SUMMARIES

2019 Myrtle Rust Science Symposium

The Myrtle Rust Science Symposium will be a thought provoking, informative and interactive event for everyone who is passionate about safeguarding and sustaining Aotearoa's myrtles. Discuss the latest research progress and what it means in the real world. Find out what's happening on the ground and what organisations managing myrtle rust want from the science. Make connections and have your say on what needs to happen now.

Day one – Monday 9 September

9.50am What's happening 'on the ground'	***Auckland Council - minimising myrtle rust*** ***Murray Fea, Senior Biosecurity Adviser, Auckland Council*** *Auckland Council's approach to myrtle rust management is currently based on minimising the amount of myrtle rust in the environment. We continue to remove infected material when discovered, and advise private landowners to do the same. Council nurseries are following best practice fungicide regimes and monitoring, and the regional parks revegetation program has stopped raising pōhutukawa for two years while we find out more information. Due to some previous instances of infection occurring in pōhutukawa seedling stock outside the revegetation programme, Biosecurity and Biodiversity staff have begun conversations around adopting a similar approach more widely across the Council whanau. We are also investigating options to collect information about myrtle rust distribution within other workstreams. Our needs from science include information on host susceptibility and ecology, rust distribution, and risk of spread, so that we can rationalise the approaches described above or take up new tactics as appropriate. In addition, improved protocols for managing susceptible specimen or high-value trees will be invaluable for protecting them long-term.*
11am ***Surveillance, monitoring and impact of myrtle rust***	***Myrtle rust surveillance and impact on native Myrtaceae*** ***Beccy Ganley, Plant Pathology Science Group Leader, Plant & Food Research*** *Surveillance of myrtle rust is critical to understand where and how severe the disease is. This information can be used to target control or management methods, and long-term to assess the impact of the disease. However, for this to occur it is important that the right kind of information is collected and that this is consistent across different groups who are collecting data. With this in mind, researchers used a co-design approach with mana whenua, councils, industries and government organisations that have a long-term interest in myrtle rust. We developed a surveillance form suitable and available for long-term monitoring, with consistent data recording to allow future data merging between differ user groups and agencies. This form has been used to monitor myrtle rust in a naturally occurring stand of myrtle plants and results are concerning. Rōhutu and ramarama hybrids have been severely impacted, with up to 90-100% of new flush infected and fruit becoming infected and prematurely dropping. All seedlings monitored became infected and the majority died or are expected to die in the near future. Infection has also observed on mānuka and climbing rātā in the stand.*
11am ***Surveillance, monitoring and impact of myrtle rust***	***Novel method of surveillance and monitoring*** ***Grant Pearse, Scientist, Scion*** *Remote sensing provides powerful tools to monitor the impact of unwanted pests and pathogens on our native tree species. We have demonstrated that advanced sensors carried on*

