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STRATEGY FOR COMBATTING AVOCADO ROOT ROT

J M KOTZÉ
DEPT. MICROBIOLOGY AND PLANT PATHOLOGY UNIVERSITY OF PRETORIA

OPSOMMING

'n Moderna strategie vir die beheer van avokadowortelvrot word beskryf. Beheer berus op vier belangrike beginsels, nl. siektevrye kwekerye, bestande onderstamme, die oordeelkundige gebruik van swammiddels en gesonde verbouingspraktyke.

SUMMARY

A modern strategy for the control oí avocado root rot is described. Four important principles for an integrated control approach are indicated, viz. disease-free nurseries, resistant rootstocks, judicious use of fungicides and sound cultural practices.

INTRODUCTION

Several root pathogens are associated with avocado root rot, like *Verticillium theobromae, Rhizoctonia solani, Fusarium oxysporum, F. moniliforme, Pythium* spp. and *Cylindrocladium scoparium,* but no pathogen found so far in South African avocado roots was nearly as pathogenic as *Phytophthora cinnamomi.* In practice all the other pathogens are ignored at the present stage while all control efforts are aimed at *P. cinnamomi.* This may prove to be a serious mistake. Root rot is a complex problem and a single solution will not last, no matter how good it seems to be. Constant pressure of a specific nature, Like the use of a single fungicide will tend to give rise to other problems, for example, other pathogens may gradually or suddenly cause serious damage. A multipronged approach is necessary.

The severity of *Phytophthora* root rot in South Africa is probably due to the prevailing high soil temperatures, summer rains which sometimes cause water logging, badly drained soils, lack of rootstock resistance, and the low calcium and magnesium status of the soils, (Zentmyer, 1979)

CONTROL

Since 1977, an intensive research programme was sponsored by the S.A. Avocado Growers' Association in order to find means of controlling the disease. The objectives of this programme were threefold:

1. To evaluate fungicides and techniques of application in order to save existing orchards.
2. To develop methods of establishing disease-free nurseries; improve orchard practices which will suppress disease development and to encourage biological control.
3. To introduce resistant rootstocks from California, and to select for resistance under our own severe disease conditions.

It will be noted that these objectives were short, medium, and long term. The research programme yielded positive results within a year when very promising results were obtained with soil applications of fungicides (Darvas, Kotzé & Toerien, 1978).

The fungicide that gave the most significant control of the disease on fully grown trees and seedlings was metalaxyl, which was used as a soil application in a 5% granular formulation. After registration of the product, thousands of trees were treated with two applications per year. After a few years the results with metalaxyl were less convincing and the trees deteriorated despite treatment. There is evidence now that *P. cinnamomi* has become resistant to metalaxyl in some localities in South Africa. (Darvas, 1983).

Fosetyl-Al was introduced as a foliar spray, but up to six applications were recommended per season. This control programme was laborious and expensive, and the recovery of infected trees was slow. Alternative methods of application were explored, and Snyman & Kotzé (1983) showed that fosetyl-Al applied as a stem paint or in a plastic sponge-band around the trunk was as effective as were foliar sprays. These techniques are easier and cheaper to the grower. Darvas, Toerien & Milne (1983) demonstrated that diseased trees recover remarkably well when injected with a water solution of fosetyl-Al. This technique is a significant break-through, especially under severe disease conditions. The cost of material is considerably reduced as 0,4 a.i. is applied per m^2 canopy. Two injections per season were sufficient to effect almost complete recovery of severely infected trees. There is no doubt that this technique is by far the most effective way of controlling *Phytophthora* root rot.

Chemical control of avocado root rot has become a means to survive until such time the long-term control measures, like resistant rootstocks, can be fully adopted. The progress made with chemical control is so remarkable that farmers consider root rot as a solved problem. The truth, is, however, that we have developed techniques to employ chemicals to our best advantage. At the same time, nursery techniques, plant hygiene and the introduction of resistant rootstocks play major roles in the establishment of a sound avocado industry.

DISEASE MANAGEMENT

The management of avocado root rot depends on four principles.

1. Disease-free Nursery Plants

The objectives of an elite nursery are as follows:

Complete elimination of *P. cinnamomi is* practiced. All the soil and potting media are heat or steam sterilized or fumigated with methyl bromide before these materials are allowed to enter the nursery. No worker is allowed to enter the nursery without washing of hands, sterilizing of tools, and wiping of the feet in copper sulphate powder. All the plant material used in the nursery is washed and treated with fungicides. Water, which is an important distributor of *Phytophthora* inoculum, is closely scrutinized. Borehole water is preferred because most of the rivers are heavily infected. River water is sometimes filtered but always chlorinated and afterwards left to stand for 24 hours before use. Hygiene standards are high and are applied voluntarily by the nurseryman. If there is relaxation of standards, *Phytophthora* claims a high toll.

