Biosecurity New Zealand
Tiakitanga Pūtaiao Aotearoa

MPI 18607 Project Report 9 (3.1-5)

Improved myrtle rust surveillance: Selection of indicator species for surveillance

Biosecurity New Zealand Technical Paper No: 2019/20

Prepared for the Ministry for Primary Industries
By Beccy Ganley[1] and Rob Beresford[1]

[1] New Zealand Institute for Plant and Food Research Limited

ISBN No: 978-0-9951272-4-1
ISSN No: 2624-0203

May 2019

New Zealand Government

Ministry for Primary Industries
Manatū Ahu Matua

Disclaimer

While every effort has been made to ensure the information in this publication is accurate, the Ministry for Primary Industries does not accept any responsibility or liability for error of fact, omission, interpretation or opinion that may be present, nor for the consequences of any decisions based on this information.

Requests for further copies should be directed to:

Publications Logistics Officer
Ministry for Primary Industries
PO Box 2526
WELLINGTON 6140

Email: brand@mpi.govt.nz
Telephone: 0800 00 83 33
Facsimile: 04-894 0300

This publication is also available on the Ministry for Primary Industries website at http://www.mpi.govt.nz/news-and-resources/publications/

Contents

1 Project background

To better understand myrtle rust and limit its impact in New Zealand, the Ministry for Primary Industries commissioned a comprehensive research programme in 2017 with more than 20 projects valued at over $3.7 million. Projects in this programme were completed by June 2019.

The projects covered research in the following themes:

- Theme 1 - Understanding the pathogen, hosts, and environmental influence.
- Theme 2 – Building engagement and social licence: Improved understanding of public perceptions and behaviours to allow better decisions about investment, improved design of pathway control strategies and maintain social license for use of management tools.
- Theme 3 – Te Ao Māori: Greater understanding of Te Ao Māori implications of myrtle rust in order to support more effective investments, and improved use of Mātauranga, specific Māori knowledge, and kaupapa Māori approaches in management regimes.
- Theme 4 – Improving management tools and approaches: Improved diagnostic and surveillance speed, accuracy and cost-effectiveness, supporting eradication efforts and enabling scaling up of surveillance efforts for a given resource. More effective treatment toolkits to avoid emergences of MR resistance to treatments and to enable disease control over increasingly large scales that will lead to reduced or avoided impacts.
- Theme 5 - Evaluating impacts and responses: Improved understanding of environmental, economic, social and cultural, impacts to inform risk assessment and management and to communicate implications to decision/makers and stakeholders.

This report is part of the MPI commissioned research under contract MPI18607 which addressed research questions within Theme 2, 4 and 5.

Text in the report may refer to other research programmes carried out under the respective theme titles.

2 Introduction

There are over 200 species of Myrtaceae present in New Zealand, of which approximately 30 are native species. The distribution and density of Myrtaceae in urban, rural and native environments varies across the country. In this report we outline potential species of Myrtaceae that could be used as indicator species for surveillance for rapid assessment of the spread and impact of myrtle rust across New Zealand. The selection of plants as indicator species is based on known distribution of species known to be susceptible to *Austropuccinia psidii*, are represented within the estimated distribution of myrtle rust in New Zealand and whether or not the species is appropriate for visual or remote sensing detection methods.

2.1 Susceptible host species

Austropuccinia psidii is known to infect over 450 species of Myrtaceae worldwide (Giblin & Carnegie, 2014). The list of species that myrtle rust has been found on in New Zealand during the incursion response has been used for assessing indicator species (Table 1). This list is based on DNA analysis, using a Myrtaceae barcoding library, of leaf samples taken from infected plants during the incursion. While the number of susceptible host species is expected to increase as the pathogen establishes, this list should provide information on the susceptibility of common and/or widely distributed species that could be suitable for as indicator plant species. Other worldwide lists of susceptibility of Myrtaceae to *A. psidii* were not as they are based on overseas cultivars in environmental conditions that are different from those in New Zealand.

2.2 Frequency and severity of disease

Host records in the surveillance database maintained by AsureQuality Limited (Beresford 2018) show that for nine Myrtaceae species, where more than 1,000 plants have been surveyed, the prevalence of *A. psidii* is 7.81% on *Lophomyrtus*, 1.50% on *Syzygium* spp. and 0.73% on *Metrosideros*. The other six species, including *Leptospermum scoparium* have prevalence < 0.25%. The *Lophomyrtus* records did not include a nursery where approximately 2,000 plants were found infected and destroyed because the high number of infected plants at this site would have biased the national estimate of prevalence for this genus. Within the *Lophomyrtus* records, the majority of detections have been on *L. bullata* and *L. bullata* x *L. obcordata* hybrids, although there have been a few detections on *L. obcordata* alone. Similarly, the majority of detections in *Metrosideros* have been on *M. excelsa* and *M excelsa* hybrids with other *Metrosideros* species. The *Syzygium* detections have all been on *S. australe* and *S. australe* x *S. paniculatum* hybrids.