	UAVs (Unmanned Aerial Vehicles) can be used to help scientists monitor the impact of myrtle rust on susceptible species. We showed that the technology could be used to assess disease impacts in the upper parts of the forest canopy that would otherwise be inaccessible. We also demonstrated the potential for this technology to capture valuable structural and health-related data that can assist in monitoring the long-term impacts of the disease on our forests at multiple scales. In addition, we successfully tested new methods to rapidly map susceptible host species using AI-powered computer vision algorithms trained to detect key species over large areas. These techniques will give scientists and conservationists new tools to detect and monitor the impacts of myrtle rust so that we can better manage the disease and protect our vulnerable myrtle species.
11am ***Surveillance, monitoring and impact of myrtle rust***	***Species distribution models and combination with climate risk model*** ***James McCarthy, Researcher, Ecosystems & Global Change, Manaaki Whenua – Landcare Research*** *In responding to the arrival of an exotic disease like myrtle rust, it is important to have some idea of where myrtle plants (the hosts) may occur. In New Zealand, we have a lot of point records describing locations where different myrtle plant species occur, but to get maps that predict species range on a nationwide scale we need to combine point records with environmental information (soil and climate) and predictive computer models. Manaaki Whenua – Landcare Research was contracted by MPI to produce these maps for all New Zealand's native Myrtaceae. These maps can be used to inform disease spread simulations and prioritisation of areas for monitoring and control, and in conjunction with maps depicting spread of the disease, support identification of areas of refuge for particularly susceptible species.*
11am ***Surveillance, monitoring and impact of myrtle rust***	***What is DOC doing with the data, and how are results from science being used on the ground?*** ***Fiona Thomson, Myrtle Rust Project Manager, Department of Conservation*** *This presentation will provide an overview of the myrtle rust work currently being undertaken by the Department of Conservation. DOC's monitoring and surveillance work across the country, including Raoul Island, will be summarised and some of the key issues or knowledge gaps identified. It will finish with a discussion on how the results and tools presented in this session can help land managers understand myrtle rust's distribution and its impacts on myrtle species.*
1pm ***The international experience***	***Global impact of myrtle rust*** ***Angus Carnegie, Principal Research Scientist, Forest Health & Biosecurity, New South Wales Department of Primary Industries, Australia*** *Myrtle rust has long been recognised as a significant threat to Myrtaceae, following epidemics in all-spice plantations in Jamaica, eucalypt plantations in Brazil and paperbark (Melaleuca) trees in Florida. Previously confined to the Western Hemisphere, in the past dozen years myrtle rust has spread across the globe to Hawaii, Asia, Oceania and South Africa. The host range has consequently quadrupled to more 525 host taxa across 69 genera. Unsuccessful eradication attempts were made in Australia and New Zealand. Naïve flora is now dealing with an exotic invader. In these invaded countries plant industries are being significantly impacted, especially nursery and garden, essential oils and cut flowers; although not the eucalypt forest industry. However, the most severe impact is occurring in native ecosystems, especially in Australia; several native species are now on the brink of extinction. Engagement with Traditional Owners on the impacts of myrtle rust is in its infancy in Australia, and meaningful engagement from environmental agencies is slowly gaining momentum. An international multi-disciplinary approach is needed to combat this globally invasive disease.*

1.30pm ***Epidemiology, ecosystems and resilience***	***Identifying resistance to myrtle rust in New Zealand*** ***Grant Smith, Bioprotection Technologies Scientist, Plant & Food Research*** *Seedlings of six New Zealand myrtle plants (mānuka, kānuka, rawiri mānuka, pōhutukawa, ramarama, rohutu) were grown from seeds collected from different parts of New Zealand, and then infected with spores of the myrtle rust pathogen (Austropuccinia psidii). Disease development on leaves, stems and shoot tips was monitored and assessed. Initial results revealed that there is resistance to this pathogen in mānuka, kānuka and rawiri mānuka, and some seedlings did not develop any myrtle rust symptoms during the trial. However, there are also substantial levels of susceptibility. Only one resistant pōhutukawa seedling and no resistant ramarama or rohutu seedlings have been found to date. A regional effect was also found - mother plants growing in some regions produced more resistant seedlings than those from other regions. Further seed is being collected and tested.*
1.30pm ***Epidemiology, ecosystems and resilience***	***Myrtle rust epidemiology in New Zealand*** ***Rob Beresford, Principal Scientist, Plant & Food Research*** *Experiments on three key factors affecting infection and development of myrtle rust were studied to understand regional risk of disease development and identify management opportunities. These were studied on pōhutukawa and a Lophomyrtus hybrid under controlled temperatures in Brisbane and in the field in Auckland. Modelling results showed that low winter temperatures in the lower North Island and upper South Island can halt myrtle rust development, but that leaf emergence on Lophomyrtus can continue, slowly, providing a seasonal opportunity to out-grow rust development. For pōhutukawa, leaf emergence stops at a higher temperature, so there is less opportunity to outgrow the rust. Fortunately, pōhutukawa shows some field resistance to rust attack. A management opportunity exists to manage myrtle rust severity by limiting growth in spring by avoiding fertiliser when warming temperatures favour rust infection. Conversely, fertilising to encourage late growth in autumn as temperatures decrease and become unsuitable for rust will help to avoid rust infection.*
1.30pm ***Epidemiology, ecosystems and resilience***	***Decoding the myrtle rust genome*** ***Peri Tobias, Researcher, University of Sydney*** *Unlike other rust fungi, myrtle rust occurs on a very broad host range (over 500 plant species), making it a particularly dangerous plant pathogen. In only nine years since it was first found in Australia, myrtle rust has caused near extinction of at least three species, caused the decline of at least one keystone species, and impacted commercial production of species such as tea-tree and lemon myrtle. To combat myrtle rust we need to understand the mechanisms it uses to infect its hosts. To study and understand these mechanisms we have assembled a high-quality genome based on the latest sequencing technology. We have determined that it is the largest assembled fungal genome to date. We are now unravelling its complexity so that we can address the impact on iconic plants such as eucalypts and pōhutakawa.*
1.30pm ***Epidemiology, ecosystems and resilience***	***Initial identification of genetic markers linked to resistance*** ***David Chagne, Science Group Leader, Molecular & Digital Breeding*** ***New Cultivar Innovation, Plant & Food Research*** *Plant tolerance to disease is encoded in their genes. A full genome of mānuka was recently developed by Plant & Food Research. We looked at 76 mānuka populations and identified genetic variation that showed differences between local provenances within New Zealand, and between New Zealand and Australian related species. Next, seeds were collected from the same*

