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Quantifying the impact of myrtle rust and endemic pathogens in highly disturbed forests

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Executive Summary

Trials evaluating the impact of the exotic pathogen *Austropuccinia psidii* (causing myrtle rust) and the endemic pathogen *Quambalaria pitereka* (causing Quambalaria shoot blight: QSB) were established at two locations in southeast Queensland. These trials were set up on sites that had recent forestry operations including tree planting and harvesting operations which resulted in coppice regrowth. Three myrtaceous species were included in the study: *Eucalyptus cloeziana*, *E. siderophloia* and *Corymbia citriodora* subsp. *variegata*. Two-year old *E. cloeziana* trees appeared to have reach a stage (height) where they had outgrown susceptibility to myrtle rust. However, *Corymbia citriodora* subsp. *variegata* trees at the same age were being moderately impacted by QSB. Coppice regrowth of these species was more impacted by the fungal pathogens than intact trees. Three fungicides were also evaluated during this study (one commercial fungicide and two novel fungicides). All had beneficial effects against the fungal diseases in terms of disease incidence or tree growth. The efficacy of the two novel fungicides warrants further investigation which may lead to an application for APVMA registration.

Introduction

Forestry operations in native forests, environmental plantings and planted forests are major disturbance events, leading to abundant coppice/seedling/juvenile growth that is ideal for the development of myrtle rust (*Austropuccinia psidii*) (Coutinho et al., 1998) and endemic fungi of leaves/stems e.g., *Quambalaria pitereka* (Carnegie et al., 2008). The interaction of myrtle rust with endemic fungi and impact on recovery of these disturbed forests are unknown (Carnegie and Pegg, 2018), warranting investigation. Additionally, two untested novel fungicides will be assessed for efficacy against these diseases.

Aim

To investigate the impact of myrtle rust and endemic fungi in a young plantation on intact and coppice trees and assess the impact of these fungi on the coppice regrowth of older trees. Additionally, we will investigate the efficacy of novel fungicides to manage these impacts, encouraging ecosystem recovery and forest establishment.

Methods/Process

Replicated field trials across two locations in southeast QLD have been established to examine current impact of myrtle rust and endemic fungi on environmental plantings and regrowth forests following forestry operations (Theme 3.2 MR Action Plan).

Site 1 Doonan

This site is an environmental planting located at Doonan, SE Queensland (-26° 27 ’43’’, 153° 1 ’10’’E), planted in October 2019. It has a mix of species including the following myrtaceous species:

1. *Eucalyptus cloeziana* (Gympie messmate),
2. *E. siderophloia* (grey ironbark),
3. *E. propinqua* (small-fruited grey gum),
4. *Corymbia citriodora* subsp. *variegata* (spotted gum, abbreviated here as CCV) and
5. *C. intermedia* (pink bloodwood).

There were sufficient tree species 1, 2 and 4 (above) in the area permitted under the Australian Pesticide & Veterinary Medicines Authority (AGVET) permit to conduct small-scale trials with AGVET Chemicals Permit 7250 for these trees to be included in an evaluation of two novel fungicides, an approved fungicide, and a nil treatment control. The young *E. cloeziana* trees (average height [Ht] at 12 months 2.77 m with a diameter at breast height over bark [DBH] of 2.6 cm) in this planting were being impacted by myrtle rust, *Austropuccinia psidii*. The *Corymbia citriodora* subsp. *variegata* trees (average Ht at 12 months 3.65 m with a DBH of 3.4 cm) were being damaged by QSB (*Quambalaria pitereka*). Coppicing was randomly done on half of the trees for these two species to ensure that the disease impact could be closely monitored from the ground level. The other half of the trees of each of these two species were left intact to enable observation of the impacts of fungicide treatments on tree growth rates relative to untreated controls. For *E. siderophloia* (average Ht at 12 months 2.82 m with a DBH of 2.9 cm) there was only enough trees for a trial of intact (not coppiced) trees (Table 1).

Natural fungal infection in this environmental planting was high with both myrtle rust and QSB observed on many trees before the trial was initiated. However, no fungal attack was observed at the commencement of this study on the *E. siderophloia* trees.

