

The Problem

The oomycete *Phytophthora cinnamomi* is a soil-borne pathogen of economic and environmental significance worldwide. With a host range greater than 1000 species, the pathogen can devastate natural systems resulting in massive losses in species richness and diversity.

From field observations we know there are some plant species that continue to thrive or actively recolonise heavily diseased areas. However, very little is known about what it is that makes them resistant to this destructive pathogen. One method of approaching this problem is an increased understanding of the natural resistance mechanisms that exist within some plant species.

This study aims to elucidate key components of resistance to *P. cinnamomi* within a model system. Insights gleaned from this model will be directly compared to native species.



Figure 1) *Xanthorrhoea australis* is highly susceptible to *P. cinnamomi* and is a key indicator species for the presence of the pathogen in the field. (a) This *X. australis* is over 100 years old and infection by *P. cinnamomi* can result in the complete collapse and death of the plant (b) in less than 12 months (scale = 75 cm)

A Model Approach

A limitation of studying resistance within Australian native plants is the lack of available genetic information. A model system using the sequenced crop species *Zea mays* was therefore optimised for this study. *Z. mays* has proven an ideal model for studying host-pathogen interactions within laboratory conditions. It has a rapid growth rate, uniform seed germination and is amenable to both hydroponic and soil growth systems (Fig 2).



Figure 2) The growth rate of *Z. mays* is highly uniform and a large number of plants can be rapidly germinated from seed.

1. Macroscopic Responses

Macroscopic responses to infection by *P. cinnamomi* within the model crop plant *Zea mays* were compared to the field resistant Australian native plants *Lomandra filiformis*, *Dianella revoluta*, *Acacia paradoxa* and the highly susceptible *Eucalyptus sieberi*.

All plants were inoculated above the root tip with a suspension of 2×10^4 zoospores mL^{-1} or mock inoculated with dH_2O . They were then screened for root necrosis, leaf chlorosis or mortality. Root and lesion length were measured every 24 hpi for 7 days.

Z. mays, *L. filiformis* and *A. paradoxa* demonstrated restricted lesion development (<5% total root length) and formation of lateral roots directly above and below the lesion site (Fig 3). There was no significant difference in root length between control and inoculated plants (Fig 4). In contrast, water soaked lesions were visible on *D. revoluta* (Fig 5d) and *E. sieberi* within 48 hpi.



Figure 3) Restricted lesion development, rapid formation of lateral roots and healthy root growth past the lesion site in *Z. mays* 96 hpi (scale = 0.5 cm)