Assessment of the putative susceptibility of the most commonly infected plant species or susceptible species that are widely distributed in New Zealand was made based on the percentage incidence of infected plants and symptom severity observed in the field (Table 2). Information was gathered from the surveillance database, personal field observations, discussions with others who have seen the levels of infection in the field or photographs of the infections. No artificial susceptibility tests have been untaken. Photographs of field infection observed during the incursion response for *L. bullata*; *M. excelsa*; *S. australe*; *A. flexuosa, E. globoidea* and *L. scoparium* are provided in Figure 1.

Table 1. Host species *Austropuccinia psidii* has been found on in New Zealand.

Host species
Acca sellowiana
Agonis flexuosa
Callistemon viminalis
Leptospermum scoparium
Lophomyrtus bullata
Lophomyrtus bullata/ L. obcordata hybrid
Lophomyrtus obcordata
Metrosideros bartletti/robusta hybrid
Metrosideros bartlettii
Metrosideros carminea
Metrosideros collina
Metrosideros collina/ M. excelsa hybrid
Metrosideros diffusa
Metrosideros excelsa
Metrosideros excelsa/ M. kermadecensis hybrid
Metrosideros excelsa/ M. robusta hybrid
Metrosideros hybrids (mixed species)
Metrosideros fulgens
Metrosideros kermadecensis
Metrosideros perforata
Metrosideros perforata/ M. carminea hybrid
Metrosideros robusta
Myrtus communis
Syzygium australe
Syzygium australe/ S. paniculatum hybrid
Syzygium maire
Eucalytpus globoidea
Thryptomene calycina
Ugni molinae

Table 2. Potential host species that could be used as indicator plants for surveillance purposes.

Host species	Common name	Status in New Zealand	Overseas susceptibility (ranking if known)[1]	Putative NZ disease severity and incidence ranking[2]	Distribution[3]	Structural class
Acca sellowiana (O.Berg) Burret	Feijoa	Horticultural; Urban	Susceptible (Low)	Low	Widespread in urban environments across New Zealand; limited distribution as a plantation species	Tree-like shrub
Agonis flexuosa (Willd.) Sweet	Willow myrtle	Urban	Susceptible (High)	High	Present in the North Island in urban environments, not common. Unclear of distribution in the South Island.	Tree
Callistemon viminalis (Gaertn.) Loudon and *Callistemon* spp. hybrids	Bottle brush	Urban	Susceptible	Low	Common in urban gardens across New Zealand.	Tree-like shrub
Eucalyptus globoidea Blakely	Eucalypt	Forestry; Urban	Susceptible	Low	Eucalypts represent a small fraction of forestry in NZ, this species is uncommon but is a species selected for future plantations.	Tree
Leptospermum scoparium J.R.Forst. & G.Forst.	Mānuka	Horticulture; Native; Urban	Susceptible	Low	Widespread across New Zealand. Common in urban environments plants represent native specimens as well as ornamental novelties. Common in native bush and lands across NZ, both planted and natural regeneration, commonly used for honey and oil production.	Tree-like shrub
Lophomyrtus bullata Burret and *Lophomyrtus bullata* x *L. obcordata* hybrid	Ramarama	Native; Urban	Susceptible	High	Widespread in urban environments across New Zealand; present in native bush, scarce in the South Island.	Tree-like shrub

Host species	Common name	Status in New Zealand	Overseas susceptibility (ranking if known)[1]	Putative NZ disease severity and incidence ranking[2]	Distribution[3]	Structural class[3]
Lophomyrtus obcordata (Raoul) Burret	Rohutu	Native; Urban	Unknown	Low-mod	Common in urban environments across New Zealand; present in native bush but not a dominant species. Patchy distribution across the country.	Tree-like shrub
Metrosideros carminea W.R.B.Oliv.	Crimson rātā	Native; Urban	Unknown	Low	North Island only, common in urban and native environments.	Climbing vine
Metrosideros collina (J.R.Forst. & G.Forst.) A.Gray	Tahitian pōhutukawa	Urban	Unknown	Low	Common in urban gardens in northern parts of the North Island. Not frost tolerant.	Shrub
Metrosideros diffusa (G.Forst.) W.R.B.Oliv.	White rātā	Native; Urban	Unknown	Low	Common throughout the North and South Islands, both as an urban plant and in native bush	Climbing vine
Metrosideros excelsa Sol. ex Gaertn.	Pōhutukawa	Horticulture; Native; Urban	Susceptible	Mod-high	Widespread in urban gardens and native coastal forests in northern parts of the North Island. Urban plantings elsewhere in New Zealand.	Tree
Metrosideros kermadecensis W.R.B.Oliv.	Kermadec pōhutukawa	Native; Urban	Susceptible	Mod-high	Endemic to Raoul Island, specimens present in northern parts of the North Island.	Tree
Metrosideros perforata (J.R.Forst. & G.Forst.) A.Rich.	White rātā	Native; Urban	Unknown	Low	Common throughout the North and South Islands, both as an urban plant and in native bush.	Climbing vine