Table 1. Details of treatments applied at the trial at Doonan, southeast Queensland

Species	**Coppicing treatments**	**Fungicide treatments**			
E. cloeziana	Coppiced (7 replicates)	Nil (Water control applied by spraying – 2 applications)	Zaleton®* (Approved commercial fungicide applied by spraying – 2 applications)	Sumitomo (Novel fungicide applied by spraying – 2 applications)	Elmsavers (Novel fungicide applied as a stem application – 1 applications)
	Not coppiced (8 replicates)				
C. citriodora subsp. *variegata*	Coppiced (6 replicates)				
	Not coppiced (6 replicates)				
E. siderophloia	Not coppiced (4 replicates)				

* Yates Zaleton® dual action systemic fungicide, with a combination of tebuconazole 200 g/L which reportedly works systemically within the plant to control fungal diseases and trifloxystrobin 100 g/L which helps prevent fungal infection.

The coppicing treatment undertaken using a chainsaw was completed 1/12/2020 and the trees had sufficient coppice regrowth to allow the first application of the fungicides on 15/02/2021. The second fungicide application for those treatments that required a second application was completed on the 25/03/2021 (Figure 1).

The first measure and assessment following the fungicide treatments occurred on the 21/04/2021. Data was collected on the following traits: height (HT), diameter at breast height over bark (DBH), growth between measures, overall damage incidence, damage severity, crown damage index (CDI, Stone et al., 2003, Bonora et al., 2020), Leader Damage (1-2 score with 1 = no 2 = yes), health of top 1/3rd of the tree, presence of myrtle rust (MR) and the presence of QSB.

Figure 1. Application of the fungicides (Zaleton®, Sumitomo (Novel 1) and the nil treatment control) by spraying (LHS) and direct application of the Elmsavers (Novel 2) fungicide to the stem of the *Corymbia citriodora* tree using a syringe (RHS).

Three measurements and assessment have been completed at this site to evaluate the impact of the fungicide treatment on fungal development and growth.

Doonan data analysis

Data was analyzed using GenStat 64-bit Release 21.1 with two types of analysis undertaken: Repeated Measures – using REML for height, diameter, incremental height and diameter growth and overall damage incidence, damage severity, crown damage index and myrtle rust incidence. Following this, we undertook a general analysis of variance for each variate. If significance between results were detected, a post hoc Duncan's multiple range test was undertaken at the $P<0.05$ level.

Each species and coppicing treatment had to be analyzed separately.

Site 2 Traveston

Two trials were initiated at a 13-year-old tree planting at Traveston (-26° 19 '50'', 152° 42 '44''E). Sufficient trees of two species were available and suitable to establish trials at this location: *E. cloeziana* (from Gympie provenance trees) and *CCV* (from Richmond Range, NSW provenance trees). During 8-11 March 2021, approximately 200 trees were felled using a chainsaw and the logs removed to simulate a forestry harvesting operation to investigate the impact of myrtle rust and QSB on coppice regrowth from the stumps. The stumps were cut at 60 cm to encourage coppice growth. Coppice in eucalypts is derived from epicormic buds that occur near the vascular cambium and are a means for eucalypt species to recover from fire (Burrows 2002). In myrtaceous native heaths following fire, myrtle rust was found to severely impact the epicormic growth of many species that had been damaged in the fire (Pegg et al., 2020). It is not known if forestry operations that result in epicormic growth (coppice growth) will be similarly impacted by fungal diseases, hence this study.

Data on coppice growth, vigour and fungal disease was captured at this site for both species. No data analysis was undertaken for these trials as no treatment was applied due to the slow coppice development and low incidence of disease for *E. cloeziana*. Data from the coppice experiment is summarized below.

Results

Site 1 Donna

Eucalyptus siderophloia

The *E. siderophloia* trees had an average Ht of 5.5 m and DBH of 6.9 cm by the third measure (seven months post fungicide application). Only non-coppiced *E. siderophloia* trees were available. For most variates in the repeated measures analysis, time of the measure and assessment were not significant for this species. The one exception was DBH growth where time of the measure was significant but the time × treatment and treatment (fungicide) were not significant. The lack of significant effects for these fungicides on *E. siderophloia* may be due to the low replication (4) which was limited by the number of trees for this species and the permitted sizes of the trial area under the AGVET Chemicals Permit 7250. No myrtle rust or other fungal disease was observed on this species. Means for key variates for each treatment and timepoints are shown in Table 2.

Variate*	Fungicide treatment			
	Control	Zaleton®	Sumitomo (Novel 1)	Elmsavers (Novel 2)
CDI 1	3.15	1.44	0.48	1.25
CDI 2	4.0	0.2	0.4	0.8
CDI 3	8.4	1.1	2.4	1.9
DBH growth (cm) 1-2	0.48	0.55	0.73	0.50
DBH growth (cm) 2-3	1.15	1.13	1.15	1.25
Ht growth (m) 1-2	0.82	0.80	0.44	0.85
Ht growth (m) 2-3	0.23	0.58	0.78	0.47

Table 2. Fungicide treatment means for various traits measured on *E. siderophloia* at Doonan.