	trees that were genetically sequenced and grown into seedlings. The seedlings were inoculated with myrtle rust. We will now look for correlations between seedling tolerance/susceptibility to myrtle rust and the genetic variations that we previously identified. This will enable us to discover if any of the genetic variations are associated with tolerance to myrtle rust. This knowledge could be used to select more tolerant types of mānuka for planting.
1.30pm ***Epidemiology, ecosystems and resilience***	***The community of microbes living in New Zealand Myrtaceous species are diverse and can inhibit germination of rust spores*** ***Hayley Ridgway, Senior Scientist, Plant & Food Research*** *All plants have microbes living on them and in them. These microbes can help plants resist diseases. For the New Zealand Myrtaceae it was unknown whether the microbes that live in them could help the plants resist myrtle rust. The new season's growth (young tissue) is always more heavily infected by myrtle rust than old season's growth. We therefore investigated whether microbes differed in young and old plant tissue. The research focused on mānuka (Leptospermum scoparium) and pōhutakawa (Metrosideros excelsa). The results showed that the community of microbes in new foliage was different from that in older tissue. An experiment showed that some microbes from the old tissues could inhibit the growth of rusts. This work supported a role for the microbial community in tolerance to infection by rusts.*
1.30pm ***Epidemiology, ecosystems and resilience***	***Screening of four New Zealand native Myrtaceae species for resistance against the South African strain of myrtle rust*** ***Julia Soewarto, Researcher, Scion*** *The pandemic strain of myrtle rust that is present in New Zealand is the most widely distributed strain globally. It is also different to the myrtle rust strains present in South America and South Africa, and those strains have different host ranges and severity. If these other myrtle rust strains were introduced into New Zealand this could lead to additional myrtle species becoming infected, making myrtle rust an even more serious threat to the natural diversity of New Zealand. In order to better understand the risk that these other myrtle rust strains pose to New Zealand, seeds from mānuka, kānuka, mānuka rawiri and pōhutukawa from different regions were collected and sent to South Africa where they were exposed to the myrtle rust strain present in that country. The seedlings were assessed for disease severity and the results showed that all the species are susceptible. All indications are that the South African strain of myrtle rust poses a threat to New Zealand forests. This work highlights the need for continued vigilance at the borders to prevent further introductions of new myrtle rust strains.*
3.15pm ***Managing the myrtle rust invasion – one size doesn't fit all!***	***Evaluating impacts of and responses to myrtle rust in NZ*** ***Simon Wegner, Social Scientist, Scion*** *Myrtle rust has the potential to harm important ecological, economic, social and cultural values. Management actions may help mitigate these harmful effects but may also have their own consequences. It is necessary to understand what these impacts are and to measure them so that we can make better decisions about management and evaluate whether that management is effective. Our research first established an iterative process for assessing potential indicators. We then drew on international literature, evidence from other myrtle rust research, and the expert knowledge from others involved in myrtle rust research and management to identify an initial set of indicators for key values. Using these indicators and existing data, we established ecological and economic baselines and modelled the impacts myrtle rust might have in the future. We also identified areas where data was lacking and further research or monitoring would be necessary. This was particularly a problem for social and cultural indicators, which are*