Host species	Common name	Status in New Zealand	Overseas susceptibility (ranking if known)[1]	Putative NZ disease severity and incidence ranking[2]	Distribution[3]	Structural class[3]
Metrosideros robusta A.Cunn.	Northern rātā	Native; Urban	Unknown	Low	Common in the northern part of the North Island but absent from Hawkes Bay and scarce in the bottom half of the island. Common in the northern part of the South Island but absent in the southern part.	Tree
Syzygium australe (Link) B.Hyland and *Syzygium australe* x *S.paniculatum* hybrid	Monkey apple or lilly pilly	Horticultural; Urban	Susceptible	Mod-high	Common in urban gardens and rural areas as windbreaks. Common in the North Island, unclear of distribution in the South Island.	Tree-like shrub
Syzygium maire (A.Cunn.) Garn.-Jones	Swamp maire	Native; Urban	Unknown	Low	North and South Island, now often scarce or absent over large parts of its former range due to the clearance of swamp	Tree
Ugni molinae Turcz.	Chilean guava/ NZ cranberry	Horticultural; Urban	Susceptible	Low	Common in urban gardens across New Zealand.	Shrub

[1] Giblin F & Carnegie AJ (2014) *Puccinia psidii* (Myrtle Rust) – Australian host list. Version current at 24 Sept. 2014. http://www.anpc.asn.au/resources/Myrtle_Rust.html; Hood (2016) Myrtle Rust and the New Zealand Forest Industry. Scion report 57365.

[2] Low = generally one or a few leaves are infected, number of lesions per leaf is low; Moderate = ranges from a few to multiple leaves infected and from a few to multiple lesions per leaf; tip dieback has been recorded but is not common; High = multiple leaves infected with multiple lesions per leaf; tip dieback is common.

[3] New Zealand Plant Conservation Network. Accessed 12 April 2018 http://nzpcn.org.nz/flora_details.aspx?ID=943; NatureWatch NZ, Accessed 12 April 2018 http://naturewatch.org.nz/taxa/411137-Lophomyrtus-obcordata

Figure 1. Infection of *Austropuccinia psidii* on A. *Lophomyrtus bullata*; B. *Leptospermum scoparium*; C. *Metrosideros excelsa*; D. *Syzygium australe;* E. *Agonis flexuosa* and F. *Eucalyptus globoidea*. (Photos courtesy of the Ministry for Primary Industries**).**

3 Selection of indicator species

Lophomyrtus bullata and *Agonis flexuosa* (Table 2) are only species that appear to have high susceptibility to *A. psidii* considering the plant species infected during the New Zealand incursion response. *Lophomyrtus bullata* is good candidate for an indicator species for myrtle rust. As well as having high susceptibility, the species is found across New Zealand in urban and native environments. The limitations to using this species as an indicator species are that the distribution is patchy across New Zealand, meaning it may have limited use in some regions; and as it is a shrub or shrub-like-tree, it is not an overstorey canopy species that could easily be detected by remote sensing in native or urban environments. Its applicability as a visual or remote sensing indicator species needs to be evaluated further. *Agonis flexuosa* is not considered a suitable indicator species in New Zealand due to its limited distribution and its presence only in the urban landscape.

Plant species that are widely distributed across New Zealand in urban and native areas include *Leptospermum scoparium*, *Kunzea ericiodes*/*K. robusta* and some of the *Metrosideros* climbing vines species. Although the rust has been detected on *L. scoparium* (Figure 1) and climbing *Metrosideros* species (Table 2), the severity of infection and incidence of infection is so low that at present they would not be considered suitable as indicator species. The rust has not yet been recorded on *K. ericiodes*/ and *K. robusta* and these species are not included in Table 2.

For remote sensing purposes, plant species that can easily be visually detected is important, especially in native forests where shrub species can be obscured by large trees. For native forests, tree species such as *M. excelsa*, *M. robusta* or *S. maire* are potential options. Of these tree species, *M. excelsa* is the most susceptible to the disease and the majority of detections on *Metrosideros* have been on this species or hybrids of *M. excelsa* with other *Metrosideros* species*. Metrosideros kermadecensis* also has high susceptibility but as it is endemic to the Kermadec Islands and has a limited planted distribution in mainland New Zealand, it is not suitable for use as a mainland indicator species. Whilst *M. excelsa* would be a good choice for the northern North Island region, there is no clear native indicator tree species suitable for the remainder of New Zealand. If *M. robusta* had a higher susceptibility to *A. psidii* than indicated by previous and current observations (both disease severity and incidence), then it could also be used as an indicator species. Whether the level of disease in mature *M. excelsa* trees is also high enough for this species to be used as an indicator species needs to be evaluated.

