

Myrtle Rust Sentinel Project at Auckland Botanic Gardens, New Zealand

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Introduction

A sentinel survey is when a group of plants outside their natural range, *e.g.*, in a botanic garden, are regularly monitored for pests, diseases and pathogens that might be new to that species. This acts as an early warning system for biosecurity agencies where pests or pathogens are not yet in their country but are present overseas on the species of interest.

The International Plant Sentinel Network (IPSN) has been developed by Botanic Gardens Conservation International (BGCI) to facilitate collaboration between botanic gardens and arboreta, and plant health organisations and scientists (IPSN, 2014). Auckland Botanic Gardens (ABG) is one of the 67 members of the IPSN.

Botanic gardens have key roles in education, conservation and research. Botanic gardens hold documented living collections which have incredibly valuable information to support research and conservation. Databases of botanic garden collections are useful tools to plan sentinel surveys. Species outside of their natural ranges and gardens with known host plants in the range of specific pests and pathogens can be identified. Botanic gardens are therefore well placed to support biosecurity initiatives such as surveillance of new pests or pathogens.

Myrtle rust (*Austropuccinia psidii*) is a fungal disease that affects plants in the Myrtaceae family (MPI, 2020). Plants in this family include *Acca sellowiana* (Feijoa), *Leptospermum scoparium* (Mānuka), *Psidium cattleianum* (Guava), *Metrosideros excelsa* (Pōhutukawa) and *Syzygium smithii* (Lilly pilly). Myrtle rust infects leaves, flowers, fruits and stems of plants, reducing their vigour and reproductive output and can eventually lead to plant death.

The myrtle rust sentinel survey has run at ABG since 2014, initially with the aim of detecting the arrival of myrtle rust in NZ and subsequent to its arrival detecting preferred hosts and documenting impacts. Plants were initially selected for the sentinel survey based on their geographical location, evenly spaced across the site with

initial detection in mind. The species contained a range of native and non-native species, as well as being informed by species highly susceptible in Australia. It served this purpose until myrtle rust arrived in New Zealand in 2017 when the information that researchers and organisations required changed to understanding host preferences and susceptibility, rather than just presence information. Myrtle rust was first detected at ABG in July 2018.

Sentinel Survey 2014–2017

The aim of this survey was to detect myrtle rust as soon as possible in any incursion at ABG. Myrtle rust was expected to arrive naturally from Australia (where it is an invasive organism originating from Chile). ABG wanted to assist the Ministry of Primary Industries (MPI) in the early detection of this organism to increase the chances of eradication being a possible goal.

The garden was divided into 16 zones to ensure wide coverage of the site. In each zone, at least one plant in the Myrtaceae family was selected for monthly checking for symptoms of myrtle rust. Plants were selected for their accessibility, known susceptibility in Australia, economic importance and rarity (Table 1). An additional three areas held multiple individuals of susceptible species (the nursery, *Leptospermum* collection and *Eucalyptus* on the lawn) and in these areas many plants were inspected.

At each selected tree species, if there was more than one plant of this species at each zone, one was selected to look at carefully. All other Myrtaceae in the vicinity were briefly scanned for myrtle rust as well. For larger groups of Myrtaceae, including the area Nursery, *Leptospermum* or *Eucalyptus*, 25% of the plants in that area were scanned for myrtle rust. All accessible sides of the tree were checked. Flowers, fruit and new leaf growth were visually inspected for yellow pustules. Plants were never touched to avoid potential spread of myrtle rust. On the field data sheet, presence/absence was recorded.

Table 1. List of plant species included in sentinel survey from 2014–2017.

Name	Country of origin
<i>Acca sellowiana</i> 'Triumph'	Garden origin
<i>Agonis flexuosa</i>	W. Australia
<i>Backhousia citriodora</i>	Australia: Queensland
<i>Callistemon citrinus</i> 'Anzac White'	Garden origin
<i>Callistemon viminalis</i> 'Hannah Ray'	Garden origin
<i>Eucalyptus cinerea</i>	Australia
<i>Eucalyptus</i> spp	Australia
<i>Kunzea ericoides</i>	New Zealand
<i>Kunzea sinclairii</i>	New Zealand
<i>Leptospermum</i> cultivars	Garden origin
<i>Leptospermum scoparium</i>	New Zealand
<i>Lophostemon confertus</i>	Australia
<i>Melaleuca alternifolia</i>	Australia: NSW, Queensland
<i>Metrosideros bartlettii</i>	New Zealand
<i>Metrosideros excelsa</i> 'Vibrance'	Garden origin
<i>Metrosideros nervulosa</i>	Lord Howe Island
<i>Psidium guajava</i>	C. & S. America
<i>Psidium littorale</i>	E. & S. Brazil to NE. Uruguay
<i>Syzygium jambos</i>	Himalaya to W. Malesia
<i>Syzygium luehmannii</i>	New Guinea, Australia

