Office of the Prime Minister's
Chief Science Advisor
Kaitohutohu Mātanga
Pūtaiao Matua ki te Pirimia

Myrtle Rust

An invader in Aotearoa New Zealand's ecosystems

Summary

Myrtle rust is an invasive airborne fungal disease that affects plants in the myrtle (Myrtaceae) family. Myrtle rust attacks new plant growth which makes seedlings especially susceptible, and severe infections often kill plants. It has had considerable negative impacts internationally. In the last decade, it has spread along the east coast of Australia and into South Australia, Victoria, the Northern Territory and Tasmania. Myrtle rust was first detected on Aotearoa New Zealand's mainland in May 2017. It has now been found across most parts of the North Island and in the northern and west coasts of the South Island, and it is expected to continue to spread. Species in the myrtle family provide ecological, cultural and economic benefits for Aotearoa New Zealand. Examples include native species such as mānuka, pōhutukawa, rātā and ramarama as well as exotic commercial species like eucalyptus and feijoa. With the current tools and level of knowledge, eradication of myrtle rust is not possible. However, a significant programme of collaborative research is underway working closely with iwi and landowners. This research aims to grow our understanding of how the disease behaves in native ecosystems and explore options to make ecosystems more resilient. Research is also examining social behaviours and public perceptions of the disease.

Background

Myrtle rust is a disease that arises from the fungus *Austropuccinia psidii,* which has several different strains.[1] The 'pandemic' strain is present in Aotearoa New Zealand. Rust fungi typically form raised spots on the underside of leaves which become red-orange spore masses after some time, before turning grey or black. This causes leaves to deform and drop off the plant.

Figure 1 Various stages of myrtle rust infection on myrtle plants in New Zealand. Images (a), (b) and (c) by Peter de Lange/pjd1 via iNaturalist (CC0) and image (d) by jacqui-nz via iNaturalist (CC BY-NC 4.0).

Myrtle rust is thought to have originated in South and Central America, and since reaching Hawaii in 2005, the spread has increased exponentially.[1] Recent research confirms that Aotearoa New Zealand natives are susceptible to both the

pandemic and South African strains.[2] The arrival of myrtle rust to Aotearoa New Zealand was expected given the severity of infection in eastern Australia combined with the ability for the spores to disperse extremely long distances by wind.

Rusts are fungal diseases that typically affect just one species of plant. Myrtle rust is unusual compared to other rusts as it affects hundreds of species globally [3] and is expected to impact 37 native taxa, including species of pōhutukawa, mānuka, kānuka and rātā.[4] It can attack the new growth, flowers and fruits of infected plants. Repeated infections reduce the plant's ability to regenerate and mature.[5]

Figure 2 Two iconic native species threatened by myrtle rust in Aotearoa New Zealand: (a) Mānuka (*Leptospermum scoparium*) by jacqui-nz (CC-BY-NC-SA 4.0) via iNaturalist; (b) Pōhutukawa (*Metrosideros excelsa*) by E. Rykers.

The fungus can reproduce quickly (between two and four weeks) in conditions of high humidity and temperatures around 25°C. After infection, it will take up to two weeks for the disease symptoms to present, which makes it hard to identify in the early stages. Most fungi reproduce asexually, but myrtle rust can reproduce sexually. Sexual reproduction introduces more genetic variability, meaning myrtle rust may adapt more rapidly—with the potential it might infect new host plants as a result.[6] If the South African strain arrived in Aotearoa New Zealand, in addition to the damage it would cause, there is also concern that the two strains could sexually reproduce to potentially form more aggressive new strains.[2] Myrtle rust is mostly transmitted by wind, but spores can also be spread via contaminated clothing, insects and equipment.[7]

Figure 3 Rātā moehau/Bartlett's rātā is a critically endangered species endemic to Northland with only 13 known adult trees in the wild. Image: Peter de Lange/pjd1 via iNaturalist (CC0).

