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DEFICIENCY SYMPTOMS IN AVOCADOS

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ABSTRACT

Colour photographs of typical nutrient deficiency symptoms in avocados, obtained in water and sand culture under carefully controlled conditions, are presented.

UITTREKSEL

Kleurfoto's word weergegee van tipiese voedingstekortsimptome by avokado's wat in water en sandkultuur onder beheerde toestande verkry is.

INTRODUCTION

Nutritional problems experienced by plants growing under field conditions, manifest themselves in a number of different ways: growth, and often yield, declines and so-called deficiency symptoms occur. These occur because the levels of one or more element is inadequate to ensure normal growth and especially leaf colouration.

The deficiency symptoms obtained under these conditions are usually complex, and mostly the result of changes in soil conditions that involve several, and seldom only one, aspects. There are exceptions, of course, and where one is experienced with a particular crop, things are often made easier.

Deficiency symptoms should ideally be avoided. By the time that they have developed, nutritional imbalances can have progressed to the stage that yield is likely to be adversely affected. This is not always the case, however, and awareness of typical deficiency symptoms is an important part of the overall management of any crop.

In order to obtain specific, rather than the complex, deficiency symptoms mentioned above, one needs to make use of the so-called elimination technique. Ideally this is conducted in a medium in which there are no interactions between the nutrients and the medium, such as in water or sand culture. A control treatment receives all the essential nutrients at suitable levels and time intervals. The elimination treatments involve the leaving out, or elimination, of the one element that is under investigation, while all the other elements are supplied in as ideal and comparable a manner as possible. Any growth abnormalities are noted. In this way, specific deficiency symptoms can be determined and ascribed to a particular element.

MATERIALS AND METHODS

Specific deficiency symptoms for avocados have to date not been comprehensively documented with photographs. An investigation was conducted with this in mind.

Initially a water culture investigation using this technique was conducted (Barnard, 1988). Although growth was satisfactory in the initial stages, and some good deficiency symptoms obtained, root disease ultimately destroyed most treatments.

Subsequently a sand culture experiment was carried out (Barnard, 1990). This was much more satisfactory and plants could be grown and studied for considerably longer. Full details of treatments and concentrations may be obtained from the above-mentioned publications.

In the water culture investigation, Hass on Duke 7 and G755 was used, the latter proving considerably hardier in withstanding the root diseases. In the sand culture investigation, Hass on the three rootstocks G755, G6 and Duke 7 was used. There were considerable differences, as indicated by the photographs.

At various growth stages, photos of plants showing nutrient deficiences or growth abnormalities were taken.

The deficiency symptoms were compared with those generally described in several reference books (Chapman, 1966; Bould, Hewitt & Needham, 1983).

Some specific symptoms for avocados have been described by Chapman (1966). These descriptions are compared with the deficiency symptoms obtained in the water and sand culture investigations for the various elements in question.

DEFICIENCY SYMPTOMS

Complete controls

These treatments received complete nutrient solutions and serve as comparisons. [Plates 1(a), 2(c) and 2(d).]

Nitrogen

The reduction of chlorophyll caused by nitrogen deficiency leads to a loss of colour in the leaves.

In the early stages a slight fading of normal colour and slight retardation of shoot elongation occurs. This can later be associated with fruit-set.

Later stages show uniform loss of colour. The dark green leaves turn light green to yellow. Foliage is sparse and leaves are smaller. According to Bould, Hewitt and Needham (1983), the plants are also smaller. [Plates 1(c), 1(d), 2(e) and 2(f).]

Phosphorus

The visual effects of phosphorus deficiency are not always distinctive.

Foliage has a dull colour that can turn to bronze. Veins underneath the leaves turn purple and petioles may even have a purple cast (Chapman, 1966).

Other indications are slow growth rates, sparse foliage and early leaf shedding. No definite symptoms of this nature could be obtained in these investigations, however, although severe die-back did occur.

Potassium

Older leaves show the first signs of potassium deficiency.

Interveinal and irregular marginal chlorosis develops. The chlorosis changes from light yellow in colour to tan, then to brown. Finally scorched lesions appear all over the leaf. The leaves may also curve downwards. [Plates 2(g) and 2(h).]

Calcium

With calcium deficiency the young leaves are first affected. They are distorted and have irregular margins.

Leaves show spotted/necrotic areas that fade generally. Necrosis also occurs at the tips of leaves.

In extreme cases defoliation occurs. The symptoms obtained were not, however, dramatic. [Plates 3(c) and 3(d).]

Magnesium

Older leaves are first to show magnesium deficiency, usually in the latter part of the growing season. Loss of colour between the veins, with darker brighter veins is common symptoms.

In acute stages necrosis develops interveinally and/or along leaf margins. Thus dead lesions appear. [Plates 3(a) and 3(b).]

Sulphur

Sulphur deficiency symptoms are in many respects similar to those of nitrogen.

Young leaves are more sensitive than older ones, in contrast to nitrogen deficiency where all the leaves are affected. Typical symptoms include the yellow colour and smaller leaf size. [Plates 1(e), 1(f), 3(e) and 3(f)]

Iron

The reduction in chloroplast concentration associated with iron deficiency leads to chlorosis. Leaves first show interveinal chlorosis, with distinctive green veins. Later the veins also become chlorotic and leaves may fall. [Plates 1(g) and 1(h).]