Sentinel survey 2018–2021

Incursion of myrtle rust detected on mainland New Zealand in 2017 changed the purpose of the sentinel survey from an early detection/warning system, to gathering information about host preferences and susceptibility. Our focus shifted to which native plants, threatened plants and popular garden plants (Table 2) that we recommend, get myrtle rust and if they get it, how severe the impacts are on them through time. Plants were added or removed based on changes with plantings in the gardens. For example, many *Lophomyrtus bullata* died from heavy thrip damage rather than myrtle rust infections and therefore few individuals remained and these were different to the plants that were previously checked in the first sentinel surveillance programme (Fig. 1). Plants in both surveys are indicated in table 2 with an asterisk.



Figure 1. Bec surveying myrtle rust in the garden. Photo: Emma Bodley

Table 2. List of plant species in sentinel survey from 2018–2021. An asterisk (*) indicates plants that were also in the 2014–2017 sentinel survey.

Name	Country of origin
<i>Acca sellowiana</i> 'Triumph'*	Garden origin
<i>Austromyrtus dulcis</i>	E. Australia
<i>Backhousia citriodora</i>	Australia: Queensland
<i>Callistemon viminalis</i> 'Little John'	Garden origin
<i>Callistemon</i> 'Great Balls of Fire'	Garden origin
<i>Callistemon viminalis</i> 'Hannah Ray'	Garden origin
<i>Kunzea amathicola</i>	New Zealand
<i>Kunzea ericoides</i>	New Zealand
<i>Kunzea linearis</i>	New Zealand
<i>Kunzea robusta</i>	New Zealand
<i>Kunzea salterae</i>	New Zealand
<i>Kunzea serotina</i>	New Zealand
<i>Kunzea sinclairii</i>	New Zealand
<i>Kunzea tenuicaulis</i>	New Zealand
<i>Kunzea toelkenii</i>	New Zealand
<i>Kunzea triregensis</i>	New Zealand
<i>Leptospermum</i> cultivars*	Garden origin
<i>Leptospermum scoparium</i>	New Zealand
<i>Lophomyrtus bullata</i>	New Zealand
<i>Lophomyrtus obcordata</i>	New Zealand
<i>Lophostemon confertus</i> *	Australia
<i>Luma apiculata</i>	Argentina, Chile
<i>Melaleuca alternifolia</i> *	Australia: NSW, Queensland
<i>Metrosideros bartlettii</i> *	New Zealand
<i>Metrosideros carminea</i>	New Zealand
<i>Metrosideros diffusa</i>	New Zealand
<i>Metrosideros excelsa</i> 'Awhitu'	Garden origin
<i>Metrosideros excelsa</i> 'Shakespear'	Garden origin
<i>Metrosideros excelsa</i> 'Te Kaha'	Garden origin
<i>Metrosideros excelsa</i> 'Titirangi'	Garden origin
<i>Metrosideros excelsa</i> 'Vibrance'*	Garden origin
<i>Metrosideros excelsa</i> 'Waimatuka'	Garden origin
<i>Metrosideros excelsa</i> x <i>collina</i>	Garden origin
<i>Metrosideros fulgens</i>	New Zealand
<i>Metrosideros perforata</i>	New Zealand
<i>Metrosideros robusta</i> x <i>excelsa</i>	Garden origin

Detections and control

Over the seven years of survey data seven species and 14 cultivars have been detected with myrtle rust at ABG (Table 3) however only two of these were on the sentinel survey including *Syzygium jambos* and *Austromyrtus dulcis* (both detected in 2021). *Syzygium jambos* (Fig. 2) is the only plant that has been removed as a sentinel plant due to its high level of infection (in 2021), four years after the incursion of myrtle rust in New Zealand and three years after the first incursion at the Auckland Botanic Gardens. Not all plants infected with myrtle rust at ABG are completely removed, so that we get an understanding of the impact myrtle rust has on plant health and host preferences. Some infected plants are removed (Table 3) because they have no conservation value or horticultural merit. Some infected plants have been kept and infected material removed e.g., isolated symptomatic branches.



Figure 2. *Syzygium jambos* heavily infected with myrtle rust.
Photo: Emma Bodley



Figure 3. *Lophomyrtus bullata* infected with myrtle rust.
Photo: Emma Bodley

Table 3. Detections of myrtle rust at Auckland Botanic Gardens on sentinel and non-sentinel survey plants, as well as how myrtle rust was managed in each individual case.