	often subjective, have limited data available, and may not have standardised methods for measurement. The process will need to be revisited as more data becomes available and circumstances change.
3.15pm ***Managing the myrtle rust invasion – one size doesn't fit all!***	***Building engagement and social licence*** ***Andrea Grant, Risk & Resilience Social Scientist, Scion*** *Biosecurity responses to plant diseases like myrtle rust could build stronger commitment of communities and ongoing involvement in response efforts if they focused more on social licence to operate (SLO). We identify areas for achieving and maintaining social licence before, during and after response operations. A willingness to engage in partnerships for response operation and long-term management needs support, to make better use of the resources of impacted communities and stakeholders and increase response capability. SLO and partnership guidelines have been developed as tools for self-assessment and improvement of biosecurity operations and community engagement in post-border biosecurity. Five personas based on impacted and interested individuals' survey responses can help design and develop communication and engagement activities; a values-based scale to support myrtle rust management, communication and future research activities can also contribute to more effective public engagement. At the end of the myrtle rust incursion response official activity had receded, including surveillance, leaving some people unsure of what they could do, and how they could become involved.*

Day two – Tuesday, 10 September

9am **Te Ao Māori and Mātauranga Māori**	**Māori contributing to myrtle rust research and decision-making as full partners of Te Tiriti o Waitanga** **Alby Marsh, Māori Relationship Advisor & Te Raranga Ahumara, Plant and Food Research** *Te Ao Māori is Kaupapa Māori-centred research, led by Māori, for Māori. The important aspect of Kaupapa Māori research is that it seeks to understand and represent Māori, as Māori. Using a mixed-methods process involving Māori researchers and stakeholders, this reserach included interviews, surveys, focus groups (hui/wānanga), mapping and analysis, as well as impact and response assessments in the form of regional protection plans. We worked with a range of rōpu Māori and individuals which included:* • *Te Tira Whakamātaki, the Māori Biosecurity Network including their executive team, researchers, and members, but specifically their biosecurity leads and technicians* • *Iwi leaders Pou Taiao Advisors Rōpū* • *Various hapū and iwi* *A number of hui and conversations, interviews, surveys and protection plan discussions have been conducted during the course of the project. Emerging from these conversations have been some areas of concern. A mistake we have quite often made at past hui is making it all about ourselves! The team understood this and were willing to make concessions to our objectives, to achieve the following:* • *Strong robust relationships built on integrity and trust* • *Open and honest conversations* • *In-depth understanding of what their needs, wants and desires are as kaitiaki and Mana Whenua.*