* Number after the variate refers to the time of the measure 1 = 24/04/2021, 2 = 23/06/2021, 3 = 25/10/2021. No significance difference was detected between treatments.

Eucalyptus cloeziana

Non-coppiced trees

The non-coppiced *E. cloeziana* trees had an average height of 7.3 m and DBH of 9.6 cm by the third measure. In the repeated measures analysis time was significant for DBH growth, Ht growth but there was no interaction between time and treatment or treatment by itself. For CDI and percent of trees with myrtle rust, no significant effects were detected. Only seven of the non-coppiced *E. cloeziana* trees exhibited myrtle rust infection in April 2021 which declined to three trees by the third measure. Leader damage (growing parts of the main stem) of the trees were not damaged by disease or chewing insects. Means for key variates for each treatment and timepoints are shown in Table 3. No significant results from the analysis of variance at each time point were detected (Table 3).

Table 3. Fungicide treatment means for various traits measured and assessed on non-coppiced *E. cloeziana* trees at Donna

Variate*	Fungicide treatment			
	Control	Zaleton®	Sumitomo (Novel 1)	Elmsavers (Novel 2)
CDI 1	0.58	2.06	1.34	3.00
CDI 2	0.81	2.00	0.62	0.43
CDI 3	1.81	1.27	2.25	0.64
DBH growth (cm) 1-2	0.90	1.04	0.95	1.04
DBH growth (cm) 2-3	1.94	1.85	1.75	1.79
Ht growth (m) 1-2	0.81	0.75	0.89	0.78
Ht growth (m) 2-3	0.99	0.78	0.76	0.84
MR 1 (% infected)	12.5	37.5	25.0	12.5
MR 2 (% infected)	25.0	25.0	37.5	0.0
MR 3 (% infected)	0.0	12.5	12.5	12.5

* Numbers after the variate refers to the time of measure 1 = 24/04/2021, 2 = 23/06/2021, 3 = 25/10/2021. No significance difference was detected between treatments.

Coppiced Trees

By the third measure the coppiced *E. cloeziana* trees had an average height of 3.5 m and DBH of 2.4 cm. In the repeated measures analysis, time was significant for DBH growth and for Ht growth. However, there was no interaction between time × treatment or treatment by itself. For CDI, time of the measure was significant as was the time × treatment interaction. For this variate, treatment by itself was also significant. The incidence of myrtle rust was significantly higher at the start of the assessment period however no significant effects of treatments were detected. Means for key variates for each treatment and timepoints are shown in Table 4. Significant results from the analysis of variance at each time point are shown in Table 4.

Table 4. Fungicide treatment means for various traits measured and assessed on coppiced *E. cloeziana* trees at Doonan

Variate*	Fungicide treatment			
	Control	Zaleton®	Sumitomo (Novel 1)	Elmsavers (Novel 2)
CDI 1	26.7 b	0.5 a	2.5 a	14.2 ab
CDI 2	9.5 b	0.7 a	1.9 a	4.0 ab
CDI 3	2.7	0.7	1.8	2.4
DBH growth (cm) 1-2	0.60	0.56	0.61	0.40
DBH growth (cm) 2-3	1.22	1.49	1.30	1.04
Ht growth (m) 1-2	0.44 a	0.76 ab	0.79 b	0.53 ab
Ht growth (m) 2-3	0.70	1.24	1.08	0.80
MR 1 (% infected)	86	57	57	71
MR 2 (% infected)	29	57	43	43
MR 3 (% infected)	29	14	14	29
Leader damage 1	1.8 b	1.0 a	1.3 ab	1.3 ab
Leader damage 2	1.6	1.1	1.1	1.3
Leader damage 3	1.2	1.2	1.0	0.9

* Numbers after the variate refers to the time of the measure 1 = 24/04/2021, 2 = 23/06/2021, 3 = 25/10/2021. Different letters indicate significant differences between treatments (Duncan's multiple range test at the $P< 0.05$).

