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NUTRIENT ELIMINATION TREATMENTS WITH POTTED AVOCADO PLANTS

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PROGRESS REPORT

ABSTRACT

Hass on Duke 7 and G755 were compared in a water culture nutrient elimination study. Hoot disease conditions, which developed in water cultures (especially associated with Cylindrocarpon spp) especially affected Duke 7 plants and these became stunted and eventually died. Deficiency symptoms of N, S, Cu and Fe were clearly shown. Observations relating to the elimination of N, P, Caand B, and disease manifestation, warrant further investigation.

OORSIG

Hass op Duke 7 en G755 is in 'n waterkultuur nutrient-eliminasieproef vergelyk. 'n Wortelsiekte (veral geassosieer met Cylindrocarpon spp) het veral Duke 7 plante nadelig geaffekteer en hulle het verpot geraak en uiteindelik gevrek. Tekortsimptome van N, S, Cu en Fe is duidelik aangetoon. Waarnemings met betrekking tot die eliminasie van N, P, Ca en B, en siektevoorkoms, behoort verder ondersoek te word.

INTRODUCTION

Water cultures have been used in basic nutritional studies in the Department of Soil Science and Plant Nutrition at the University of Pretoria for many years (Barnard, 1977). Demonstration elimination treatments, that normally exhibit vast growth differences, are also normally maintained on an ongoing basis.

It was the latter that initiated discussions between Professor J M Kotzé, Head of the Department of Microbiology and Plant Pathology, and the author relating to the possibility of undertaking similar studies on avocados, ¡n this regard the following could receive attention:

1 Obtaining specific deficiency symptoms under controlled nutrient conditions, for subsequent publication in colour.

2 Studying the differential nutrient effects of rootstock and scion.

3 Studying possible interactions between artificially introduced plant pathogens and the nutrient 'condition' of plants. This could include differential resistance to disease,

as well as 'predisposition', through sub-optimal or adverse nutritional conditions, to the onset of disease.

In the preliminary study reported on here, attention was given to aspect one and, to a limited extent, to aspect two.

MATERIAL AND METHODS

For the first phase of the investigation, plant material was obtained from the nursery at Westfalia Estate. In consultation with Professor Kotzé and Messrs Toerien, Slabbert and Vorster, it was decided to study two combinations Hass on Duke 7 and Hass on G755.

On receipt in April 1987, the plant material was carefully washed free of growth medium and planted singly in Ahr-type vegetation vessels containing 11 liter of 1/4 strength Hoagland nutrient solution (Hoagland and Arnon, 1950). Because of uncertainty about the effect of N-source on avocados, some NH_4-N was, however, included with the predominantly NO_3-N supply. The composition of this solution is given in Table 1.

TABLE 1 Composition of control quarter strength nutrient solution applied initially

Element	Me/dm^3	Element	Me/dm^3
Ca^{++}	2,5	NO_3^-	2,5
Mg^{++}	1	$SO_4^{=}$	3,5
K^+	1,5	$H_2PO_4^-$	0,25
NH_4^+	1,25		
	6,25		6,25

Microelements

Fe as Fe– EDTA, Mn, Cu and Zn as the sulphates and B, Cℓ and Mo as the sodium salts, on the following basis:

Fe, Mn, B and Cℓ = 0,125 mg/dm^3
Zn = 0,0125 mg/dm^3
Cu = 0,005 mg/dm^3
Mo = 0,0025 mg/dm^3

The purpose of this preliminary background treatment was to ensure that the plants did not suffer from any serious general nutritional depletion prior to initiation of the elimination treatments. The vegetation vessels were arranged on rotating tables (Barnard and Fölscher, 1973) to ensure uniform growing and environmental conditions, and aerated during daylight hours by means of a central air compressor. Maximum glasshouse temperature was maintained as close to 27°C as possible.

Root development and proliferation commenced fairly quickly and the plants grew well, although by this stage it was during the winter months. However, some plants died, especially on Duke 7 rootstock. In mid-August, even though the plants were not showing any deficiency symptoms, it was decided to apply the differential elimination treatments.