The species that are affected by myrtle rust support our environment through ecosystem services. These include providing habitat for other organisms, producing food for pollinators and the process of nutrient turnover. They also provide benefits for humans such as food, medicine and construction materials, and some species were extensively used by Māori.[8, 9] Owing to the cultural and practical values, some of these species are formally recognised as taonga (treasures).[10, 11] MPI suggest that ramarama and pōhutukawa appear to be the most susceptible species. [12] While manuka previously showed few symptoms of infection, recent research has found that myrtle rust can infect manuka fruit and seeds. A lack of symptoms does not equal resistance and research is ongoing to identify variants across the myrtle family with resistance.[13] There is particular concern for already threatened species, such as the critically endangered rātā moehau (Bartlett's rātā, *Metrosideros bartletti*) which could be vulnerable to myrtle rust.

The current status in Aotearoa New Zealand

Despite concerted responses to manage myrtle rust, it is continuing to spread throughout suitable climates in Aotearoa New Zealand. As of March 2019, it was found on 988 properties.[14] It is mostly found in the North Island and is present on the north and west coasts of the South Island.[15] Because myrtle rust is widespread, the primary focus is on effective management to mitigate impact. Sightings of myrtle rust are now primarily led by citizen science (reporting through iNaturalist.nz, see **Figure 4**). New hosts and new areas may also be identified through the High Risk Site Surveillance programme, led by the Ministry for Primary Industries (MPI).

