6 MAGNESIUM

6.1 Role in citrus production

Magnesium (Mg) is the central ion in the molecule of chlorophyll but more, ±70%, of the total Mg content of plants is in a mobile form. The rest is present in chlorophyll, pectin and oxalates.

The main role of Mg is its participation as co-factor in enzyme reactions in the processes of phosphorylation. It acts as a bridge between the pyro-phosphate structure during energy transfers. Magnesium is therefore important in the energy management of the plant. The involvement with enzyme reactions is similar to that of manganese but differs from that of Ca and K.

The Mg status of the trees can therefore also be misinterpreted by using leaf analyses data without orchard information. Due to its mobility, the Mg is relocated from old to new leaves. The old leaves are being shed too early leaving the trees sparsely foliated. The analytical result will reflect the content of magnesium of a tree with a low leaf density. Please refer to the hidden deficiency symptom of nitrogen in Chapter 2.

Magnesium deficiency

A magnesium deficiency will reduce the assimilation rate of CO_2 and other processes long before the chlorophyll per se is reduced. Assimilation of nitrogen into protein is also reduced by a lack of magnesium.

Magnesium deficiency symptoms will develop on old leaves. The magnesium is relocated from the old leaves and symptoms usually appear during autumn or early spring when the demand from new growth is highest. These deficient leaves are shed prematurely and photosynthetic capacity is lost.

Magnesium deficiency can induce an alternate bearing pattern. This is more possible with certain mandarin types, especially the seedy varieties.

Magnesium deficiencies occur country wide and are aggravated when potassium nutrition is emphasised to improve fruit size. Absorption of magnesium is suppressed by potassium applications to the soil and foliar sprays.

To correct a magnesium deficiency might take a number of years. It is therefore essential to increase the potassium applications with caution while the magnesium status is monitored closely. A magnesium deficiency will also result in too small fruit and can mask the effects of an increased potassium status.

Excess magnesium

An excess of magnesium can substitute Ca in the cell walls but the resultant compound has the same qualities.

An excess Mg is mainly of importance due to its inhibiting effect on the absorption of potassium. This will therefore also result in too small fruit.

In soils, excess magnesium might act as sodium in destructing the soil's structure. It can also aggravate crusting and all other negatives resulting from an excess of sodium.

6.2 Sources of magnesium

Magnesium can be supplemented by applying any of the following sources (Table 20). Other factors like pH of the soil and additional elements required, will dictate the most suitable source.

Table 20. Magnesium sources for use in citrus orchards

Source	% Magnesium
Magnesium oxide	50 – 54
Magnesium hydroxide	40 – 45
Magnesium sulphate	10
Dolomitic lime	15 – 30
Magnesite	20 – 30
Magnesium carbonate	15 – 25
Calmafos	11
Magnesium nitrate	5.3 – 9.6
Potashmagnesium	6
Mixtures	Varying

Magnesium oxide and hydroxide are excellent sources of magnesium and can be used on virtually all soils (especially on sandy soil) as a slow release form of magnesium. These two materials are both alkaline and can also be used as liming material. The application rate to increase or maintain the magnesium status is not more than 500 kg per ha. Such an application will not increase the pH of neutral to slightly alkaline soils too much. Both are slightly soluble and the particle size is therefore important.

Both are more effective on soils with a pH (water) <6.5 but can also be applied to soils with a pH (water) up to 7,5.

Table 21 illustrate the response of citrus trees and the soil to applications of magnesium oxide. One application of 208 kg magnesium oxide was applied to a soil containing 11% clay. The samples were taken 7 months before and 5 months after the application.

Table 21. The result of magnesium applications on the soil and trees.

	Before	After
pH(water) of the soil	7,15	7,33
Available magnesium in the soil mg/kg	74	107
Leaf content % Mg	0,28	0,40

Magnesium sulphate is very soluble in water but is not a good source of magnesium when using conventional systems. It is a good source of Mg and sulphur for dripper systems and hydroponics. Applications of magnesium carbonate like dolomitic lime and magnesite cannot correct magnesium deficiencies but is useful to maintain a satisfactory status in the soil and leaves.

Magnesium nitrate is a good source of magnesium in drip and hydroponic systems and can be used on all soil types. It is also an excellent source of magnesium for foliar sprays.

6.3 Fertilisation with magnesium

Soil applications

The magnesium content of the soil expressed as a % of the four cations, Ca, Mg, K and Na, should be between 15 and 25%. Deficiency levels of magnesium in the soil are usually related to acid soils and can be corrected with dolomitic lime. However, deficiencies in the trees as indicated by foliar analyses and visual symptoms can also be found on soils containing enough magnesium.

Fertigation with microjets

Although magnesium sulphate can be applied through the microjet, applications of magnesium oxide or hydroxide or even dolomitic lime via conventional fertilisation are preferred. The application of magnesium sulphate through microjets has not been tested properly.

Fertigation with drippers

Magnesium sulphate and nitrate are the most popular sources for application through the drippers. Because Mg is very mobile in the plant, it can be “accumulated” to be utilised when supply is insufficient. Therefore the application of magnesium can also be postponed to control the EC and applied at a later/earlier stage when the demand for Ca is less. It is not required to apply the magnesium continuously every day.

6.4 Foliar sprays

A number of magnesium chelates are available. However, magnesium nitrate is still a popular and effective product. Two sprays with 1250 g Mg as magnesium nitrate per 100 litres water is about 80% effective in correcting mild magnesium deficiencies. Magnesium nitrate can be applied in July with or without urea to correct serious deficiencies before flowering.