Date	Name	Sentinel plant	Control measurement
28/06/2018	<i>Lophomyrtus x ralphii</i> 'Red Dragon'	No	Removed
13/03/2019	<i>Lophomyrtus bullata</i>	No	Removed
28/03/2019	<i>Lophomyrtus</i> cultivars* (Fig. 3)	No	Removed
4/04/2019	<i>Lophomyrtus</i> cultivars*	No	Removed
6/05/2019	<i>Metrosideros excelsa</i> 'Vibrance'	No	Pruned
17/07/2019	<i>Metrosideros excelsa</i>	No	Pruned
4/02/2020	<i>Myrtus communis</i>	No	Removed
19/01/2021	<i>Syzygium jambos</i>	Yes	Removed
22/02/2021	<i>Metrosideros carminea</i>	No	Monitoring
22/02/2021	<i>Metrosideros excelsa</i> 'Vibrance' (Fig. 4)	No	Pruned
26/02/2021	<i>Myrtus communis</i>	No	Removed
9/04/2021	<i>Austromyrtus dulcis</i>	Yes	Monitoring
27/05/2021	<i>Metrosideros excelsa</i>	No	Removed

**Lophomyrtus* in these detections included *Lophomyrtus bullata*, L. 'Black Beauty', L. 'Kathryn', L. 'Lilliput', L. 'Little Star', L. 'Multicolor', L. *obcordata*, L. 'Pinkadoo', L. 'Pixie', L. 'Plum Duff', L. 'Purpurea', L. 'Red Dragon', L. 'Rose', L. 'Traversii' and L. 'Variegata'.

How we manage Myrtaceae

Our general principals and aims for managing Myrtaceae on a day-to-day basis at ABG include:

- Minimise the use of fungicides by staff and reduce inoculum at ABG site outside nursery.



Figure 4. Myrtle rust on *Metrosideros excelsa* 'Vibrance'.
Photo: Emma Bodley

- Document impacts of myrtle rust on native, rare and exotic edible and amenity plants.
- Grow rare plants such as *Metrosideros bartlettii* (rātā moehau) to protect them from extinction by holding insurance plants and cross-pollinating flowers for seed production (Stanley and Bodley, 2020).
- Support research into myrtle rust through observations, provision of plant material etc. (Beresford *et al.*, 2020).
- Participate in research and policy forums to stay up-to-date and contribute our observations and promote the use of the ABG site and staff for research capacity.

In the Garden we manage plants by:

- Removing dead and very sick/dying plants and smaller plants that are producing lots of inoculum.
- Discussing options for trees that may be highly affected and releasing inoculum (which are costly to remove and may not be budgeted for).
- Monitoring plants less visibly affected to document impacts of myrtle rust and inform research.
- Removing infected branches or parts of plants to research effectiveness of this technique.
- Avoiding pruning of any Myrtaceae that would result in a flush of growth in autumn, the peak time for myrtle rust activity.

The ABG nursery grows 60,000 native plants, primarily Myrtaceae, for revegetation projects throughout Auckland in parks. Nursery biosecurity is a critical component of our work to prevent the spread of pests and pathogens to wild locations (Stanley and Dymond, 2020). In the nursery we follow the New Zealand Plant Propagators Inc. (NZPPI) protocols in terms of propagation, fungicide regimes and distribution policies to minimise the risk of myrtle rust spread to wild environments. We also minimise the time Myrtaceae plants are held in the nursery to minimise the amount of fungicide applications, e.g. once revegetation is dispatched the only reason to apply fungicide is for ABG plants. Myrtaceae are planted as early in the planting season as possible to reduce numbers in the nursery. Placement of plants in the nursery is to ensure the leaves of plants dry out e.g., the windiest place for better airflow.

Benefits of sentinel projects

One of the aspects of being part of the IPSN is it builds the network of expert contacts locally, and worldwide, which is needed to strengthen our collective biosecurity systems. Out of being part of the network has come collaborations such as the B3 trail which allows visitors to self-guide a trail at ABG of 12 future threats to New Zealand's biosecurity, participation in a worldwide project on rose pests and pathogens, and joint conference presentations.

Conclusion

The sentinel survey has contributed several new species to the growing list of myrtle rust plant hosts for New Zealand, a valuable contribution to the biosecurity and research community. Some myrtle rust detections were not on sentinel plants such as *Myrtus communis* and *Lophomyrtus x ralphii* 'Red Dragon', and therefore this survey is not used as a full surveillance tool, but rather an indicator of presence and susceptibility. Although the survey is a long-term project, it is regularly reviewed for its purpose and what information we are capturing.



Figure 5. Students from a local high school investigating myrtle rust and other plant pathogens at the gardens. Photo: Rebecca Stanley

The sentinel project has also been a useful tool for teaching professionals and students about myrtle rust and other plant pathogens (Fig. 5). We can use our plant collections to teach people Myrtaceae identification skills, as well as identifying myrtle rust.

References

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