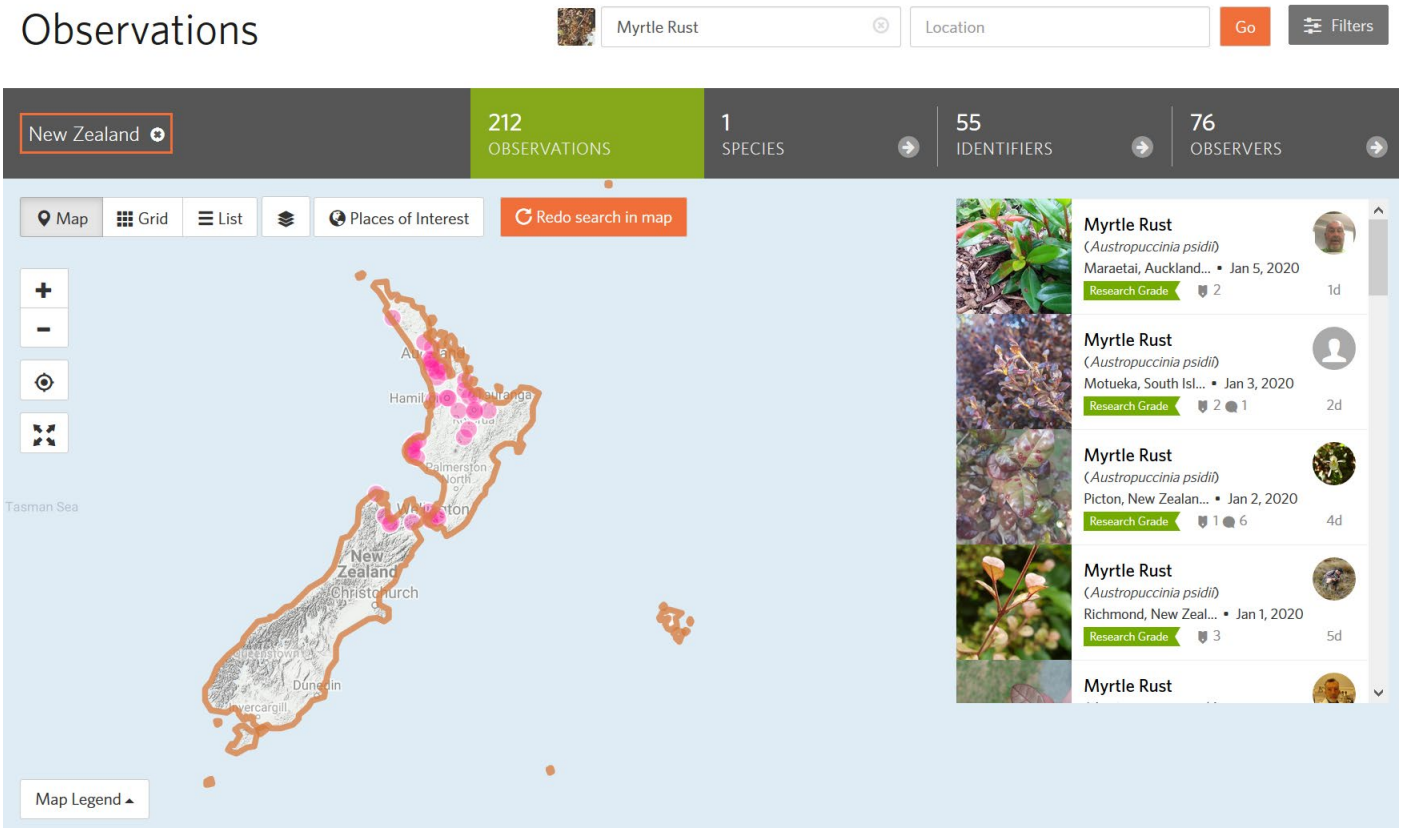

Figure 4 iNaturalist myrtle rust observations in Aotearoa New Zealand as of 06/01/20. MPI recorded infected site observations up to the 25/06/2019 which can be seen here.

To safeguard native myrtle species, seed collection began in 2017 led by the Department of Conservation (DOC) with the assistance of the New Zealand Indigenous Flora Seed Bank (NZIFSB). These collections aim to act as insurance policy against regional or national extinctions. As of July 2019, 49% of the seed required has been collected.[16] Work is now being undertaken to assess the quality and quantity of collections, including the viability of the oldest collections of stored seed. A nationwide strategy for preserving native Myrtaceae co-designed with mana whenua is still required with adequate resources and infrastructure to implement it.[4]

How myrtle rust will behave in our largely temperate climate and how it will impact ecosystems is not well understood. Nationwide data are no longer being collected on its spread, intensification and impacts, with limited resource available to carry out robust, long-term, national surveillance and monitoring in the future.[4] MPI-funded research has allowed the development of a monitoring form to assist community-led tracking. Furthermore, the societal implications of myrtle rust in Aotearoa New Zealand, including those for Māori communities, have only been partially explored.[8, 17] In particular, Māori are at risk of losing cultural identity as some species affected by myrtle rust are threatened with local extinction in their rohe. Myrtle rust is expected to have considerable negative impact on the economy with losses in GDP between $144 and $411 million estimated by 2030.[13]

Research in Aotearoa New Zealand

There has been considerable input and cooperation from Aotearoa New Zealand's research community in response to the arrival of myrtle rust, as well as collaboration with international researchers, particularly from Australia. Work in this area has been supported by MPI through operational science funds and by the Ministry of Business, Innovation and Employment (MBIE) through the Catalyst fund until mid-2020. Currently there is no dedicated operational science research funding.

A stocktake of myrtle rust research was published by New Zealand's Biological Heritage National Science Challenge in early 2021.

Since 2017, MPI has funded more than twenty research projects which were completed in June 2019. The research reports and summaries of this work were recently presented at the Myrtle Rust Science Symposium 2019 and are available online. The areas of research can be grouped as surveillance and monitoring, evaluating the impacts, control tools, seed banking and breeding, understanding myrtle rust, Te Ao Māori and building engagement. These are expanded on below.

Surveillance and monitoring

There have been recent innovations in remote monitoring (unmanned aerial vehicles), modelling of myrtle species distributions, improved long-term community monitoring methods and the identification of 'indicator' species for surveillance.

Evaluating the impacts

A framework to understand the environmental, economic, and social-cultural responses to and impacts of myrtle rust has been developed.

The economic impacts of myrtle rust to mānuka/kānuka has been estimated to $157.7 million over 20 years.

Control tools

A review of control tools that have been used overseas was carried out. Expanding for these results, trials of fungicides and work to identify the methods to implement them in Aotearoa New Zealand.

Seed banking and breeding

Resistance in myrtle species, and how this might be enhanced has been explored.

Conservation strategies for seed and germplasm have several issues, including particularly at-risk species and a need for purpose-built infrastructure.

