NEW INSIGHTS INTO THE SUPPRESSION OF PLANT PATHOGENIC FUNGUS (*PHYTOPHTHORA CINNAMOMI)* BY COMPOST LEACHATES

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1. INTRODUCTION

Use of compost as a soil conditioner and low-grade fertiliser is gaining popularity worldwide (Epstein, 1997). Compost not only adds plant nutrients to the soil, but also improves physical properties of soil such as buffering capacity, cation exchange capacity and water holding capacity. In addition to these benefits, compost can also suppress plant diseases caused by *Phytophthora cinnamomi* (Hoitink *et al.,* 1977), *Pythium aphanidermatum* (Mandelbaum and Hadar, 1990), *Rhizoctonia solani* and *Sclerotium rolfsii* (Gorodecki and Hadar, 1990).

Irwin *et al.,* (1995) reported that the diseases caused by *P. cinnamomi* are directly responsible for considerable economic losses in many horticultural, ornamental and forestry industries throughout Australia. Phytophthora spp. continue to be the focus of attention of many researchers due to the diversity of *P. cinnamomi*-host interactions and their potential economic impact on a wide range of industries.

The practise of using methyl bromide and other chemicals for disinfection of soil is widespread (Trillas *et al.,* 2002). However, the use of methyl bromide and other chemicals is phased out in the USA and Europe. The suppression of soil-borne plant fungus by composts produced from tree barks (Spencer *et al.,* 1982) and municipal solid wastes is well documented (Trillas *et al.,* 2002).

Composts that suppress plant disease have been extensively described and are used in greenhouse production systems (Lazarovitis *et al,* 2001). However, most studies have focused on composting different types of materials and their effect on fungal pathogens inhibition rather than composting conditions that may produce suppressive composts. An objective of this study was to investigate the role of moisture, aeration and compost maturity in enhancing the inhibition effect of compost on the plant pathogen *P. cinnamomi.* A further objective was to generate an increased understanding of the mechanism of growth inhibition.

2. RESULTS

Compost leachates were obtained by suspending compost in water (ratio of 2:3). A sterile filter paper soaked in 1 mL of the leachate was placed underneath the agar layer of a standard agar plate. A PC agar plug was placed on top of the agar as inoculum. This avoided direct contact between the fungus and the compost microorganisms. It was found that the inhibition effect of different composts was extremely different, ranging from no inhibition effect to complete inhibition of *P. cinnamomi* growth.

To differentiate whether the inhibition effect was caused by the chemicals in the compost leachate or by the living microbial cells, the leachate was filter sterilised (0.2μ) and tested again. The sterile leachate caused no detectable inhibition in the growth of *P. cinnamomi* but the backwash from the filter inhibited *P. cinnamomi* growth to an extent similar to that of the unfiltered extract. This indicated that the bacteria from the compost were able to produce metabolites that severely interfered with the growth of *P. cinnamomi.*

As traditional agar medium used (potato dextrose agar) may provide the bacteria with large concentrations of artificial substrates that are not normally available in the soil. Consequently, it was possible that major environmental changes caused by the bacterial metabolism such as accumulation of toxic aldehydes, alcohols or organic acids were the reason for the inhibition of *P. cinnamomi* growth. To avoid this laboratory artefact, a dilute agar (5% potato dextrose) and a water agar (washed agar) were also tested. Again the bacteria from the compost could completely inhibit the development of *P. cinnamomi*, while controls showed good spreading of the fungus across the agar surface. This result indicated that very low quantity of *P. cinnamomi* growth inhibitory compounds must be released by the bacteria, as the agar did not supply significant amounts nutrients that provide a substrate for the production of substantial metabolites.

Microscopic examination of *P. cinnamomi* growth on mira cloth discs in sterile and non-sterile leachates was also carried out. Spore formation, both sporangia and chlamydospores were inhibited in the presence of non-sterile leachate form composts. Moreover, mycelium death in the presence of non-sterile leachate was also observed. Inhibition of *P. cinnamomi* growth in non-sterile leachates is similar to growth inhibition on agar plates.

To investigate the level of inhibitory compounds produced in different composts the effect needed to be quantified. This was accomplished by investigating the effect of different dilutions of compost leachates on *P. cinnamomi* growth. The most capable composts showed significant inhibition after up to 100 or 1000 times dilution of the leachate with sterile water.

Phytophthora cinnamomi growth inhibition effect was observed in a number of different composts made from chicken manure/ wheat chaff, horse manure and grass clippings. No clear relationship between compost feedstock used and the inhibition effect caused could be established. However, the composting conditions showed an effect on the level of inhibition developed. The effect of aeration level (temperature profile), moisture and compost maturity were investigated. Results indicated that composts with a clear anaerobic phase followed by a thermophilic aerobic phase produced the strongest levels of inhibition. However, by limiting the air supply to avoiding the development of high temperatures did not result in more inhibition of *P. cinnamomi* growth. In identical composts produced from grass clippings, horse manure and jarrah sawdust the use of lower moisture (30%) was advantageous as compared to normal (50%) and high moisture (58%) composts.

A comparison of *P. cinnamomi* growth inhibition effect developed as a function of time of 5 different laboratory compost trials suggested that after 4 to 5 weeks the compost has maximum inhibition effect. Further maturing lowered its *P. cinnamomi* inhibition potential. If these laboratory based findings are applied in the field conditions this would suggest using relatively fresh compost for land application, rather than a completely matured material.

3. CONCLUSIONS

Our results show that *P. cinnamomi* responsible for the dieback disease of native and horticultural plants in Australia (e.g. avocado, jarrah, banksia, grass trees) is highly sensitive to the small amounts of chemicals produced by microorganisms indigenous to compost. Compost conditions can be modified to optimise the *P. cinnamomi* growth inhibition effect. The present results also show that it is possible to produce compost with a certified inhibiting effect against the dieback disease. This will boost the marketability of compost as a soil conditioner.

4. REFERENCES

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