Corymbia citriodora subsp. *variegata*

Non coppiced trees

The non-coppiced *CCV* trees had an average height of 7.3 m and DBH of 7.2 cm by the third measure. In the repeated measures analysis for the non-coppiced *CCV* trees, time was significant for DBH growth and QSB incidence, but there was no interaction between time and treatment or treatment by itself. However, for Ht growth both and CDI, time and treatment were significant but not the time × treatment interactions. Means for key variates for each treatment and timepoints are shown in Table 5. Significant results from the analysis of variance at each time point are shown in Table 5.

Table 5 Fungicide treatment means for various traits measured and assessed on non-coppiced *C. citriodora* subsp. *variegata* trees at Donna

Variate*	Fungicide treatment			
	Control	Zaleton®	Sumitomo (Novel 1)	Elmsavers (Novel 2)
CDI 1	39.4 b	7.0 a	3.9 a	16.2 ab
CDI 2	14.5 b	1.3 a	2.1 a	5.4 ab
CDI 3	12.1	2.4	5.5	1.5
DBH growth (cm) 1-2	0.33	0.58	0.50	0.47
DBH growth (cm) 2-3	0.90	1.2	1.1	1.1
Ht growth (m) 1-2	0.42 a	0.99 b	0.97 b	0.82 ab
Ht growth (m) 2-3	0.61 a	1.03 ab	1.15 ab	1.5 b
QSB 1 (% infected)	67	50	50	67
QSB 2 (% infected)	78	93	87	78
QSB3 (% infected)	50	33	16	50

* Numbers after the variate refers to the time of the measure 1 = 24/04/2021, 2 = 23/06/2021, 3 = 25/10/2021. Different letters indicate significant differences between treatments (Duncan's multiple range test at the $P< 0.05$).

Coppiced trees

By the third measure the coppiced *CCV* trees had an average height of 3.5 m and DBH of 2.0 cm. In the repeated measures analysis time was significant for QSB incidence, Ht growth and CDI, however the time × treatment interaction and treatment were not significant. For DBH growth, both time of the measure and the time × treatment interaction were significant. Treatment was marginally insignificant (p=0.053) for Leader Damage and likely reflects the 25% mortality in the coppiced *CCV* trees having impacted the analysis and our ability to detect significant effects of the fungicide treatments. Means for key variates for each treatment and timepoints are shown in Table 6.

Table 6 Fungicide treatment means for various traits measured and assessed on coppiced *C. citriodora* subsp. *variegata* trees at Doonan

Variate*	Fungicide treatment			
	Control	Zaleton®	Sumitomo (Novel 1)	Elmsavers (Novel 2)
CDI 1	18.9	18.1	26.1	24.2
CDI 2	2.4	10.1	17.9	20.7
CDI 3	4.1	7.9	18.6	15.2
DBH growth (cm) 1-2	0.4	0.4	0.4	0.7
DBH growth (cm) 2-3	1.0	0.6	0.9	2.0
Ht growth (m) 1-2	0.42	0.35	0.13	0.58
Ht growth (m) 2-3	1.17	0.83	1.49	1.25
QSB 1 (% infected)	99	99	100	100
QSB 2 (% infected)	80	83	75	50
QSB 3 (% infected)	80	79	50	50
Leader damage 1	1.8	1.6	1.8	1.4
Leader damage 2	1.4	1.6	1.8	1.0
Leader damage 3	1.8	1.6	1.3	1.0

* Numbers after the variate refers to the time of the measure 1 = 24/04/2021, 2 = 23/06/2021, 3 = 25/10/2021. No significance difference was detected between treatments.

Site 2 Traveston

Coppice growth on *E. cloeziana* was sufficiently developed to allow assessment for the impact of fungal attack evaluated on the 23rd of July 2021. At this time only 8 trees were observed to be infected by myrtle rust. At this time less than half the *Corymbia citriodora* trees had coppiced and the coppice was too small to assess for fungal incidence (Figure 2).

The Traveston site was assessed again on the 28/10/2021 and sufficient numbers of *E. cloeziana* and *CCV* trees had coppiced to allow an assessment of both species to be undertaken. The number of coppiced trees impacted by myrtle rust was low at both the assessment for *E. cloeziana* and the trees that were being impacted by the disease at first assessment in July, which were not necessarily the same trees that were impacted at the second measure. At the second assessment, 22% of the *E. cloeziana* trees had myrtle rust damage (Table 7). The disease incidence ranged from no observed sign of myrtle rust to the entire coppice regrowth being impacted (Figure 3).

At the same time approximately 200 m away, a large number of the *CCV* coppiced trees were being moderately to severely impacted by QSB (Table 2), with disease incidence again varying from no visible disease to the entire coppice being impacted (Figure 3).