Eucalpytus species and *S. australe* are not native to New Zealand but are tree species planted throughout New Zealand on urban, horticultural and forestry land. For *Eucalyptus* spp., only one seedling has been found infected in New Zealand. In Australia, trees older than approximately three years are considered relatively resistant to the pathogen (A. Carnegie, pers. comm.), which limits their utility as indicator species. The incidence of infection on *S. australe* is higher than for many other Myrtaceae species and while Figure 1 shows high susceptibility to *A. psidii*, the severity of infection on this species is variable. However, it does have the potential to be used as an indicator species. As *Syzygium* species can be difficult to distinguish morphologically without flowers or fruit capsules, there is the potential that *Syzygium* spp. (i.e. *S. australe*, *S. smithii* and *S. paniculatum*) could be used, increasing the number of plants across the country. Both *S. smithii* and *S. paniculatum* are known to be susceptible to *A. psidii*.

4 Recommendations and conclusions

4.1 Conclusions

The most suitable indicator species for myrtle rust surveillance are *Lophomyrtus bullata* and *L. bullata* x *L. obcordata* hybrids (which can be morphologically indistinguishable) based on distribution and apparent susceptibility. This plant species is present across New Zealand in urban and native environments and has putatively high susceptibility to *Austropuccinia psidii*. The key limitation of this species as an indicator species is the size of the plants. As a shrub it might not be a suitable choice for remote sensing techniques and further research should examine if this is the case.

The second selection for an indicator species for surveillance is *Metrosideros excelsa* and hybrids that are morphologically indistinguishable. Although this species is putatively moderately susceptible to *A. psidii*, it distribution is predominantly in the northern part of the North Island making it an unsuitable indicator species for the entire country. Urban plantings of this species beyond its native range do extend its distribution to some degree. Further investigation is needed to determine if the potential disease severity in the canopy of mature trees is enough for it to be useful as an indicator species.

A further two species, *M. robusta* and *Syzygium australe* (or *Syzygium* spp.) also could potentially be used as indicator species. Currently, the susceptibility of *M. robusta* to *A. psidii* is considered low. However, this could change under increased inoculum pressure as the pathogen further establishes in New Zealand. *Metrosideros robusta* is native and has a wider distribution across New Zealand than *M. excelsa*. The suitability of this species as indicator species is dependent on whether the level of susceptibility will provide useful information. *Syzygium australe* and other *Syzygium* species are distributed across the country in urban areas and are frequently used as shelter belts in the North Island. The susceptibility of this species is moderate high. Further investigation is needed to determine if the potential disease severity and its distribution in the South Island, as well as only being present in urban areas, provides enough information for it to be useful as an indicator species.

4.2 Future work

At time of preparation of this report, consultation with the Research theme from Te Ao Māori, around their preliminary assessment of taonga species had not been completed and was undertaken later once researchers for this theme had been contracted. Results of this work are summarised in the report “Improved myrtle rust surveillance”.

The suitability of these species as indicator plants needs to be tested under field environments and will be completed in other milestones of this project and summarised in the report “Improved myrtle rust surveillance”.

5 Acknowledgements

This work has been undertaken under contract MPI 18607 led by Scion, Plant and Food Research and Manaaki Whenua Landcare Research and the following collaborators: AsureQuality, Biosecurity Research Ltd., Learning for Sustainability and Te Tira Whakamātaki.

The information and opinions provided in the Report have been prepared for the Client and its specified purposes. Accordingly, any person other than the Client uses the information and opinions in this report entirely at its own risk. The Report has been provided in good faith and on the basis that reasonable endeavours have been made to be accurate and not misleading and to exercise reasonable care, skill and judgment in providing such information and opinions.

Neither Scion as the lead contractor, nor any of its employees, officers, contractors, agents or other persons acting on its behalf or under its control accepts any responsibility or liability in respect of any information or opinions provided in this Report.

6 References

Beresford RM, Turner R, Tait A, Paul V, Macara G, Yu ZD, Lima L, Martin R 2018. Predicting the climatic risk of myrtle rust during its first year in New Zealand. New Zealand Plant Protection 71: (submitted).

Giblin F & Carnegie AJ (2014) *Puccinia psidii (*Myrtle Rust) – Australian host list. Version current at 24 Sept. 2014. http://www.anpc.asn.au/resources/Myrtle_Rust.html