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Characteristic powdery white covering of Quambalaria pitereka *fungal growth on marri flower buds.*

Marri flowering threatened by introduced pathogen

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Over recent years, the declining health of marri (*Corymbia calophylla*) in southwest WA has been an increasing source of concern. These trees provide important flowering resources and the damage to flowers is likely to cause substantial losses of foraging resources for native fauna as well as honeybees.

Quambalaria pitereka is a fungal pathogen responsible for leaf and shoot blight known as Quambalaria Shoot Blight (QSB). QSB is known from eucalypt plantations of NSW and Queensland, but has recently emerged in WA, affecting the leaves, flower buds, flowers and fruit of WA host tree species (*C. calophylla and C. ficifolia*). The aim of this study was to ascertain the spread of Quambalaria pitereka in WA, and to determine whether the declining health of marri was due to presence of this pathogen.

Methods & Results

17 sites across southwest WA were surveyed six times over a 13 month period. *Quambalaria pitereka* is widespread over the geographic distribution range of marri (Figure 1). Severity of the disease was low in most areas, however the extreme symptoms (Header figure and Figure 2c) that were observed in Albany: December 2008 and Margaret River: May 2010 were connected to high humidity over preceding weeks.

Buds, flowers and fruit of marri were tested for the presence of *Q. pitereka*. Flower buds displaying external symptoms (Heading image) were cut open, and sporulating *Q. pitereka* was isolated from these the internal tissues of these samples after 2-3 incubation on selective medium (half strength potato dextrose agar).

Quambalaria pitereka was isolated from the carpels, and occasionally also from the 'disc' (or 'ovary roof') above the affected carpel (Fig.3). On one occasion *Q. pitereka* was isolated from the pollen of an infected flower bud, which presents significant risk for transmission of the disease by pollinators.

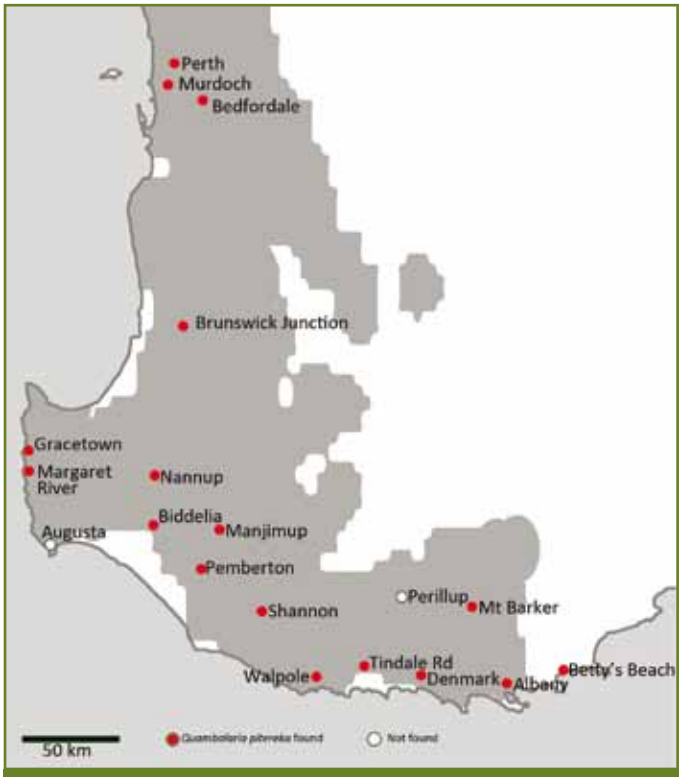

Figure 1 Quambalaria pitereka *was found across southwest WA during surveys conducted from April 2009 to May 2010. Only two of 17 sites surveyed did not test positive for* Q. pitereka.

Quambalaria pitereka was never isolated from internal tissues of asymptomatic flower buds, and attempts to isolate *Q. pitereka* from the internal tissues of pedicels and peduncles (stems) of flower buds and fruit were unsuccessful, indicating that the infection originates from the outer surface tissue of the flower buds and works its way inwards to the ovaries which are rich in nutrients.

Figure 2 Quambalaria *infection of flower buds can lead to deformities such as 'horizontal' growth of fruit (a) and unsuccessful operculum opening (b), or complete termination of the flowers (c).*

Infection of the developing fruit may arise opportunistically due to wounding or infection of the ovaries. Infected fruit grow in a deformed 'horizontal' pattern (Figures 2b, 4b), caused by infection of one or more carpels at early stages in the flower's development. The horizontal growth habit results in significantly smaller fruit and seeds and a severe reduction in the number of seeds produced per fruit. Most 'horizontal' fruit contains no seeds.

Conclusions & Recommendations

Quambalaria pitereka was first collected in WA from an amenity-planted *C. ficifolia* in 1993. By 2004, the disease had spread amongst amenity-planted *C. ficifolia*, on to natural stands of *C. calophylla*; at this time, the disease still only caused shoot blight. The first evidence of flower blight (2005) was for an amenity-planted *C. ficifolia*. It is interesting that the disease evolved from a leaf pathogen to a flower pathogen, particularly as *Q. pitereka* is not known to affect the flowering structures of its eastern Australian host tree species.

Figure 3 Quambalaria pitereka *sporulating on internal flower bud tissues – from the carpel and disc (arrows) after 3 days incubation on half strength potato dextrose agar (Bar = 2 mm).*

Both leaf and flower blight are now widespread in marri across southwest WA. The occurrence of *Q. pitereka* on marri flower buds and fruit is a recent development, with spread of the pathogen occurring only over the last ~5 years. This rapid spread of *Q. pitereka* is coupled with the recent recognition of another pathogen in marri, *Quambalaria coyrecup*, identified as causing canker disease in these trees.

The management of *Q. pitereka* in WA is likely to require a different approach to that employed in eastern Australia and other parts of the world, where the disease is principally recognised in nursery and plantation industries. QSB in WA affects both vegetative and reproductive tissues of trees in native and urban forests, and therefore cannot be controlled simply through treating seedlings with fungicide, isolating plants from infection or regulating movement of stock. In WA, we need to recognise that marri is also subject to attack by other pathogens, including three or more *Quambalaria* species. Further studies are required to ascertain the impacts of *Quambalaria* diseases on honey production, native bird food sources as well as fecundity and future for these important forest trees. Firstly we must understand the mechanism of infection and investigate the role of insects as possible vectors of the disease.

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Figure 4 A healthy marri fruit cut at longitudinal section (a) and section diagrams of infected flower bud, flower, immature fruit and mature capsule, showing how the infection of a carpel (indicated by red cross) of a flowering structure can lead to disproportionate growth of the healthy carpels, resulting in the 'horizontal' growth habit (b) (Bar = 10mm).