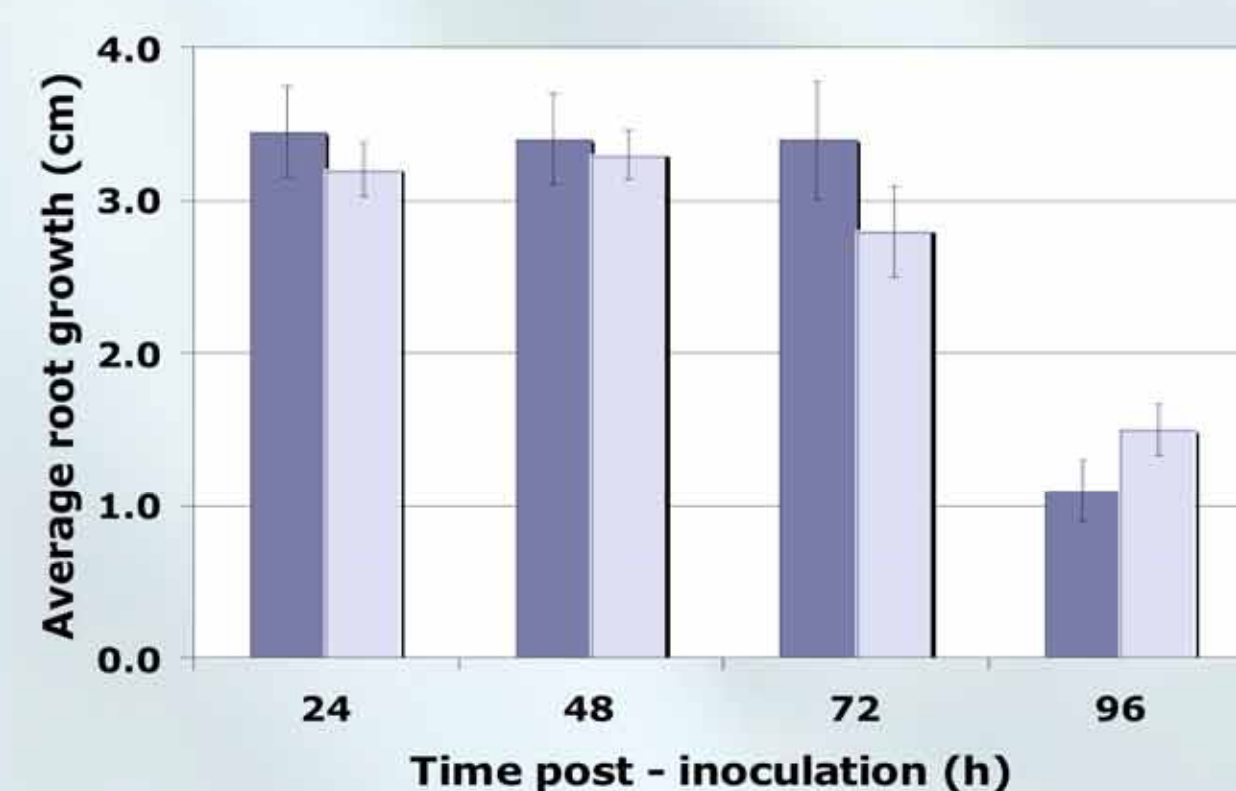
