Symptoms on mānuka seedling. Credit: Department of Conservation, Te Papa Atawhai.

NZPPI Plant Disease Management Platform

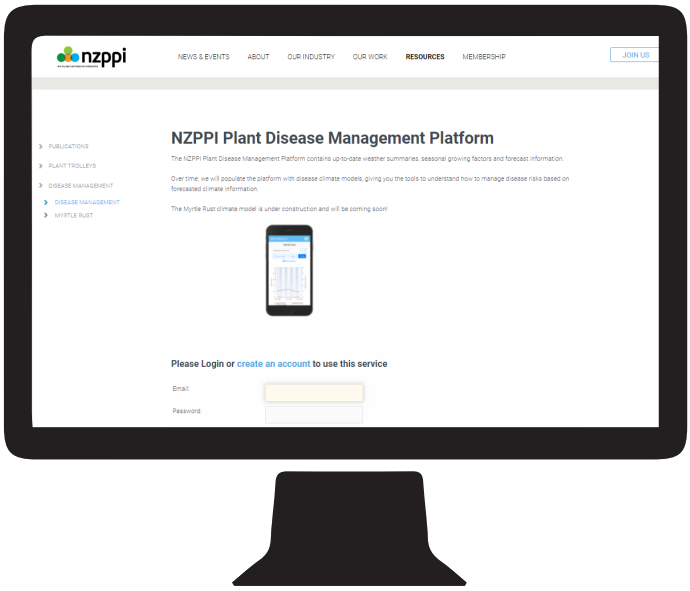
Guidance and Interpretation for the Myrtle Rust Climate Models

Myrtle rust, caused by the fungus *Austropuccinia psidii*, originates from climates more tropical than ours in Aotearoa New Zealand.

Conditions here are generally cooler than optimum, which makes myrtle rust very sensitive to seasonal weather variations. Effects of weather on the infection cycle of *A. psidii* have been modelled and the risk of myrtle rust infection can be predicted based on forecasted weather conditions.

The Plant Disease Management Platform is free to access for NZPPI members and is being made freely available to other users until December 2023.

The Platform can be accessed under the Resources menu on NZPPI's website - https://nzppi.co.nz/DISEASE-MANAGEMENT/19881/



Log In

Users will need an account to use the platform. NZPPI members can Log In with their email and password. Other users will need to Register and select a password to Log In.

Select the button - Proceed to Weather & Disease Platform.

Symptoms on Syzygium. Credit: Department of Conservation, Te Papa Atawhai.

NZPPI Plant Disease Management Platform

The Plant Disease Management Platform includes a range of weather and forecast decision support tools, including the Myrtle Rust Climate models.

These decision support tools can help reduce the risk of infection and spread of myrtle rust in susceptible plant species in the nursery. Not all myrtaceae are equally susceptible to myrtle rust. A number of species may not need specific fungicide sprays or other management actions – see the NZPPI Myrtle Rust Plant Management Protocol for a guide to susceptible species and their severity of disease.

The default weather station is shown on the map. Select **Change Station** to change the default station and select a map pin closest to your plant nursery site.

The Myrtle Rust Disease Management models are presented in two views:

1. Myrtle Rust Cumulative Risk

This model uses the daily Infection Risk and the daily Latent Period (see the Myrtle Rust Daily Risk page) to calculate the cumulative Overall Risk for a particular weather station each day. It helps users identify the timing for management actions (including fungicide application) to reduce the risk of myrtle rust infection and spread.

2. Myrtle Rust Daily Risk

This page shows the three risk factors which drive myrtle rust infection and spread and shows how daily risk changes according to relative humidity and temperature.

For both views: The area to the left of the vertical red line includes the past and current risk, based on monitored conditions at the selected weather station. Individual weather variables can be found by scrolling further down the page. The hatched area to the right of the vertical red line shows the future risk for the select period, based on weather forecast data up to 14 days ahead.

Due to weather uncertainty, forecast information is generally more reliable for a few days ahead of the current date and less accurate the further out you go.

Symptoms on pōhutukawa. Credit: Department of Conservation, Te Papa Atawhai.