Understanding myrtle rust

An improved knowledge base of myrtle rust has been developed which includes research on the myrtle rust genome and genetic resistance, host plant susceptibility, climate or microbial impacts for myrtle rust and susceptibility of natives to the South African strain of myrtle rust.

Te Ao Māori

A greater understanding of Te Ao Māori implications of myrtle rust has been developed. This knowledge aims to support more effective investments, and improved use of mātauranga, specific Māori knowledge, and kaupapa Māori approaches in management regimes.

Building engagement

Overviews of how to build engagement and social licence have been explored. This work included the development of tools for assessment, understanding motivated networks, a survey of impacts of myrtle rust and responses to the incursion in Taranaki.

Several research programs are underway to evaluate methods to increase ecosystem resilience and long-term solutions to combat myrtle rust.[18, 19] Some of these are building on the MPI-funded research, including the MBIE-funded Endeavour Programme 'Beyond Myrtle Rust' and the Strategic Science Investment Fund programme 'Ngā Rākau Taketake – Saving our Iconic Trees' administered by the Biological Heritage National Science Challenge. These programmes will involve universities (Unitec, Lincoln University, University of Auckland, University of Canterbury and the University of Queensland), Crown Research Institutes (Manaaki Whenua – Landcare Research, Scion, Plant and Food Research), Government departments (MPI and DOC) and communities. The collaboration, value and expertise of the work to date, and ongoing plans are recognised by a recent Biosecurity Award for the integrated and rapid research response of the Myrtle Rust Consortium.

There is a Strategic Science Advisory Group (SSAG) in place to support and guide the development of a prioritised research program through the recent 'Myrtle Rust Science Plan'.[20] The plan has identified the areas requiring investment as:

- Exploring tools for surveillance, monitoring and understanding the impact of disease
- Research focusing on the epidemiology of myrtle rust, how this affects ecosystems and how to encourage resilience to myrtle rust
- Developing a Te Ao Māori and Mātauranga Māori framework and strong co-design and co-implementation practices
- Understanding the social links between people and ecosystems, and the associated socioeconomic factors
- Implementation of effective species conservation, disease control and management

Connecting stakeholders across Aotearoa New Zealand

Several organisations, including DOC, MPI, New Zealand Plant Producers Incorporated and Project Crimson are involved in safeguarding the mauri of myrtle species and dependent ecosystems. Landowners including DOC and councils play a vital

role. Biosecurity New Zealand, a business unit of MPI, maintains a website (myrtlerust.org.nz) as a one-stop shop for information about myrtle rust in Aotearoa New Zealand. This work is supported by the insights of the Myrtle Rust Science Plan, and is set out in the Myrtle Rust Strategy 2019–2023. Development of this strategy was a primary purpose of the Myrtle Rust Governance Group, chaired by Biosecurity New Zealand, which has disbanded after approval of the strategy. To ensure organisations with an interest in myrtle rust remain well connected, the Myrtle Rust Stakeholder Group has been formed. Members include government agencies, regional councils, Te Tira Whakamātaki Māori Biosecurity Network, Project Crimson, botanical gardens, New Zealand's Biological Heritage Ngā Koiora Tuku Iho, forestry and plant industry associations, a representative of the Myrtle Rust SSAG, and the 'Beyond Myrtle Rust' research programme.

Key resources and reading

Biosecurity New Zealand and DOC have developed the myrtlerust.org.nz website for information and developments regarding myrtle rust.

You can also visit the Department of Conservation page for additional information, or read about the symposium on myrtle rust hosted by MPI in September 2019.

New Zealand's Biological Heritage National Science Challenge resources can be found here and education resources can be found at the Science Learning Hub.

