7 SULPHUR

7.1 Role in citrus production.

Notwithstanding the fact that citrus and many other crops require more sulphur than P, fertilisation with sulphur did not received its rightful measure of attention. Sulphur is applied indirectly through compost, manures and quite a few inorganic fertilisers and is seldom in short supply. However, when highly concentrated fertilisers were being applied extensively, sulphur deficiencies developed and started to draw attention.

Plants absorb sulphur as the sulphate (SO_4) and this process does not depend on the pH of the soil. Sulphur move mainly upwards to the tops and is hardly being relocated. Therefore young tissue is supplied with sulphur from the roots and not from older tissue. Sulphur dioxide in the atmosphere can be utilised by some plants but the majority of plants must be supplied through the roots.

Sulphate are reduced in the plant to the thiol-group and then incorporated into sulphur containing amino acids (Systine and methionine). Sulphur is also involved in the condensation of peptides into polypeptides and protein.

Sulphur is an important part of the thiazole ring in the structure of vitamin B-complex.

When S is in short supply, the protein content of plants and seeds is reduced. Many processes involved in photosynthesis require sulphur. Sulphur deficiency results in yellowing of leaves and can be mistaken for a nitrogen deficiency by the untrained eye. Leaf analyses can solve this confusion. Leaf symptoms appear at concentrations of <0,12% S in the leaf, but the deficient range starts at 0,15% S.

However, the symptom of a S deficiency is quite specific. Contrary to nitrogen, sulphur deficiency develops on the new growth. The new leaves have a “rich” yellow colour on a background of green leaves from the previous flush. Trees with a S deficiency flower poorly and hardly set any fruit.

It is therefore important to ensure a minimum S content in the leaves of 0,15% prior to blossom.

7.2 Sources of sulphur

Additional sulphur can be supplied by changing the nitrogen and/or potassium source to one that contains sulphur. Table 22 contains a list of the most available sources of S. In all these listed sources except elementary sulphur, sulphur is present as the sulphate ($SO_4^=$) which is directly available to the plants. Elementary sulphur, also known as flowers of sulphur, needs to be converted by the microbes to the sulphate.

Table 22. Sources of sulphur.

Product	% S	Applied *
Ammonium sulphate	24	C, H and F
Potassium sulphate	18	C and H
Calcium sulphate (gypsum)	19	C and H
Single Super phosphate	11	C
Magnesium sulphate	13	C, H and F
Elementary sulphur	95-100	C

***** by means of; C = conventional fertilisation, H = hydroponics and F = foliar sprays.

7.3 Fertilisation of sulphur

Soil applications

The sulphate ion moves easily through the soil profile and is subjected to leaching. Applications of sulphur to the soil are very effective to correct a deficiency or to maintain the optimal status.

When a deficiency of S is detected by means of leaf analyses (leaf level of >0,15%) it will be advantagous to correct it before flowering. Applications of gypsum in May to July can be used to correct a deficiency without any precaution or disruption of the fertilisation program. Gypsum supplies Ca and $SO_4^=$ and can be applied at any time. Maintenance of

the status can be done by applying any of the sources mentioned above, at the appropriate time for the accompanying ion (ammonium, potassium, magnesium, phosphorus or calcium).

Fertigation by microjets

Fertigation of ammonium sulphate or potassium sulphate will be as effective as applications by hand or mechanical spreaders.

Fertigation by drippers

The sulphates of ammonium, magnesium and/or potassium are used in the program to supply nitrogen, magnesium and potassium but also sulphur. In many instances, the sulphates are used to balance the N and P requirement and more than the required concentration of $SO_4^{=}$ is applied. Nutrient solutions should contain not less than 30 and not more than 600mg S per litre. Remember to incorporate the concentration of S in the irrigation water into the final concentration in the nutrient solution.

Foliar sprays.

Foliar sprays have not being researched but based on the immobility of S in the plant, has little potential to correct a deficiency. It could perhaps be applied to maintain the optimal status.