Plants were sorted into relatively uniform groups, although it must be mentioned that

there was a lot of variation between individual plants. The elimination treatments applied are given in Table 2.

TABLE 2 Elimination treatments

Treatment number	Treatment applied
1	Complete (control)
2	−N
3	−P
4	−K
5	−Ca
6	−Mg
7	−S
8	−Fe
9	−Mn
10	−Cu
11	−Zn
12	−Mo
13	−B
14	−Cℓ

The necessary adaptations were made in the individual cases to ensure that the remaining elements were given in as comparable amounts and ratios to the complete control, as possible. The total nutrient solution concentrate applied was doubled from that applied initially, as given in Table 1, to half strength Hoagland equivalent.

RESULTS AND DISCUSSION

Within a week of changing the nutrient solutions and applying the differential elimination treatments, considerable deterioration in growth on the Duke 7 rootstock treatments had occurred. Initially some treatments wilted, and their nutrient solutions were replaced to ensure absolute accuracy. It soon became apparent that the plant roots were diseased and that treatment was necessary, and Professor Kotzé was consulted. For obvious reasons, additions of commercial products that could contain various elements under elimination, was considered undesirable.

The nutrient solutions were, however, chlorinated weekly with HTH, at the rate of 2 ppm active chlorine. This helped to a certain extent, though not entirely. Once the roots started declining the whole plant did the same. Within approximately nine 10 weeks most of the treatments on Duke 7 had died, or were well on the way to doing so.

In mid-October all the roots were washed off, chlorinated as described above, and new nutrient solution added, this time a quarter strength Hoagland equivalent, as it was felt that the half strength might possibly have been too strong.

By this time some plants from the G755 rootstock showed similar tendencies and a very similar pattern emerged. Certain treatments appeared to be more susceptible, however. These nutrient solutions were again changed in mid-December, and shortly after this some treatments appeared to be more affected.

During November and December 1987 photos (coloured slides) were taken of various treatments in which deficiency symptoms had developed. These were only from the G755 rootstocks, as the others had either died or symptoms were compounded by

disease. This was planned as an ongoing activity, although unfortunately less and less plants remained available.

Typical symptoms were obtained for deficiencies by elimination of nitrogen (N), sulphur (S), copper (Cu) and iron (Fe) and to a lesser extent, manganese (Mn). These are being kept for publication in colour at a later stage.

During January 1988 the roots were again examined by plant pathologists. Mr J Botha, of the Department of Microbiology and Plant Pathology, reported the presence of the following:

Trichoderma spp	35 per cent
Fusarium solani	35 per cent
Fusarium oxysporum	10 per cent
Cylindrocarpon spp	20 per cent

Phytophthora cinnamomi was not present.

OBSERVATIONS AND COMMENTS

Although of a strictly observational and tentative nature at this stage, the following may be mentioned:

1 Hass on Duke 7 rootstock was slower at establishment, grew slowly and produced plants that appeared to be more susceptible to disease than Hass on G755.

2 Nutrient application, even the changing of nutrient solutions, appeared to provide enough of a 'shock' to result in disease manifestation shortly afterwards.

3 The minus Ca and minus B treatments were generally the first to decline and die on the G755 rootstock, although there was no clear treatment pattern on Duke 7, where most treatments died fairly rapidly.

4 The only treatments that were consistently healthy, both on Duke 7 and G755, were the minus N and minus P. This poses the question as to whether the level of N and P, generally added to the nutrient solutions, resulted in a nutritional situation more prone to disease.

RECOMMENDATIONS

The data obtained at this stage are not of such a nature that any conclusions can be reached. There are, however, a number of unanswered, and perhaps even unasked, questions.

In subsequent investigations it will be necessary to work under more sterile conditions. Aeration of water culture solutions will have to be evaluated and it will probably be advisable to change to sand culture instead of water culture.

There are also, however; a number of stimulating indications, especially regarding nutritional and disease interactions. The work in this regard has only just begun.

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