Figure 2. *Corymbia citriodora* stumps 4.5 months (July 2021) after the trees had been felled with notably, limited coppice development. Trees were felled in March 2021.

Table 7. Incidence and growth of coppiced trees at Traveston, measured and assessed in October 2021.

	Species	
	E. cloeziana	*C. citriodora* subsp. *variegata*
Myrtle rust (% trees infected)	22.2%	-
Quambalaria shoot blight (% trees infected)	-	64.8%
Average height of coppice seven months after trees were felled (cm) (Standard Error)	131 (5.19)	121 (5.76)

Achievements, Impacts and Outcomes

The three species included in this study had different responses to the environment, manual coppicing, and fungal disease. *Eucalyptus siderophloia* had no observable fungal infection, however all trees had some leaf dieback as reflected in the CDI. *Eucalyptus cloeziana* was impacted by the exotic fungal disease myrtle rust at both field sites with a higher incidence of the disease seen at Site 1 Doonan relative to Site 2 Traveston. *Corymbia citriodora* subsp. *variegata* was impacted by QSB at both sites. Of interest, one *CCV* tree at Doonan was observed with both the coevolved fungus (QSB) and the exotic fungal disease (myrtle rust) from endemic infection at the Doonan site. To our knowledge this is the first instance where a tree has been documented with both diseases at the same time from an endemic infection. Butler et al. (2019) found that the parts of the genome (quantitative trait loci: QTL) associated with Quambalaria resistance were polygenic and generally had larger effects than those for myrtle rust resistance. They also found myrtle rust resistance QTLs were typically located on difference parts of the genome to those associated with Quambalaria resistance. Both myrtle rust and QSB impact *Corymbia* plants in a similar manner (e.g., pustules on leaves and young stems, distortion of expanding leaves and shoots, leaf and expanding stem necrosis) in seedlings and young trees (Coutinho et al., 1998, Carnegie et al., 2008, Pegg et al., 2011) and it may be that the coevolved pathogen (*Quambalaria pitereka*) can outcompete the exotic pathogen (*Austropuccinia psidii*) for these sites on susceptible hosts.

Figure 3. Top row *E. cloeziana* coppice at Traveston, Queensland, October 2021. (a) healthy coppice, (b) coppice severely impacted by myrtle rust. Bottom row *C. citriodora* coppice at Traveston, Queensland, October 2021. (c) healthy coppice, (d) coppice severely impacted by *Quambalaria* shoot blight.

In this study both diseases impacted the epicormic growth from the stumps more severely than the foliage and stems of the non-coppiced trees, which is consistent with findings that the diseases impact younger trees (Coutinho et al., 1998, Carnegie et al., 2008). At the Doonan site, myrtle rust incidence decreased across all treatments with time whereas the incidence of QSB remained constant through the assessment period.

The three fungicide treatments afforded some protection to the coppiced *E. cloeziana* and *CCV* trees as evidenced by increased height growth and lower levels of damage to the growing stems (leader damage) at the first of these assessments relative to the nil fungicide (control) treatment. This protection however appears to be transitory in the coppiced trees, with only the first assessments of these traits having significant differences. The fungicide treatments also resulted in a significant height growth increase for the non-coppiced CCV trees with this effect becoming more pronounced at the latest measure with the Elmsavers fungicide (Novel 2) having significantly larger height increment than the Control (Table 5). This could result in increased yield of trees protected by this fungicide. Similar effects were not observed in the non-coppiced *E. siderophloia* or *E. cloeziana* trees. Pegg et al 2018 found that alternate monthly application of the fungicides: Bayfidan® = Triademenol 250g/L + Zaleton® = Tebuconazole 200g/L, Trifloxystrobin 100g/L significantly increased plant growth and reduced apical leader damage in *Melaleuca quinquenervia* coppice regeneration, while not eliminating the disease. They also found that fungicide and insecticide or insecticide treatments by themselves resulted in significantly better growth than application of a fungicide by itself or the control treatment. In addition, they found over a 24-month period that the control treatments had a lot more deaths than the fungicide and fungicide and insecticide treatments. This suggests we should monitor these trials for longer to look at the long-term impact of the applications to the trees.

Discussion and Conclusion

This study has provided baseline information on the impact of myrtle rust and QSB on two types of disturbed forests:

1. An environmental planting with young trees some of which were coppiced to simulate seedling growth and the others left as intact trees.
2. Trees regrowing from stumps following a forestry harvesting operation.