Myrtle Rust Cumulative Risk

The Cumulative Risk Model can help to identify when specific management actions, particularly fungicide sprays, are needed to reduce the risk of infection and spread of myrtle rust in the nursery environment.

Setting up the Cumulative Risk graph:

1. A default weather **Station** is provided. Click on the blue arrowhead and select a map pin closest to your plant nursery site. You can scroll out the map to make it larger and move it around the screen.
2. Select the **Exposure Date**:, which is when susceptible plants are first exposed to myrtle rust in the environment (e.g., moved outdoors into an open growing area, or stock brought in from another site).
3. Select the **Start and Stop Dates** to show the period of interest. It is recommended that you select a Stop Date at least 7 – 10 days ahead to use the forecast information to help identify incoming risk events and whether a management action may be needed.

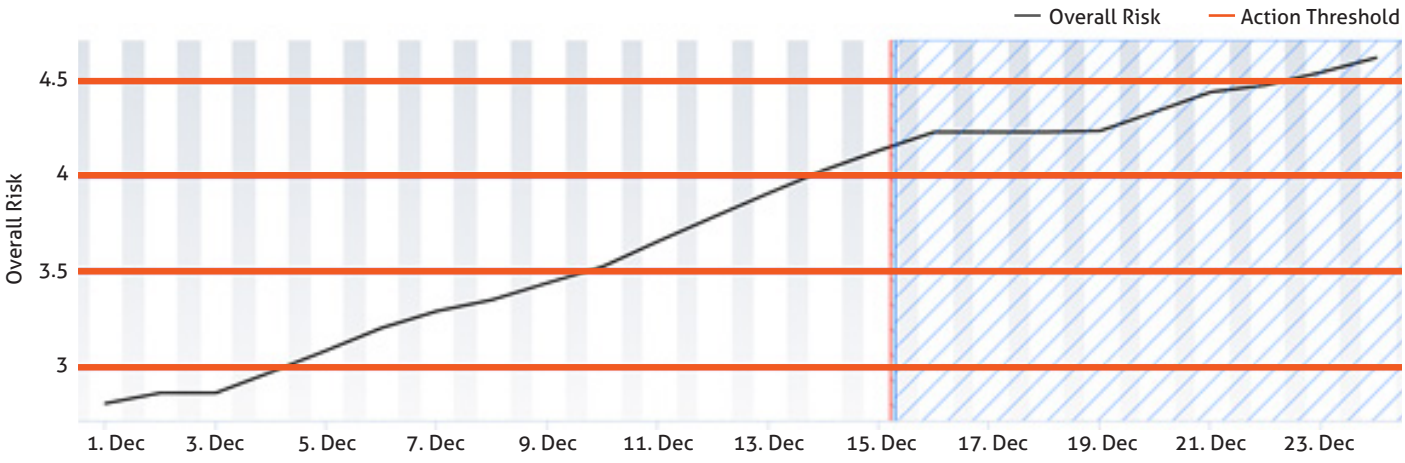
Interpreting the Graph

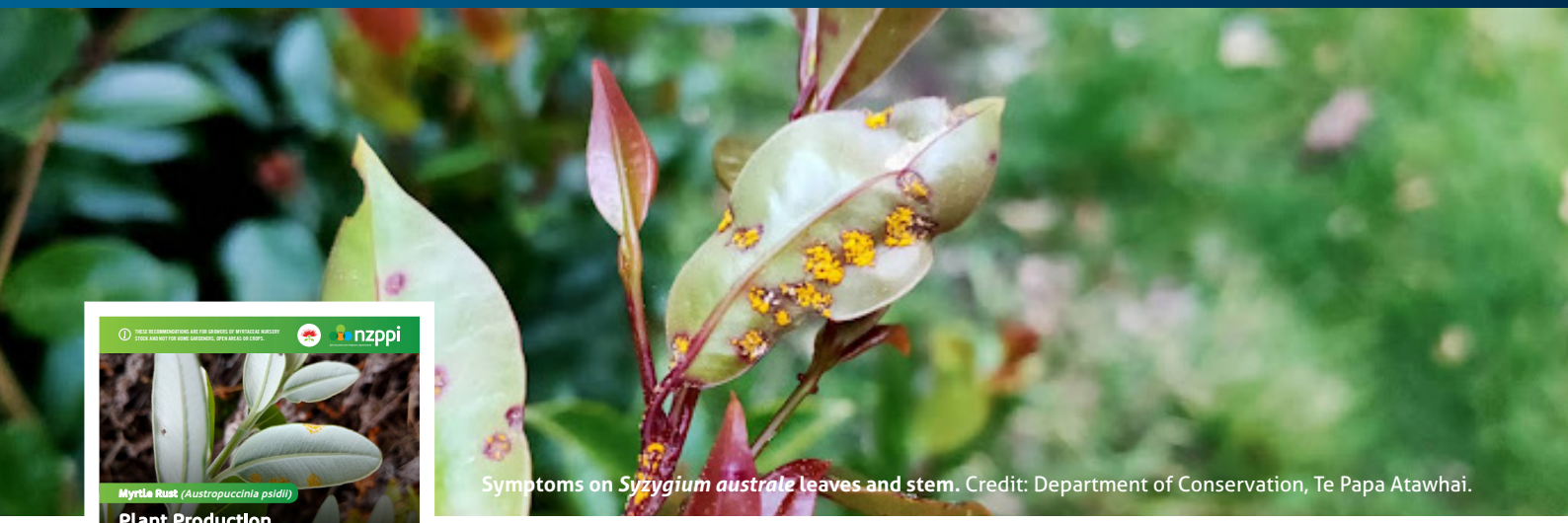
Each of the **orange horizontal lines** represents a step in the level of risk accumulation, or in other words an action threshold. When the plotted black line crosses over the orange line (a risk level), management action should be taken in the nursery environment to protect susceptible stock from myrtle rust spores present in the environment.

During high-risk periods, the plotted line will rise steeply and could move over action thresholds within a few days to a week. During these periods infected plants will be producing spores and conditions will be very conducive to infection. During low-risk periods, such as the middle of winter, the plotted lines may not cross an action threshold. For example, in the winter months the latent period between infection and sporulation could be 60 days or more).