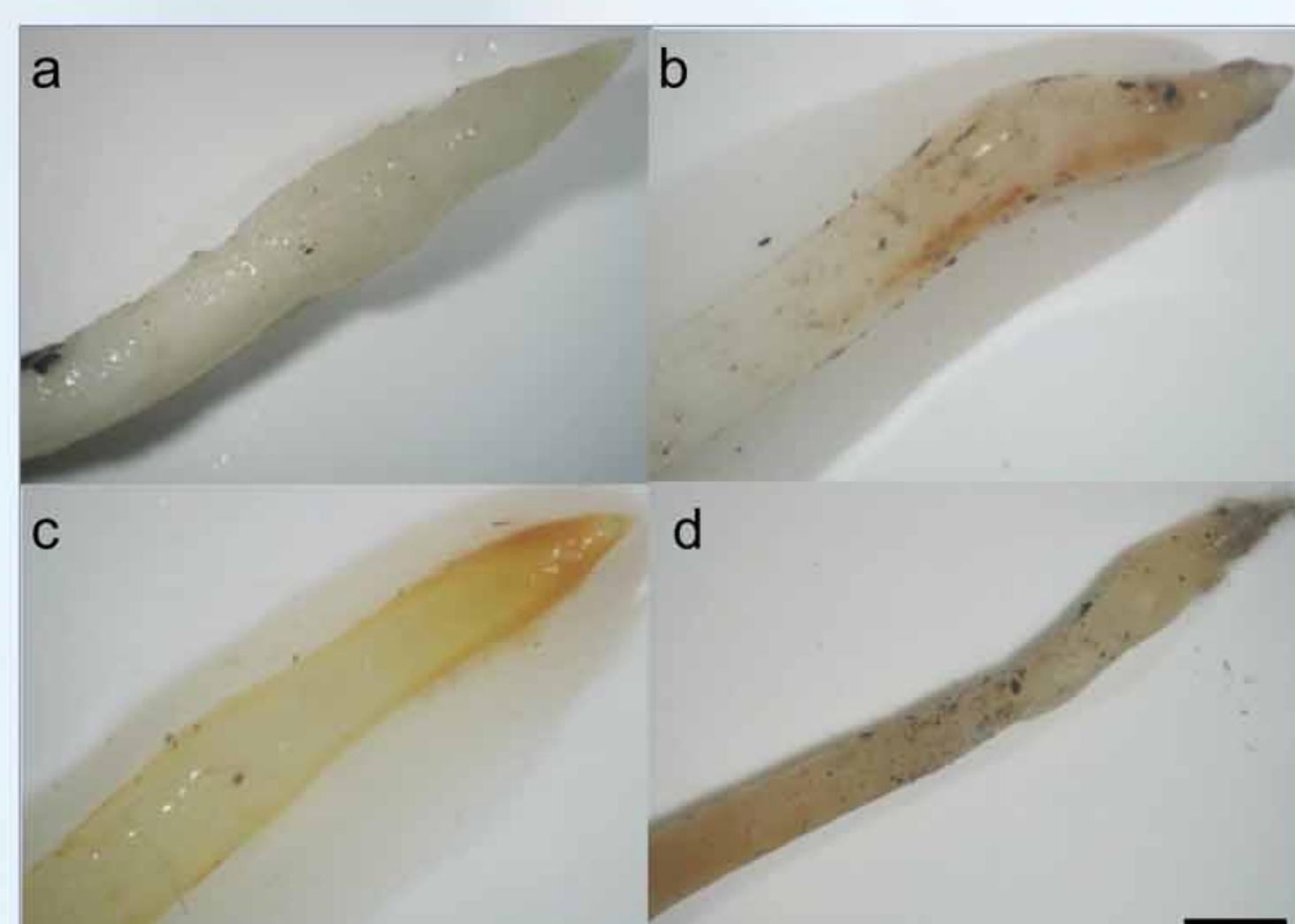