Results were similar in both highly disturbed forest types, with myrtle rust impacting the young (coppice) growth of *E. cloeziana* and QSB impacting coppice and young CCV trees (up to age two).

At the Doonan site, the impact of myrtle rust appears to decrease with increased age for *E. cloeziana*. Only six intact *E. cloeziana* trees had myrtle rust at the first measure across all fungicide treatments. By the October measure however, only one of these trees was observed with myrtle rust. Nineteen of the coppiced *E. cloeziana* trees had myrtle rust at the beginning of the study, whereas six had the disease at the most recent measure. For *E. cloeziana* therefore the impact of the race of myrtle rust that occurs in Australia appears to be transitory with impact decreasing as the trees get older, with the controls and fungicide treated trees behaving similarly. This is like the impact of the disease observed in Brazil and other areas where it naturally occurs with *E. cloeziana* being noted as one of the more susceptible eucalypt species in field trials (Dianese et al., 1984) but growing through the impact in most instances (Coutinho et al., 1998).

At the Traveston site *E. cloeziana* produced abundant coppice growth more quickly that the CCV trees. Due to the slower coppice development at Traveston compared to Doonan, and the restrictions under the AGVET Chemical Permit no fungicide treatments were applied at this site. Therefore, this site, could be used in follow-up fungicide studies if permitted under an AGVET Chemical Permit and funding was available. Interestingly, the level of myrtle rust and QSB observed at Traveston was similar to that observed for the coppiced trees with the control treatment (nil fungicide) at Doonan during the October measure.

Corymbia citriodora subsp. *variegata* is one of the most harvested species from natural forests and is also one of the recommended species for hardwood plantation development in Queensland (Lee, 2007; Hogg et al., 2021). The incidence of QSB on the CCV trees remained high throughout the study period on both intact and coppiced trees. Myrtle rust does not appear to be a threat for this species, even though it is susceptible in nursery trials (Pegg et al., 2014). This may be due to its greater susceptibility to QSB as suggested from results in which *Q. pitereka* outcompeted *A. psidii* in susceptible tissues. This needs further study. The fungicides all had beneficial impacts on the growth of the non-coppiced CCV trees with the Elmsavers (Novel 2) treatment resulting in significantly greater height growth at the latest measure (age 2), relative to the control. The ongoing impact of these fungicide treatments warrants further study.

Brawner et al (2011) evaluated seven CCV progeny trials with over 500 families from 25 native populations that had been planted in southeast Queensland. They recommended that QSB resistant CCV germplasm be planted that has been selected for reduced leader damage and increased growth as both traits were moderately heritable. Use of QSB resistant germplasm in conjunction with fungicides should result in improved growth and form of CCV plantings.

The three fungicides tested (Zaleton® and two novel fungicides) all appear to provide some protection to the trees either via a reduced incidence of the pathogen or growth benefits (particularly height growth). The period of efficacy of these fungicides, however, needs further investigation with the current study indicating longer term benefits from the Elmsavers fungicide than the commercial fungicide (Zaleton®) and the other novel fungicide tested. Notably, Zaleton® which is approved for use against *A. psidii*, has been discontinued by Yates (Website accessed 19/11/2021), so there is an urgent need to find replacement fungicides for environmental, plant conservation and to protect disturbed forests. This study is an important step in addressing this, but further research is needed.

Recommendations

Based on this study the following recommendations are made:

- Further investigation (e.g., repeat fungicide application, additional effects by rotational spraying with other approved/proven fungicides from other trials and efficacy through time) of the efficacy of the two novel fungicides is justified based on the results of this study.

- As all the fungicides appear to be somewhat effective based on the current results, additional novel fungicides should also be evaluated for efficacy against these diseases.

- It is recommended that additional measures and assessments be undertaken at designated times in the future on the same trees at the two trial sites to investigate the longer-term impacts of the fungicide treatments on tree growth and pathogen incidence and severity and to determine how the trees recover from the two diseases over an extended period.

- Forestry operations (planting or harvesting) can put species at risk of myrtle rust or QSB infection and this risk needs to be mitigated through implementation of effective monitoring.

- Further research is required to augment the results from this fungicide trial before an application can be made to the APVMA for consideration of approval of a permit for forestry use, with the aim to support registration of these fungicides.

Appendices, References, Publications

Field trip

A Forestry Australia field trip including 26 people attended the site at Traveston which discussed the project and the impact of the two pathogens on coppice regrowth.

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