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DIEBACK RESEARCH - Dwellingup Research Station.

Studies on Jarrah Dieback in 1980 have been primarily directed to understanding the epidemiology of Phytophthora cinnamomi in the Jarrah forest environment, the effect of legumes and soil type on the development of the pathogen and infection and symptom expression in jarrah.

a) Epidemiology

Major experiments undertaken to gain more information on the epidemiology of P.cinnamomi are:

1. Seasonal development of soil population levels in freely drained upland and water gaining lowland sites.

2. Infected Banksia grandis as a source of inoculum

3. Seasonal development of sporangium formation and the effect of blackening of the soil following burning.

4. Effect of irrigation on intensification and spread.

Preliminary results from this years experiments support conclusions from previous years data that the rainfall pattern during the past 5 years has been marginal for the development and spread of P.cinnamomi on freely drained sites.

This year, warm rains in association with N.W. winds in May stimulated sporangium numbers. Soil population numbers of P.cinnamomi increased in Autumn and were maintained right through winter; there was no apparent decrease in soil population numbers with decline in soil temperature. Sporangial production declined as temperatures became suboptimal. The first flush of sporangia occurred in spring in association with rain on the 20th and 21st October; counts as high as 200 - 300 sporangia/discs were obtained. The second significant increased in sporangium numbers occurred in association with rain on the 17th November. At this time sporangia had formed within 1 - 2 days but had not matured until 3 - 4 days following the rain. There were no immediate follow up rains to release and spread zoospores from mature sporangia. The last increased in sporangium numbers occurred in association with rain on the 25th November, but again there were no immediate follow up rains to release and spread zoospores from sporangia once they had matured.

The raw data (no correction for soil moisture) of P.cinnamomi soil population numbers around infected B.grandis or in randomly collected samples in large plots suggests that an increase in soil population numbers may have occurred towards the end of October to early November. The data does support the observations on sporangium formation that the sequence of rainfall during spring has been generally unfavourable for release and spread of zoospores.

Naturally infected plots have been irrigated twice, sometimes three times a week since mid-September. There was an increase in soil population numbers by mid-November, but no apparent change since. Irrigation is continuing.

Field and glasshouse observations suggests that 3 - 4 days is the minimum time needed for the formation and maturation of sporangia, before zoospores are released. Therefore, springs considerably wetter than those we have experienced over the last 5 years would be required to give the correct sequence of rainy days to allow rapid spread and intensification of the pathogen.

b) Studies on the effect of legumes on development of P.cinnamomi

1. Effect of Acacia pulchella on sporangium formation

2. Effect of A.pulchella on soil population numbers from infected Banksia plugs.

3. Increase in soil nitrogen under A.pulchella and A. lateriticola and the effect on P.cinnamomi.

4. Effect of A.pulchella on zoospore survival and infection of roots (with CSIRO, Kelmscott)

5. Effect of A.pulchella on sporangium formation, using intact spoil cores incubated under standard conditions (with CSIRO, Kelmsoctt)

6. Effect of different legume spp. (with CSIRO Kelmscott).

Preliminary data for this year confirms previous years work that showed sporangium production, and development from infected Banksia plugs was less under A. pulchella than B. grandis.

As part of her honours work Jennie Cary is undertaking glasshouse and field experiments to determine nitrogen levels under A.pulchella and A.lateriticola and the effect on P.cinnamomi. Because of considerable variability there was no consistent difference in total nitrogen between burnt and non-burnt acacia plots. There was more amonium nitrogen in soil under the Acacia spp. than B.grandis (3 ppm compared to 1.5 ppm respectively). Ammonium nitrogen was slightly but consistently higher in burnt than non-burnt plots. There has been no consistent difference in soil population levels of P.cinnamomi between treatments.

Zoospore survival and root infection has been less under A.pulchella than B.grandis. The effect of A.pulchella on stimulation of sporangium production using intact soil cores has been confounded by the ability of the soil to stimulate sporangia. In the past soil leachates have been used to test stimulation of sporangia, but this system is very artificial and does not relate to the natural soil environment. When intact cores were used, stimulation of sporangia was only obtained if the soil in the core had been exposed to a sequence of wetting and drying during the normal course of the season. Therefore, these observations suggest that there is needed a sequence of wetting and drying of the soil for the stimulants needed to initiate sporangium production in addition to a sequence of rainy days needed to release and spread zoospores.

Fourteen legume spp. germinated following the medium intensity burn in Hakea earlier this year. A pot trial has been started at CSIRO, Kelmscott to evaluate the degree of susceptibility of the legumes to P.cinnamomi infection and their effect on development of the pathogen.

c) Effect of soil type on the development of P.cinnamomi.

As part of his honours programme, Stan Sochacki is comparing in glasshouse and field experiments, the effect of a red earth and a conducive black gravel on the development and survival of P.cinnamomi. Using intact soil cores sporangium production was less in the red earth than the black gravel. Again stimulation of sporangium production was dependent on the soil having undergone a wetting and drying sequence in the field.

d) Jarrah infection studies

1. Infection of the stem and large roots.

2. Inoculation studies (with CSIRO, Kelmscott)

In a survey of 11 recently dead Jarrah and 6 apparently healthy controls nearby, we were able to isolate P.cinnamomi from the base of the stem of the dead trees and the large woody roots of dead and apparently healthy trees. The fungus was also recovered from the base of the stem of two dead jarrah from a rehabilitated bauxite mining area. Infection of the stem and large roots of some of the dead jarrah was similar to that observed for Banksia. Further work is being undertaken to determine how frequent infection of the stem and large roots occurs in comparison to infection of feeder roots, how the physiology of the tree affects the type of infection and the ways in which the tree can compartmentalize infected areas. Artificial inoculation studies, in conjunction with CSIRO, Kelmscott are being undertaken to determine how the timing of the infection in relation to tree growth affects the degree to which the tree becomes invaded.