10am **Species conservation, disease control and management**	**Options for storing seeds from New Zealand myrtle plants** **Jayanthi Nadarajan, Science Team Leader – Germplasm Conservation, Plant & Food Research** *The current threat of myrtle rust to a number of New Zealand's indigenous and socio-economically important species requires an integrated strategy for conservation. However, New Zealand's myrtle plants have not received a lot of attention in terms of long-term conservation outside their natural habitats. We assessed the optimum conservation strategies for some New Zealand myrtle plants. We investigated options for storing seeds from myrtle plants, including assessing tolerance to desiccation (drying), establishment of tissue culture (e.g. plant cuttings) storage, and development of cryopreservation (freezing) techniques.*
10am **Species conservation, disease control and management**	**Scoping a resistance breeding programme** **Heidi Dungey, Science Leader, Genetics & Research Leader, Tree Breeding, Scion** *This research was aimed at informing people about what breeding approaches to take and what species to target in their response to myrtle rust. Where natural resistance exists, breeding can be effective to reduce the impact of disease in post-incursion management. A high-level resistance breeding strategy to maintain healthy New Zealand myrtle populations was developed, including the development of a 'decision framework' for possible breeding responses. Strategies included seed collections to preserve genetic diversity, selection for enhanced resistance and conservation plantings. For highly susceptible, already threatened species and taonga species or trees, a key recommendation was seed collections, ensuring enough seed for all needs, and that conservation plantings be undertaken for high priority species. We also identified native population sampling strategies, determined the probability of extinction for different types of native populations, and the possible impact of re-introducing resistant plants into natural populations. The report recommended that responses for different species are developed on a case-by-case basis and co-developed with Te Ao Māori. This could be actioned through the formation of a group including kaitiaki, to further plan and implement the breeding triage system. High-risk species should have breeding action-plans developed and implemented urgently.*
10am **Species conservation, disease control and management**	**Potential disease control tools most likely to be effective against myrtle rust** **Soonie Chng, Scientist, Plant Pathology, Plant & Food Research** *We need a range of different control options for myrtle rust in New Zealand because the disease affects many different plant species, both native and exotic, in many different environments (such as natural, urban and commercial areas). This project aimed to undertake a comprehensive review of literature on the best control options (e.g. cultural, chemical, and biological controls) that have been used to manage myrtle rust and other rust diseases. We identified some control practices and options that can be implemented immediately for short-term control of myrtle rust in New Zealand. We also identified further control options that will require more research to determine how specific, effective and feasible they are. Engagement with Māori to incorporate kaupapa and mātauranga to co-develop control solutions is critical. There is no single solution to controlling myrtle rust. Ideally, the most effective way is to use a combination of control methods, known as integrated disease management.*
10am **Species conservation, disease**	**Pilot trials of management tools for control of myrtle rust: Assessing the efficacy of fungicides** **Stuart Fraser, Forest Pathologist, Scion**

control and management	*Controlling myrtle rust with fungicides provides a way to prevent infection of valued (native or exotic) trees in the short term, while long-term management strategies are developed. An extensive review of the treatments used globally to control rust diseases indicated that some fungicides were more effective than others (strobilurins and triazoles). Our objective was to trial products available in New Zealand that contained these types of fungicides, to see if they could be used as preventative treatments against myrtle rust on iconic New Zealand species. Firstly, we determined that combining the fungicide with other substances that maximise spray coverage significantly improved coverage of the fungicide sprays on upper and lower leaf surfaces, particularly Actiwett (an alcohol ethoxylayte). We then tested the preventative effects of three different fungicides (Timorex Gold, Vandia and Radial) in controlled studies. Of the three fungicides tested for preventative control in these preliminary studies, Radial was the most effective, while the natural product extract or "biological", Timorex Gold, was not effective.*
10am **Species conservation, disease control and management**	**Botanic Gardens and myrtle rust management** **Bec Stanley, Curator, Auckland Botanic Gardens** *The incursion of myrtle rust has provided an opportunity for Botanic Gardens to assist in the long-term management of plants, gardens and nurseries by seed banking, sentinel surveys, threatened plant propagation, nursery hygiene, providing advice to the community and education. Many Gardens now have myrtle rust and an outline of management to date in gardens will also be presented.*
11.30am **Beyond Myrtle Rust**	**Beyond myrtle rust: Towards ecosystem resilience** **Mahajabeen Padamsee, Principal Investigator, Beyond Myrtle Rust** *Myrtle rust has never been eradicated from any country, despite significant effort to control its spread. The disease is now part of the story of New Zealand, and we have a narrow window of opportunity to reduce its impact on our forested landscapes. To do so, we must first understand the short- and long-term impacts of myrtle rust in New Zealand. Then we must understand the nuances of this organism, because even though myrtle rust biology has been studied in other countries, we don't know how this fungus will behave here. We can then adapt the learnings from other countries to identify the best approaches and tools to minimise the impacts of myrtle rust on our forests and natural landscapes, with a focus on natural tools that draw on traditional Māori knowledge and medicinal approaches.* *Responding to the aspirations of Māori, industry and communities, we aim to develop new, targeted ways to reduce myrtle rust damage to vulnerable plants and landscapes, and future-proof them against other plant diseases. In the same way HIV is managed to reduce the development of AIDs, our research aims to boost the resilience of our landscapes, despite the presence of disease.*

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