Characterising the distribution of *Phytophthora* “taxon Agathis” (PTA) in bark, cambium and wood of diseased New Zealand kauri (*Agathis australis*)

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RESEARCH QUESTION

New Zealand’s iconic kauri is much valued for its timber[1]. With increasing numbers of standing dead kauri as a result of PTA (Fig. 1) the question is: can dead and dying kauri be harvested for cultural or commercial use without increasing the risk of spreading the pathogen? If PTA is found systemically (i.e. in xylem) then kauri wood and timber would represent a vector/ pathway for PTA spread.

Fig. 1: Yellow thinning canopies and stag heads symptomatic of kauri dieback disease, in regenerating mixed kauri–broadleaved forest.

OUR AIMS

To assess what kauri wood can be used culturally or commercially without being a biosecurity risk, we will:

- Further characterise the presence of PTA in bark and cambium
- Determine the presence and depth of PTA in xylem tissue and true wood
- Determine the height limit on the bole that PTA can be recovered from in kauri tissue
- Determine if PTA is present in canopy leaves and branches and the reproductive structures (male and female cones)

SYMPTOMATOLOGY

Kauri dieback disease has been shown to be pathogenic to kauri in all size classes, including mature kauri[2]. Symptomatology includes: yellowing thinning canopy, sudden canopy collapse, resinosis of the lower trunk, discolouration of bark and wood tissues beneath resinosis [3,4] (Fig. 2). Often the lesion fronts appear to be spreading up the trunk to 2.0m above ground level.[4]

Fig. 2: Symptoms of kauri dieback disease.

KAURI WOOD ANATOMY AND PTA IN KAURI TISSUE

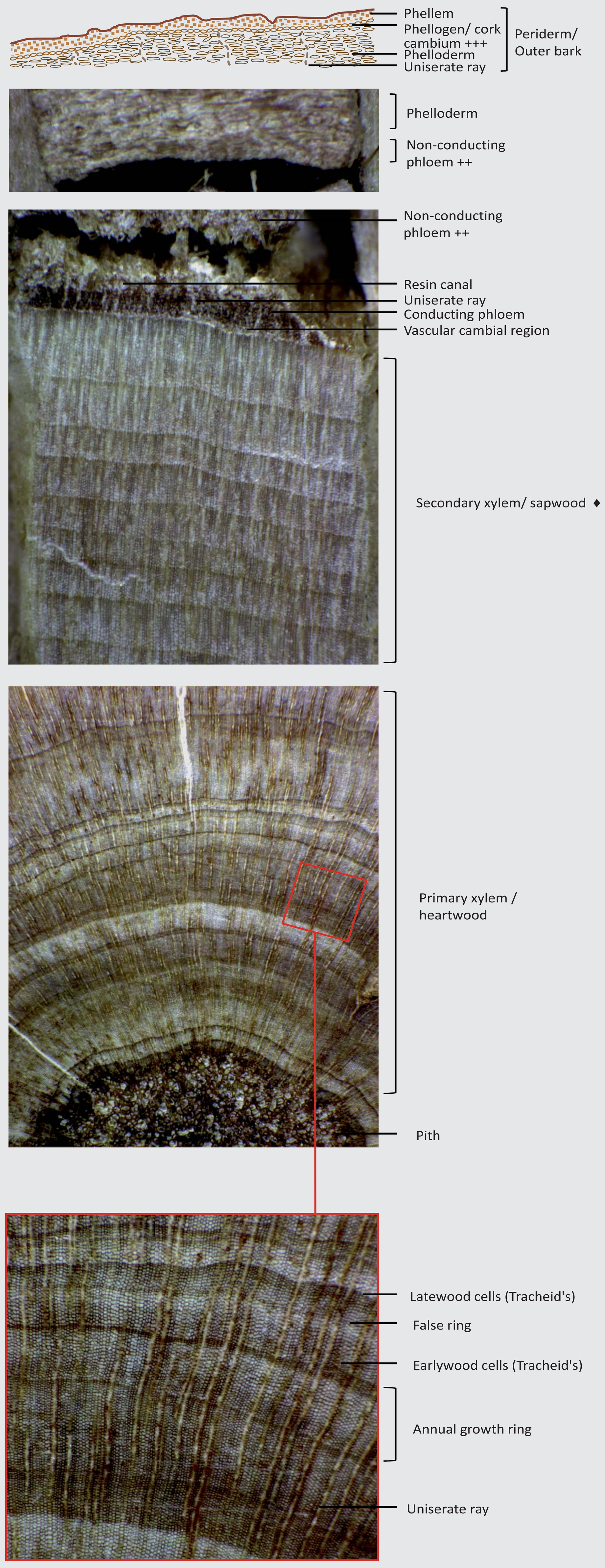

Fig. 3: Transverse cross-section of kauri bark, cambium and wood cells[5–9] Symbols indicate tissues that PTA has been isolated from and how readily PTA is recovered from these tissues: +++ Readily recovered, ++ less readily recovered[4], and ◆ very rarely isolate d.[10] Sieve cells, axial and ray parenchyma, fibres, sclereids and resin canals are present in non-conducting phloem – but are not distinguishable in these images.

- *Phytophthora* spp. have been recovered from invaded xylem tissues beneath phloem lesions in broadleaved trees, e.g. *P. kernoviae* in *Fagus sylvatica* and *P. ramorum* in *Quercus cerris*.[11]
- *P. cinnamomi* has been isolated from the bark and wood of wound-inoculated *Pinus radiata*, a conifer.[12]
- There is *a-priori* evidence for the presence of PTA in the tissues behind lesions in kauri: Beever (unpublished) recovered PTA from the xylem of a kauri tree (L10) at Maungaroa Ridge in the Waitakere Ranges (Fig. 4).

Fig. 4: Resinosis prior to outer bark and cambium removal (A) and location where PTA was isolated from wood tissue (B).[10]

THE EXTENT OF PTA IN XYLEM AND BEYOND THE LESION FRONT

- Assess late-stage symptomatic and recently dead kauri to identify PTA prior to sampling
- Use a pre-screening ELISA test to determine presence of *Phytophthora* if PTA status of the kauri is not known
- Use an increment borer to obtain core samples from the bark through to the xylem at a maximum depth of five cm in a grid-like sampling pattern
- Use arborist to collect upper-canopy wood and reproductive structures (Fig. 5)
- Microscopy, wet/ dry elution and RT-PCR will be used supplementarily with direct plating on selective media

Fig.5: Arborist using a cambium saver to obtain upper canopy wood, leaf and reproductive-structure samples from PTA-symptomatic kauri. Note the thinning canopies of these kauri on Great Barrier Island.

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