Figure 4) No significant difference in growth was observed within control and inoculated roots of *Z. mays* ($p > 0.05$) (Mean \pm SE)

Figure 5) (a & c) Control roots of *L. filiformis* and *D. revoluta* respectively. (b) Restricted lesion development in *L. filiformis* was observed 48 hpi (d) Water-soaked tissue was observed in inoculated *D. revoluta* 48 hpi (scale = 0.5cm)



2. Cellular Responses

The production of resistance markers such as phenolics, suberin, callose and lignin was examined within *Z. mays*. Roots were sectioned by hand directly above the visible lesion. A marked increase in lignin and callose production was observed in the vascular tissue of inoculated roots at 48 and 120 hpi. These findings are consistent with those in resistant Australian native plants.

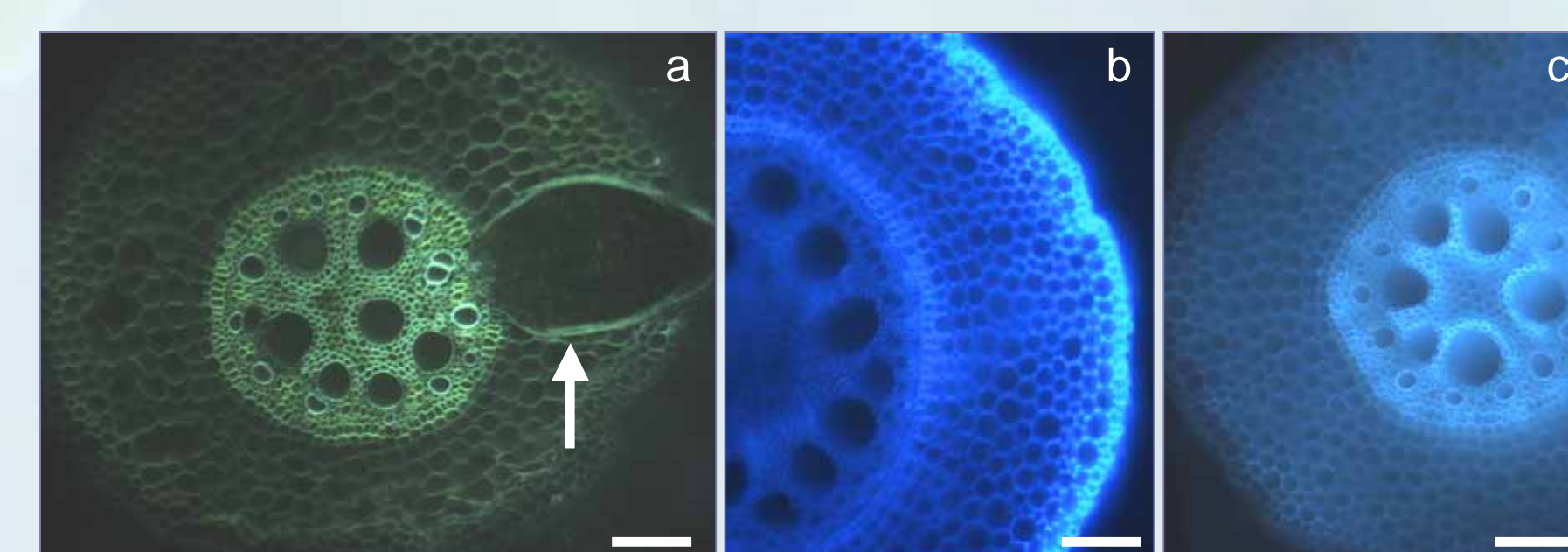


Figure 6) Aniline blue staining of *Z. mays* (a) Lateral root formation 120 hpi (b) highly suberized epidermis in control root (c) callose deposition within vascular tissue 120 hpi (scale = 100 μm)

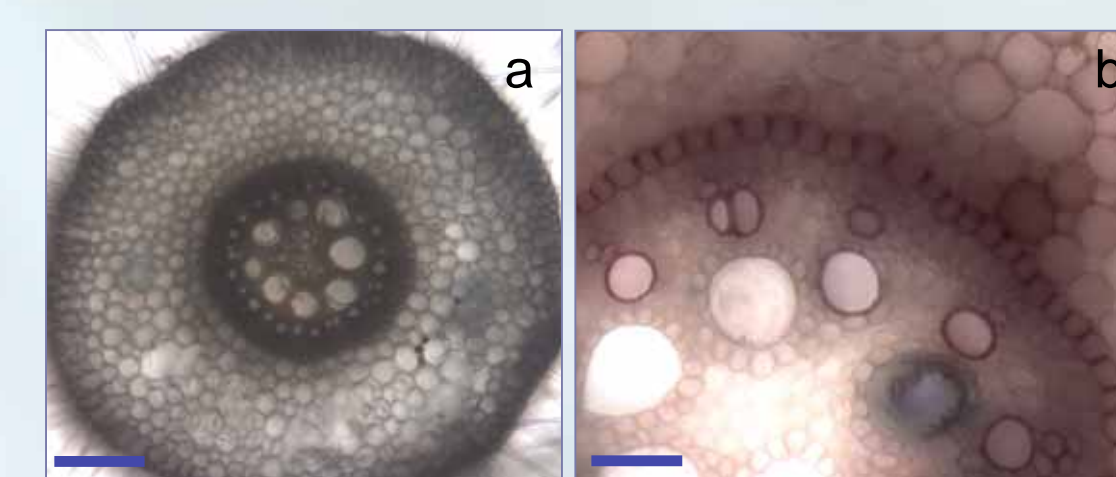


Figure 7) Phloroglucinol-HCl staining of *Z. mays* (a) minimal lignin in control root (scale = 200 μm) (b) extensive lignin production within cortex, endodermis and vascular tissue in inoculated roots 120 hpi (scale = 50 μm)

Future Directions

The effect of chemical elicitors on levels of lignin, callose and other resistance markers will be examined throughout this project. Resistance genes such as phenylalanine ammonia lyase (PAL) and pathogenesis-related (PR) genes will be investigated in *Z. mays* to determine their role in the defence response to the pathogen.

An increased knowledge of the key components of resistance to *P. cinnamomi* is a fundamental step towards the preservation of vulnerable species with the ultimate goal the application of this knowledge to susceptible plants.

Acknowledgements

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