References

1. Carnegie, A.J. and G.S. Pegg, *Lessons from the Incursion of Myrtle Rust in Australia.* Annual Review of Phytopathology, 2018. **56**(1): p. 457-478.
2. Soewarto, J., *Screening of four New Zealand native Myrtaceae species for resistance against the South African strain of myrtle rust*, in *2019 Myrtle Rust Science Symposium*. 2019: Auckland, New Zealand. https://www.myrtlerust.org.nz/assets/Uploads/2019-Myrtle-Rust-Science-Symposium-Summaries2.pdf.
3. Ministry for Primary Industries, *Myrtle Rust – Austrapuccinia psidii*. 2018. https://www.mpi.govt.nz/dmsdocument/3641-a-biosecurity-risk-for-new-zealand-myrtle-rust-austropuccinia-psidii.
4. Department of Conservation, *Myrtle rust in New Zealand update 2019*, J. Barnsley, Editor. 2019.
5. Biosecurity New Zealand and Department of Conservation. *About myrtle rust*. n.d. [cited 2019 24 September]; Available from: https://www.myrtlerust.org.nz/about-myrtle-rust/.
6. Biosecurity New Zealand and Department of Conservation, *Myrtle rust in New Zealand – January 2019 Newsletter*. 2019.
7. Department of Conservation. *Myrtle rust*. n.d. [cited 2020 16 January]; Available from: https://www.doc.govt.nz/nature/pests-and-threats/diseases/myrtle-rust/.
8. Black, A., et al., *How an Indigenous community responded to the incursion and spread of myrtle rust (Austropuccinia psidii) that threatens culturally significant plant species – a case study from New Zealand.* Pacific Conservation Biology, 2019. **25**(4): p. 348-354.
9. Teulon, D.A.J., et al., *The threat of myrtle rust to Māori taonga plant species in New Zealand.* New Zealand Plant Protection, 2015. **68**: p. 66-75.
10. Department of Conservation, *Ngāi Tahu taonga plant species*. 2006: Christchurch, New Zealand. http://www.chchplan.ihp.govt.nz/wp-content/uploads/2016/07/NCHT-32-Evidence-of-Claire-Mulcock-03-08-2016.pdf.
11. Waitangi Tribunal, *Ko Aotearoa tēnei : a report into claims concerning New Zealand law and policy affecting Māori culture and identity. Te taumata tuatahi*. 2011: Wellington, New Zealand. https://forms.justice.govt.nz/search/Documents/WT/wt_DOC_68356054/KoAotearoaTeneiTT1W.pdf.
12. Ministry for Primary Industries, *Second myrtle rust find in Auckland*. 2017. https://www.mpi.govt.nz/news-and-resources/media-releases/second-myrtle-rust-find-in-auckland/.
13. Biosecurity New Zealand, *New Zealand Myrtle Rust Strategy 2019–2023*. 2019, Ministry for Primary Industries: Wellington, New Zealand. https://www.myrtlerust.org.nz/assets/Uploads/Myrtle-Rust-Strategy-web3.pdf.
14. Ministry for Primary Industries and Department of Conservation, *Myrtle rust in New Zealand – March 2019 Newsletter*. 2019. https://www.myrtlerust.org.nz/assets/news/Myrtle-Rust-Newslestter-March-2019.pdf.
15. Ministry for Primary Industries, *First confirmed myrtle rust case on West Coast*. 2019. https://www.mpi.govt.nz/news-and-resources/media-releases/first-confirmed-myrtle-rust-case-on-west-coast/.
16. Ministry for Primary Industries and Department of Conservation, *Myrtle rust in New Zealand – July 2019 Newsletter*. 2019. https://www.myrtlerust.org.nz/assets/news/Myrtle-Rust-July-2019-Newsletter.pdf.

17. Marsh, A., et al., *Myrtle rust—Te Ao Māori Theme 2*. 2019. https://www.myrtlerust.org.nz/assets/Uploads/Myrtle-rust-Te-Ao-Maori.pdf.
18. Biosecurity New Zealand and Department of Conservation. *Investment in research*. n.d. [cited 2019 9 December]; Available from: https://www.myrtlerust.org.nz/science-and-research/investment-in-research/.
19. Manaaki Whenua – Landcare Research, *Big wins for biodiversity biosecurity and erosion management*, in *Regional Research Update*. n.d. https://www.landcareresearch.co.nz/publications/newsletters/regional/issue-2/big-wins-for-biodiversity.
20. Myrtle Rust Strategic Science Advisory Group, *Myrtle Rust Science Plan*. 2019. https://www.myrtlerust.org.nz/assets/Uploads/Myrtle-Rust-Science-Plan.pdf.