## Management information: *Phytophthora cinnamomi*

**Preventative measures:**

Menge (1998) states that, "Resistant rootstocks have the greatest possibility of successfully controlling avocado root rot in the long run. Several breeding and selection programs around the world have identified rootstocks with a high degree of tolerance to *P. cinnamomi*. In order to use resistant rootstocks, they must be clonally propagated so that they all contain the same genetic identity, which results in resistance to *P. cinnamomi*. None of the rootstocks identified so far is able to withstand infections by *P. cinnamomi* under hazardous disease conditions. That is why several other methods of control must be used In conjunction with resistant rootstocks in order to control the disease."

Botanic Gardens Trust (UNDATED) suggests that, "Sanitation of tools, machinery and boots is probably the most effective means by which the spread of *P. cinnamomi* can be limited. Sanitation procedures may seem time consuming and annoying, but prevention and limitation of a disease such as *P. cinnamomi* is the most effective means of disease control."

**Physical:**

The Botanic Gardens Trust (UNDATED) suggests that, "Plants should, wherever possible, be grown in soil mixes which have been correctly steam-air pasteurised (30 minutes at 60°C). If it is not possible to pasteurise mixes make sure that the mix components are disease free. Ensure that the potting mix is not subsequently contaminated. eg. by water draining into soil bins in heavy rain or by careless handling with implements. *P. cinnamomi* can survive in very small quantities of soil for long periods of time so nursery sanitation is very important. All plants should preferably be grown on raised wire-mesh bench at least 30 cm off the ground; this minimises water splash, which may possibly contain the fungal spores, from the ground onto the plants.

If this cannot be achieved plants should be grown on free draining blue metal. Keep the whole nursery area clean and free of dead plant material and refuse. Burning the infected plant or disposal in garbage are the most satisfactory methods of disposal. Infested potting soil should be carefully disposed."

**Chemical:**

Phosphite is a known inhibitor of *P. cinnamomi* growth and seed germination. As well, careful planting and replanting techniques by nurseries can help control *P. cinnamomi* by reducing chance that it will spread when contaminated plants are replanted (Fairbanks *et al.* 2001). Menge (1998) states that, "Two fungicides have been very successful at reducing *P. cinnamomi* in many areas of the world. Metalaxyl (RidomilR) is highly soluble, moves readily in soil and is absorbed readily by avocado roots. It may be applied as a granular, a drench or injected into the irrigation water. A single application of metalaxyl will provide 3 months of control. Some resistance to metalaxyl has been found in some *Phytophthora* spp. and rapid soil degradation may occur in some soils, although uptake of the material by roots should occur well before degradation begins. The other fungicide is phosetyl-AI (AlietteR) or potassium phosphonate which breaks down into the active ingredient phosphorous acid. They appear to be superior to metalaxyl when applied to mature trees in California (Coffey, 1992). This fungicide is translocated both upward and downward in the plant, although the upward movement is much stronger.

Trials carried out showed that an improvement in tree condition could be noted within one year after three injections with either phosetyl-Al or phosphorous acid. The tree usually responded faster with phosphorous acid than with phosetyl-Al. They also showed that the injection of some inorganic compounds (potassium hydroxide, alum and boric acid) can control *P. cinnamomi* Bezuidenhout *et al.* 1987.

Shearer et al. (2006) assessed the effect of phosphite concentration on lesion development by P. cinnamomi in stems and roots of native Australian species

Banksia grandis and Eucalyptus marginata and in stems of Banksia coccinea, during a 4.3 year period after stem injection of phosphite. One of the conclusions of this assessment, drawn by the authors is that "Longevity of action of phosphite for 4–5 years in native plant species after one injection makes phosphite injection a practical control option for the control of P. cinnamomi disease front extension and the protection of threatened flora. Research into the effect of factors affecting longevity of action of phosphite would facilitate optimization of timing of injection".

Menge (1998) states that, "Calcium is a particularly important nutrient that may be utilized in the control of *P. cinnamomi*. Applications of calcium as calcium carbonate, calcium nitrate and calcium sulfate have also been shown repeatedly to reduce *P. cinnamomi*. Messenger-Routh (1996) studied all of these mechanisms in California soils and determined that calcium primarily acted as a weak fungicide by reducing the size and number of sporangia produced by *P. cinnamomi*."

**Biological:**

Menge (1998) states that, "Today there are several commercial biocontrol products available with Trichoderma or Gliocladium as the active biocontrol agent. However, these products are mostly experimental at this time. Evidence indicates these biocontrol microorganisms do not always survive when used in avocado groves. Another interesting biocontrol approach to *P. cinnamomi* is the field production of antagonistic bacteria in field fermentors and their continuous application in irrigation water."