SCREENING FOR RESISTANCE TO Phytophthora cinnamomi ROOT ROT.

by F. Batini.

Summary

Phytophthora cinnamomi is catholic in its ability to cause root rot in woody hosts and it appears that few tree species will be immune to infection by this pathogen. However, a number of species are able to survive in field situations where mortality of susceptible species has occurred.

There are indications that trees are most susceptible to root rot in both the seedling and mature phases of development. Screening trials using seedling material are therefore considered to be justified.

Various techniques have been developed for the screening of candidate species. These techniques are briefly described and some of the advantages and disadvantages of each are discussed.

Introduction

Phytophthora cinnamomi Rands predominantly causes root and collar rots in woody hosts, trees and shrubs. This pathogen has an extensive host range which includes both indigenous and exotic forest trees of commercial importance. P. cinnamomi root rot of Jarrah (E. marginata), is a disease of economic importance to Western Australia and it appears that the pathogen is widely distributed in the Eastern States.

There is need to test for the resistance of various tree species to P. cinnamomi root rot since this pathogen can adversely affect the production, protection and recreational values of susceptible forest communities. The various techniques used will be discussed under these headings:-

A. Nutrient culture trials
B. Pot trials, and
C. Field trials.

A. Nutrient culture trials

Test seedlings are usually germinated in sand and are then transferred to aerated nutrient solution. When an adequate number of new roots have developed, the plants are inoculated with either:-

a. a suspension of motile zoospores
b. infected material bearing sporangia
c. pure cultures growing on agar, or
d. naturally infected soils.

Under these conditions, infection progresses rapidly and the final disease rating may be assessed within two weeks of inoculation. Control of a variety of factors is possible and this allows for reproducibility of results and rapidity of testing. As the root systems are visible, the progress of infection and the host reaction are readily observed.

This is a very severe test and could result in the rejection of candidates which are field resistant to the disease. Zentmyer has tested over 20,000 seedlings and cuttings of avocado (Persea sp.) with this technique, and considers that all plants with less than 80 percent root rot should be retained for further testing (Zentmyer and Mircetich, 1965). As these trials are carried out under highly artificial conditions, the results obtained require critical evaluation.

However, the technique is suitable for -

1. an initial screening of a large quantity of plant materials, and
2. detailed work requiring periodic root examination.

B. Pot Trials

Among the more common types of inoculum used are:-

a. pure cultures growing on agar
b. suspensions of motile zoospores
c. field soil from diseased areas
d. infected grain or other media
e. dipping the roots in spore or mycelial suspensions prior to potting.

Though still an artificial system, pot trials more closely resemble the natural field situation and provide for a less severe screening test. The effects of various soil factors, e.g. texture, fertility and microflora on the host x pathogen interaction can be investigated. Larger plants can be used and the trials can be maintained over a longer period.

However, the root systems are not readily observable, the activity of the pathogen cannot be readily assessed and the response to inoculation is generally less rapid. A useful screening of candidate species and environmental factors is possible, as a precursor to the evaluation of a reduced number of critical factors in field experiments.

C. Field Trials

a. Screening Trials

Preferably these should be established on sites where P. cinnamomi is currently active. If required, the level of inoculum may be increased by artificial inoculation of the site, inoculation of the test seedlings prior to planting or by pre-planting the site with a susceptible host such as Banksia sp. or New Zealand blue lupin.

Close spacing is preferable so as to concentrate the amount of host root material. In small trials, controls may be established so as to separate the effects of other environmental factors from the effects of P. cinnamomi. In larger trials, controls are of more limited value due to the likelihood of chance contamination.

These trials are a useful tool, particularly if they are supported by investigations in nutrient cultures and pots. The development of P. cinnamomi root rot may vary considerably after planting depending on the distribution and level of inoculum, the site and the season. Adequate replications in space and in time will be necessary.

b. Trials under Operational Conditions

These are established primarily by Dividional Forest Officers engaged in the reforestation of "dieback" areas. To date, a variety of species, sites, establishment techniques and fertiliser amendments have been used. These plots are normally planted at wide spacing on "graveyard" sites where the level of inoculum is reduced. These are considered to be longer term trials, but some have already provided valuable information.

c. Artificial Inoculation of Native or Exotic Stands

This technique will be used in Western Australia to test the field resistance of karri (E. diversicolor) and jarrah stands on selected sites. Investigations on the effects of soil type, aspect, slope and silvicultural treatment on the rate of spread, and the rate of intensification of the disease are planned. The possibility of artificial inoculation of established arboreta and isolated plots of exotices has also been considered. This may be a useful approach in the Eastern States if suitable areas are available where the likelihood of inadvertent contamination of commercial forests is minimised. These areas need not be large and the possibility of ditching, fencing and eventual fumigation of the site should be considered.

Discussions and Conclusions

Most of the eucalypt and pine species tested to date are hosts of P. cinnamomi and there is only circumstantial evidence that any forest trees are immune to this pathogen. However, a number of hosts are able to grow in field situations where mortality of susceptible species has occurred. It appears that tree species are most susceptible to P. cinnamomi root rot in the seedling and mature phases of development (Newhook, 1959; Copeland, 1952). The correlation between tests in nutrient cultures, pot and field trials, has generally been good (Zentmyer et al, 1962; Podger, unpublished). Initial screening trials using seedling material and therefore considered to be justified.

The basic problem in all trials is to predict accurately the ultimate field performance of a candidate species. It is suggested that best practical approach is to compare the relative performance of the test candidate to the

performance of indigenous species whose field resistance to the disease has been documented.

References

Copeland, O. L. Jr. (1952) - Root mortality of shortleaf and loblolly pine in relation to soils and littleleaf disease.
J. For., 50 : 21025.

Newhook, F. J. (1959) - The association of Phytophthora spp. with mortality of Pinus radiata and other conifers.
N. Z. J. Agric. Res., 2 : 808-843.

Zentmyer, G. A., W. A. Thorn and R. M. Burns (1962) - Field trials for resistance to Phytophthora root rot.
Calif. Avocado Soc. Yearbook 1962 : 88-93.

Zentmyer, G. A. and S. M. Mircetich (1965) - Testing for resistance of avocado to Phytophthora in nutrient solution.
Phytopathology 55 : 487-489.