PLATE 1

DEFICIENCY SYMPTOMS OBTAINED IN WATER CULTURE

(a) Complete control

(b) Minus manganese

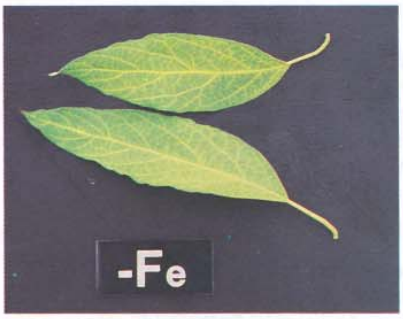
(c) Minus nitrogen

(d) Minus nitrogen

(e) Minus sulphur

(f) Minus sulphur

(g) Minus iron

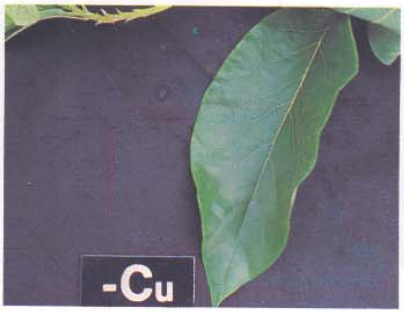


(h) Minus iron

PLATE 2

DEFICIENCY SYMPTOMS OBTAINED IN WATER AND SAND CULTURE

(a) Minus copper



(b) Minus copper

SAND CULTURE

(c) Complete

(d) Complete

(e) Minus nitrogen

(f) Minus nitrogen

(g) Minus potassium

(h) Minus potassium

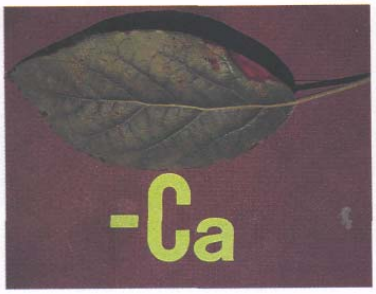
PLATE 3

DEFICIENCY SYMPTOMS OBTAINED IN SAND CULTURE

(a) Minus magnesium

(b) Minus magnesium

(c) Minus calcium

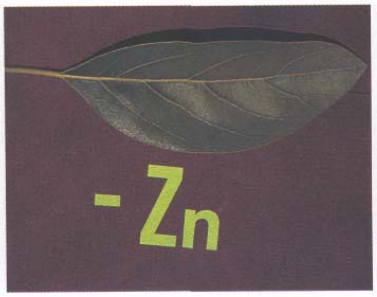


(d) Minus calcium

(e) Minus sulphur

(f) Minus sulphur

(g) Minus zinc



(h) Minus zinc

Manganese

Manganese deficiency provides a variety of symptoms.

In avocados the early stages are similar to iron deficiency. According to Chapman, 1966, chlorotic areas develop near the midrib first and then spread.

Later the dark areas become dull and the light yellow areas may become almost grey. In extreme cases the whole leaf becomes a dull yellowish green.

Early, though unfortunately not very distinctive, symptoms were obtained. [Plate 1(b).]

Copper

In copper deficiency terminal growth is affected first. Dieback of growing points is often preceded by shortening of internodes. New leaves are abortive. They almost immediately dry and die back. Older leaves are dull with reddish-brown veins. The colour may spread into the leaves.

According to Chapman (1966), plants deprived of copper develop dark green foliage and S-shaped shoots. This dark colouration was fairly dramatic. [Plates 2(a) and 2(b).]

Zinc

Terminal growth is first affected by zinc deficiency. The leaves show a mottled pattern and are narrower than normal. Kotzé (1985) published typical Zn-deficiency symptoms in a relatively old avocado tree. Typical deficiency symptoms were unfortunately not obtained. [Plates 3(g) and 3(h).]

Molybdenum

The symptoms of molybdenum deficiency are similar to nitrogen deficiency. Yellow spotting of leaves occurs. As such small amounts of Mo are required; it was not possible to demonstrate deficiency symptoms.

Boron

Boron deficiency shows very definite symptoms. Discolouration of terminal growth occurs, as well as burning and distortion of leaves. The veins split and become corklike. Twigs swell. Such symptoms were not obtained in this investigation, however.

Chlorine

The most distinctive symptom of chlorine deficiency is wilting. According to Chapman (1966), tip burn is typical. The symptoms are apparently greatly influenced by varieties, but typical symptoms were again not obtained in this investigation.

CONCLUSION

Although deficiency symptoms for all elements of plant nutritional importance were unfortunately not obtained, it is hoped that these will, nevertheless, make a contribution to our understanding of the growth of avocados in practice.

ACKNOWLEDGEMENTS

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REFERENCES

BARNARD, R O, 1988. Nutrient elimination treatments: preliminary results. *S A Avocado Growers' Assoc Yrb* 11, 25,26.

BARNARD, R O,1990, Nutrient deficiency symptoms in potted avocado plants — a progress report, *S A Avocado Growers' Assoc Yrb* 13**,** 47 - 48.

BOULD, C, HEWITT, E H & NEEDHAM, P, 1983. Diagnosis of mineral disorders in plants, *Her Majesty's Stationery Office,* London.

CHAPMAN, H D (ED), 1966. Diagnostic criteria for plants and soils. University of California.

KOTZÉ, J M & DARVAS, J M, 1985. Symptoms and causes. *S A Avocado Growers' Assoc Yrb* 8, 29 - 33.