2. Resistant Rootstocks

So-called resistant rootstocks, particularly Duke 6 and Duke 7 were introduced from California and are produced vegetatively to avoid the variation found in seedlings. The switch to Duke 7 is taking place very rapidly. Duke 7, however, is not resistant, but more tolerant than the Guatemalan seedlings used before. The new orchards on Duke 7 should perform better than the susceptible Guatemalan seedlings, but the resistant rootstock of the future will probably be selected under our own conditions of high disease pressure. Clonal Duke 7 should however be

treated with great respect and care. It is not as robust as Guatemalan seedlings and farmers are sometimes disappointed with clonal Duke 7 if these trees are not properly irrigated and cared for during the initial stages after planting. Duke 6 is no longer considered as a future rootstock because of stem-pitting and subsequent die-back. The cause of this phenomenon is not known yet. Other rootstocks from California which impress under *Phytophthora* root rot conditions are G6 and G755 (selections of *Persea schiediana).*

There is, however, a tendency, in South Africa to consider rootstocks only or primarily for resistance against *Phytophthora.* This is potentially risky for the following two reasons:

(a)There are other potentially dangerous pathogens to which the new rootstock may be susceptible. Such a weakness often manifests rather rapidly after years of good performance (like Duke 6).

(b)The horticultural characteristics of a rootstock should never be underestimated. It may grow well and vigorous under *Phytophthora* conditions, but may fail entirely to produce fruit, or the fruit quality may be inferior.

3. Judicious use of fungicides

The third, but very important principle of root rot management involves the use of fungicides. At this stage the grower has only one fungicide to rely on, viz. fosetyl-Al, if he has metalaxyl-resistant *Phytophthora.* However, there are several methods of application to choose from. When the disease is mild, regular stem sprays or painting will halt the progress of the disease. The sponge-band appears equally effective. If, however, the disease gets out of hand, the trees can be saved by stem injections. The disease management of root rot has become sophisticated. At present, fosetyl-Al offers the only practical short term solution. However, where metalaxyl has not been used, or where only limited use was made in the past, this chemical gives acceptable results when it is applied to the orchard soil.

It is expected that the chemical control techniques will yield even better results where the resistant rootstocks have been introduced. Duke 7 performs well in greenhouse experiments and is undoubtedly more resistant against the local strains of *P. cinnamomi* than the Guatemalan seedlings.

It should, however, be remembered that modern fungicides have a tendency to become less effective after continuous usage. This may be due to resistance or other reasons. A fungicide treatment, no matter how effective, should not be regarded as a permanent solution. Research on fungicides is a never ending process. Furthermore, as we are dealing with a biological system one or more of the other pathogens may become more prominent and the root rot complex may assume new dimensions which may be disastrous. The more specific the fungicide the higher is the pressure on the other pathogens to assume greater economic importance.

The root rot problem is never static and constant vigilance is of paramount importance.

4. Clean orchard soils ana sound practices

The fourth line of defence against root rot is clean orchard soils in which to plant clean plants from the nursery. New orchard soils are often not infested with *P. cinnamomi,* and it was proved that if a grower fumigates with methyl bromide the planting hole in which he plants a clean tree, root rot takes much longer before tree decline sets in. Some growers fumigate planting holes with methyl bromide at least a month before planting. A cheaper method namely solarization is being evaluated in areas with long periods of summer sunshine. A thin, transparent plastic cover over moist soil 6 weeks before planting is effective in reducing *P cinnamomi* a level where it has no or

little effect on the young plant. Solarization before planting is a promising new method that might replace fumigation in some areas. A phenomenon was recorded in Queensland Australia where *P. cinnamomi,* although present in the soil, causes no significant disease (Broadbent & Baker, 1974). The soil which behaves like this is called suppressive; and, although there is no lack of theories, we do not

Environment: climate, soil types and water quality.

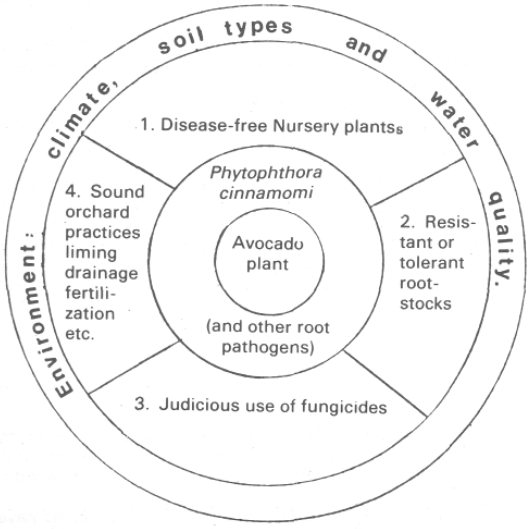

FIG. 1: Summary of the important factors in a strategy for the control of *Phytophthora* root rot of avocados.

Understand a suppressive soil well enough to produce it or to encourage its formation. The emphasis in our case is on the reduction of inoculum and on preventing any soil situation that will predispose the tree to infection.

Liming of soils before planting was found to be beneficial. Surface and subsoil drainage is very strongly recommended.

TOTAL STRATEGY

The strategy of avocado root rot control is best presented by a circle, divided into different sectors (Wolstenholme, 1979). In the centre of the circle is the avocado plant, surrounded by *P. cinnamomi.* It is a fact of avocado growing that *Phytophthora* will always be a factor to contend with. The modern strategy is summarized in fig. 1.

Figure 2: A young avocado tree stem painted with Aliette for the control of root rot.

Figure 3: A mature avocado tree treated with the sponge band in which Aliette is impregnated, covered with black plastic.

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