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ROOT ROT CONTROL IN TROPICAL RAINFOREST SOILS

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There are six important factors which will assist in reducing root rot losses.

(These factors apply particularly to red basaltic soils which previously supported tropical rainforest.)

Studies on the root rot problem in the rainforest soils at Mt. Tamborine in southern Queensland have revealed two distinct situations.

Firstly, all attempts to isolate *Phytophthora cinnamomi* from undisturbed rainforests on these red basaltic soils, even when adjacent to devastated avocado plantations, have failed. This suggests that either the fungus cannot successfully invade this very stable ecosystem or that it establishes but disappears soon after its addition to these soils. It may also reflect our inability to recover the fungus with conventional baiting techniques due to inactivation of sporangial stimulators or their active metabolites. However, limited direct root isolations, and the removal of soil and the planting of this with the very susceptible *Persea indica* seedlings have also failed to reveal the presence of *P. cinnamomi.* It has been suggested that the rainforest flora is resistant to the fungus. However, in 1975, Brown of the Queensland Department of Forestry found *P. cinnamomi* to be associated with deaths in the rainforest at Eungella and Garrawalt in North Queensland. The soils in these areas are derived from granite or rhyolite and not from basalt as in southern Queensland avocado growing areas. Although no pathogenicity studies have been done it is possible that some elements of the southern rainforest may be susceptible to the root rot fungus, but infection does not occur because the red basaltic soils are buffered against the pathogen.

On this basis a system of plantation management has been developed to restore the physical, chemical and biological properties of the soil to their original condition so that they will buffer the pathogen. Intensive cover cropping in the early years of plantation life until the natural shedding of avocado leaves continues the mulching process, and then supplementing this natural leaf fall as plantations become older with organic amendments and occasional light applications of lime or dolomitic limestone, gives good root rot control.

The legume *Lab lab purpureus* and a forage sorghum or maize for the summer, followed by New Zealand Blue Lupin for the winter provide ideal cover crops. The cover crops are slashed when mature and incorporated with disc harrows with a minimum of

soil disturbance. Fowl manure is also applied to the surface of organic mulches with a wide carbon/nitrogen ratio so that any ammonium or nitrate nitrogen produced is immobilized and then released slowly from old organic residues.

Once the surface horizon nutrient levels in plantations is near that found under rainforest, inorganic fertilizer applications are no longer encouraged. Fertilizers should be used only for the production of organic mulches.

Investigations have shown that *P. cinnamomi* can no longer be recovered from a site at Mount Tamborine where declining avocado trees were removed in early 1973 and the soil restored with intensive cover cropping, frequent light dressings of dolomitic limestone and fowl manure. The area was replanted late in 1973 with clean nursery stock. The inoculum density has apparently been reduced to a very low level.

Secondly, we have the situation in established plantations, where disease losses have been minimal despite the presence of *P. cinnamomi.* The fungus can be recovered without difficulty from beneath very healthy trees. The soils under these trees have the following characteristics.

1. High soil organic levels and thus high cation exchange capacity and high base saturation.

2. High calcium levels.

3. High nitrogen levels with most nitrogen tied up in the old organic residues.

4. pH 6-7

5. Low bulk densities and a wide range of available moisture. This means that trees are rarely under transpirational stress.

6. Soil extracts cause massive breakdown of the fungus.

DRAINAGE

Don't plant shallow soils. If clay is too close to the surface the profile above will be saturated for many days during protracted wet periods, thus favoring infection by *Phytophthora cinnamomi*

RESISTANT ROOTSTOCKS

Duke 6, Duke 7, G6, G22 and Huntalas have been shown in California to have limited resistance to root rot. Some of these rootstocks will eventually be made available to nurserymen.

CALCIUM

Maintain high soil calcium levels. Apply frequent light dressings of lime or dolomitic limestone (don't exceed 1 tonne/ha per application).

HEALTHY AVOCADOS

NITROGEN

Maintain high soil nitrogen levels but prevent too much conversion to nitrate nitrogen. An organic matter with a high nitrogen content (e.g., fowl manure) will not nitrify as rapidly as urea or ammonium sulphate.

PATHOGEN FREE NURSERY STOCK

Plant only pathogen free nursery trees. Prevent reinfection of areas where the fungus cannot be found and which may never have been infested. A large amount of pathogen inoculum may swamp out the ability of the soil to suppress or buffer the pathogen. Nursery stock with root rot may fail to establish or grow so slowly that the tree will never be able to live with the fungus.

ORGANIC MATTER

Avoid clean cultivation. Grow cover crops such as forage sorghum or maize plus *Lab lab purpureus* for summer, followed by New Zealand Blue Lupin for winter. Slash cover crops when mature and incorporate with disc harrows with a minimum of soil disturbance. For larger trees use mulches such as wheat straw or sorghum stubble which are low in nitrogen. (A mulch similar to rainforest litter is required. The rainforest litter is composed mainly of old leaves which contain a lot of structural carbohydrate and are very resistant to breakdown.) If the carbon: nitrogen ratio is too narrow the mulch will breakdown rapidly with most protein being converted to nitrate nitrogen. Where the mulch has a wide carbon: nitrogen ratio, nitrogen will be tied up initially and then slowly and continuously released into the system.

These factors apparently enable a favorable balance to be maintained between the tree and the fungus. We do not pretend to understand all the factors limiting the fungus, but believe we have sufficient information which, if applied correctly will go a long way towards solving the problem.

REFERENCE

BROWN, B. N. 1976. *Phytophthora cinnamomi* associated with patch death in tropical rain forests in Queensland. Australian Plant Pathology Society Newsletter 5: 1-4.