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Integrated Control of Avocado Root Rot

J. M. Kotzé
Dept.of Microbiology and Plant Pathology, University of Pretoria, South Africa

J. M. Darvas
Westfalia Estate, Duiwelskloof, South Africa

This article describes how avocado root rot which threatened the very existence of the avocado industry in South Africa is now being brought under control through integrated disease management.

Root rot of avocado, caused by *Phytophthora cinnamomi* Rands, has reached epidemic proportions in South Africa since the late sixties. In a recent survey, 82% of all avocado trees suffered from root rot. Although other root pathogens like *Cyclindrocladium scoparium* Morgan, *C. parvum* Anderson, *Pythium spp., Fusarium oxysporum* Schlecht, F. *moniloforme* Shel, *Rhizoctonia solani* Kuhn, and *Verticillium theobromae* (Ture) Mason & Hughes, have been found associated with avocado root rot, *P. cinnamomi* predominates the scene completely. The disease causes the death of thousands of trees, and orchards are seldom productive after 12 years. The future of the industry depends largely on the effective control of *P. cinnamomi.*

The severity of 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).

Since 1977, an intensive research program was sponsored by the S A Avocado Growers' Association in order to find means of controlling the disease. The objectives of this program 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 cultural practices which will suppress disease development.
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 program 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 fully grown trees and seedlings was metalaxyl, which was used as a sou application in a 5% granular formulation. After registration of the product, thousands of trees were treated with two applications per year. After the second year, 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 program 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 when injected with a 8 to 10% solution of fosetyl-Al. This technique is a significant break-through, especially under severe disease conditions. The cost of material is considerably reduced as 0,4g a.i. is applied per m2 canopy. Two injections per season were sufficient to effect almost complete recovery. 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 that 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 tune, nursery techniques and plant hygiene play major roles in the establishment of a sound avocado industry. 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. CLEAN ORCHARD SOILS

The second line of defense against root rot is clean orchard soils in which to plant clean plants from the nursery. New orchard soils are seldom infested with *P. cinnamomi,* and it was proved that if a grower fumigates the planting hole with methyl bromide hi which he plants a clean tree, root rot takes much longer before tree decline sets in. It is therefore recommended that planting holes be fumigated with methyl bromide at least a month before planting. A cheaper method, namely solarizarion, is making progress, however. A thin, transparent plastic cover over moist soil 6 weeks before planting is effective in reducing *P. cinnamomi* to 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 completely. Apart from being cheaper, solarization can be just as effective as methyl bromide, is cheaper and safer, provided that the time of the year is chosen discreetly. A phenomenon was recorded hi 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 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.

3. 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. This research continues.

4. JUDICIOUS USE OF FUNGICIDES

The fourth, but very important, principle of root rot management involves the use of fungicides. 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 of 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.

Root rot control has become a science of an art. The art lies in management, and not in recipes. The successful grower should understand all the different facets of root rot and he must make it part of his management program.

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