12 ZINC

12.1 Role in citrus production

Zinc (Zn) is involved in the metabolism of nitrogen and a zinc deficiency will lead to a reduction in the RNA produced and thus in cell division.

Zinc is required to produce serine a precursor of tryptophane. Tryptophane is converted to the growth hormone indole acetic acid that governs the growth rate. Hence the short internodes and small leaves when zinc is deficient.

Like Mn and Mg, zinc is also involved in the binding of substrates and enzymes.

Zn is most probably also involved in the functions of the stomata and like K fulfils a regulatory function.

A very important function of Zn is in maintaining the integrity of the membranes and can reduce the impact of stress (Swietlik, 1999). During adverse conditions like heat or cold, the membranes are damaged and may loose their ability to function properly. If Zn is in short supply the impact of the adverse condition is much larger. For instance, in the absence of enough Zn, P may leak from the membranes. The damage is not reversible and it is therefore important to maintain an optimal Zn status. A Zn spray after the event will be of little use. This could be the reason why Zn and boron sprays onto the flowers of macadamia, mango and avocado improve pollination and fruit set.

Zinc is fairly immobile in the plant and the degree of relocation depends on the current Zn status of the tree. Zinc applied to the soil will accumulate in and on the roots and a small portion is translocated to the tops. With ^{65}Zn applied to the leaves, less than 1% was relocated to other plant organs (Boaretto et al, 1999).

Zinc deficiency

The concentration of zinc in the soil is not related to the zinc status of the trees. Zn has to be applied as a foliar spray at least once per annum. Citrus trees utilise the Zn in the soil very inefficiently although Zn accumulates in the roots. Therefore, while the roots may contain enough Zn, deficiencies might still develop in the leaves.

Symptoms of a Zn deficiency are very specific. The leaves are small, the internodes are short and the chlorotic areas between the veins are clear and defined. The chlorosis resembles a manganese deficiency but the leaves are about half the normal size.

Zinc deficiency symptoms also appear as a side effect of virus infections, like in the greening disease.

A zinc deficiency will also reduce the root mass of grains and losses of up to 300% have been reported.

Excess zinc

This is a very rare phenomenon in the leaves but not in the soil. Excessive Zn in the soil will have a negative effect on the translocation of P to the top parts of the trees. Zinc phosphate is insoluble in water.

12.2 Sources of zinc

Zinc nitrate and zinc oxide are the most used sources of Zn. Zinc oxide is only applied as a foliar spray but zinc nitrate can also be used as a source in hydroponics.

Zinc oxide is effective to improve or maintain the Zn status of the trees but the suspension is corrosive on the spraying equipment. To minimise the corrosion a very fine grade (95% of the particle having a diameter of less than one micron) should be selected.

Zinc chelates are also available.

Zinc sulphate is not used extensively in citriculture.

12.3 Zinc fertilisation

Soil applications

Nursery trees can utilise Zn from the soil or growth medium effectively. This ability diminishes with age. Application to the soil is very ineffective. On a neutral (pH water = 6,93) sandy soil (14% clay) 75kg zinc sulphate or 2,50 kg Zn-EDTA were required

to mature trees to increase the Zn status of the leaves substantially.

Fertigation with microjets
Only young trees will respond to fertigation and this method is not recommended.

Fertigation with drippers
Fertigation with Zn through the drippers is possible and is successful with young trees. However, the Zn status in the leaves and soil need to be monitored properly. Due to the poor transportation of Zn via the roots to the leaves, the Zn status of the trees and the efficiency of the applications will demand higher applications. This could lead to accumulation of Zn as zinc phosphate on the roots or as the carbonate in the perimeter of the wetted zone.

It is claimed that the roots developed properly even below the drippers if all the micro-nutrients are supplied through the water. Therefore at least part of the Zn requirement should be supplied with the water. Foliar sprays should be used to supply the rest of the required mass.

12.4 Foliar sprays

Zinc nitrate is widely used as source of Zn for foliar sprays. It is available in various concentrations. The application rate of 150ml per 100 litres water of a product containing 5,5% Zn is quite successful. Any other formulation can be used as long as the concentration is ±82mg Zn per litre spray solution.

The movement of foliar applied Zn in the plant depends on the Zn status at the time of spray. At a low status, no Zn will move out of the treated leaf to nearby tissue. Only when the status is high, limited movement can be expected.

Due to the poor movement of Zn, timing the sprays is important. Zinc sprays should therefore be applied when a poor supply will have the highest impact on production. This will be during fruit set and even during flowering. It can also be applied during any stress period. Where Zn deficiencies are present, the applications should be done as soon as possible before blossom.