiency symptoms include wilting and dieback of the terminal shoots and failure of the plant or grow straight - the stem or trunk may be twisted and growing almost horizontal in some cases.

Iron

Iron is important in the synthesis of chlorophyll (the green colour) in leaves. Iron deficiency is likely to occur on soils containing lime. Often there is plenty of iron in the soil but it is in a form that renders it unavailable for the plant to use. The main symptom of iron deficiency is chlorosis - a yellowing of the leaves particularly between the veins (which remain green). New growth is pale yellow.

Magnesium

Magnesium is important in photosynthesis. Magnesium deficiency is most common in very acid soils where there are high levels of potassium. Deficiency symptoms show up first on older leaves. The main symptom is chlorosis starting from the tip and edges of the leaves and progressing inwards. There may be a green "V" along the midrib. Some older leaves may be reddish in colour. In *E. globulus* there are few symptoms in the early stages but later, chlorosis develops and is particularly evident in the older leaves. There is also restricted shoot growth.

Manganese

Manganese is found in green leaves. A common cause of manganese deficiency is the liming of acid soils to reduce the pH. The main symptom of manganese deficiency is chlorosis, similar to iron deficiency. There is also likely to be cupping of the leaves and necrosis (dead patches on the leaves). Young leaves are the first to be affected.

Nitrogen

Nitrogen is very important in plant nutrition. It is essential for photosynthesis. Nitrogen deficiency is rare in eucalypts. Deficiency symptoms first appear on older leaves. These become pale yellow in colour. There may be yellow spots on the leaves and chlorosis. In some cases the veins become reddish. The colour depends on the degree of deficiency and on the species involved. There may also be premature leaf drop. In *E. globulus* yellow spots and chlorosis occur on older leaves first. Eventually all lower leaves become chlorotic and premature leaf drop occurs. Growth is poor with small leaves, thin stems and no branching. Root development is poor.

Phosphorus

Phosphorus is also a very important element. It is involved in the development of roots, stems, flowers and seeds and is vital for photosynthesis. Australian native plants are well adapted to cope with low levels of phosphorus as most Australian soils have low concentrations of this element. Consequently phosphorus deficiency is rare. Deficiencies show up first in the older leaves which take on a purple colour, often with dry tips and margins. In *E. globulus* the only symptoms are dry tips and margins of the lower leaves. Leaves are normal size but growth may be stunted with little branching, thin stems and a few brown spots at the base of the stems. Root development is poor.

Note: It is important not to confuse the purple and yellow/green colour of healthy, immature leaves with that of nitrogen or phosphorus deficiency. These deficiencies are most apparent on older, full sized leaves.

Potassium

Potassium is important in protein synthesis and in the formation of strong roots and stems. It is needed in large quantities but is often tied up in the soil and not readily available for plants to use. Deficiencies often occur in sandy soils. Deficiency symptoms appear in older leaves first. The main symptom is dead tissue on the leaf margins spreading to the leaf tip. In *E. globulus* there are few visual symptoms in the early stages but there may be brown spots on the leaves and later curling up of the tips and margins of the leaves. Initially only older leaves are affected but later all leaves become affected.

Sulphur

Sulphur is important in root formation. Sulphur deficiency is rare. Deficiency symptoms include chlorosis with pale veins and stunted growth. In *E. globulus* the only apparent symptom is likely to be slight chlorosis in older leaves.

Zinc

Zinc is important for healthy stem and leaf growth. Zinc deficiency is often associated with copper deficiency. Deficiencies appear on young leaves first. Symptoms include chlorosis and crinkly leaves with necrotic (dead) patches. There may be dieback of the tips. As stated previously, many deficiencies cause similar symptoms which makes diagnosis difficult. In most cases many factors are involved and no one factor in particular can be credited with causing the symptoms. The suitability of the site for growing trees and the soil type are important factors in healthy tree growth. If trees are not growing well, these factors need to be examined. Deficiency symptoms may occur even where there is no shortage of the element in the soil. The element may be present but unavailable for the plant to use. Climatic conditions often complicate the issue further. For example, if there is a deficiency of boron, symptoms will appear in the dry season but may disappear when it is wet.

Another factor that is often overlooked is weed competition. Eucalypts, particularly seedlings and young trees, are very sensitive to weed competition. In plantations where weeds are plentiful, the weeds compete with the trees for water and nutrients and there may be dramatic reductions in growth rates and survival of the trees. Weed control is particularly important if the site has previously been a pasture. According to some opinions, if trees less than 4-6m high do not have healthy foliage right to ground level, the problem is likely to be either weed competition or nutrient deficiency. This view obviously assumes that insect damage, disease, moisture stress (either too much or too little) and frost have been ruled out. It is important to eliminate these factors before deciding the problem is one of deficiency. If a deficiency is suspected, leaf samples can be analysed for their chemical content but the results are often far from conclusive as so little is known about the nutrient levels in healthy eucalypts. Perhaps the easiest way to determine whether there are sufficient levels of a particular element is to apply that element to the site or to a sample plot and monitor its effect on the tree.

Summary of Nutrient Deficiencies in Eucalypts

Element	Symbol	Part of Tree Affected	Main Symptoms	Notes
BORON	B	young leaves and shoots	dieback of young shoots and tips new leaves may have yellow margins	important when trees growing in marginal areas
CALCIUM	Ca	young leaves and shoots	dieback and distortion of leaves necrotic patches on leaves poor growth little branching	deficiency most common in very acid soils are few symptoms in <i>E. globulus</i> apart from poor growth and little branching
COPPER	Cu	new leaves and shoots	dieback of terminal shoots stems/trunk twisted and curved	often linked with zinc deficiency deficiencies mainly occur in sandy soils
IRON	Fe	new leaves	pale green new growth chlorosis	deficiency often occurs on limey soils
MAGNESIUM	Mg	older leaves	chlorosis may be green "V" shape along midrib older leaves may be reddish and shed prematurely	deficiency common in very acid sandy soils with high potassium levels in <i>e. globulus</i> chlorosis is only symptom
MANGANESE	Mn	young leaves	chlorosis with cupping of leaves necrotic patches on leaves	deficiency often due to liming of acid soils
NITROGEN	N	older leaves	yellowing of leaves, yellow spots on leaves chlorosis, particularly of lower leaves small leaves poor growth premature leaf drop poor root development	not a common deficiency in eucalypts
PHOSPHORUS	P	older leaves	purple or bronze colour on leaves stunted growth dry tips and margins, particularly on lower leaves poor root development	rarely deficient in <i>E. globulus</i> main symptom is some dry tips and margins
POTASSIUM	K	older leaves	dead or scorched leaf margins, spreading to tips curled or cup-shaped leaves in <i>E. globulus</i>	often deficient in sandy soils the symptom of curled tips may be specific <i>E. globulus</i>
SULPHUR	S	older leaves	chlorosis veins may be pale in green leaves	rarely deficient <i>E. globulus</i> may show slight chlorosis
ZINC	Zn	young leaves	chlorosis stems die back from tips crinkly leaves, may be bronze coloured with necrotic patches	often associated with copper deficiency

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