The **Forecasting** ability enables producers to plan management actions in the nursery, eg. applying a preventative fungicide or non-chemical management methods (See Host Vulnerability and Management Actions on the following page, and refer to NZPPI Myrtle Rust Management Protocol and Myrtle Rust Fungicides for Prevention Protocol.)

For more information about interpreting the climate graphs, click on the blue question mark Graphs Guide





Symptoms on *Syzygium australe* leaves and stem. Credit: Department of Conservation, Te Papa Atawhai.

Host Vulnerability and Management Actions

Not all species of myrtaceae are equally vulnerable to myrtle rust disease and different management actions may be appropriate to manage risk in the nursery environment. See NZPPI Myrtle Rust Plant Production Management Protocol for more information.

Vulnerability of New Zealand myrtles to myrtle rust

Plant name *(Botanical name)*	Severe infection commonly seen	May be severe on young plants or basal growth of older trees	When growing near more susceptible species	Infection seldom seen in the natural environment	Infection not confirmed in the natural environment
Native species					
Maire tawake/swamp maire *(Syzygium maire)*	●				
Ramarama *(Lophomyrtus bullata)*	●				
Rōhutu *(Lophomyrtus obcordata)*	●				
Pōhutukawa *(Metrosideros excelsa)*		●			
Carmine rātā *(Metrosideros carminea)*		●			
Colenso's rātā *(Metrosideros colensoi)*		●			
Bartlett's rātā *(Metrosideros bartlettii)*		●			
Other climbing rātā *(Metrosideros* spp.*)*					●
Mānuka *(Leptospermum scoparium)*	(Young seedlings may become infected)			●	
Northern rātā *(Metrosideros robusta)*				●	
Southern rātā *(Metrosideros umbellata)*				●	
Kānuka *(Kunzea robusta)*					●
Exotic species					
Lilly pilly, Eugenia (*Syzygium australe)*	●				
Guava (*Psidium guajava)*	●				
Feijoa *(Acca sellowiana)*				●	
Brush cherry *(Syzygium paniculatum)*					●
Monkey apple *(Syzygium smithii)*					●

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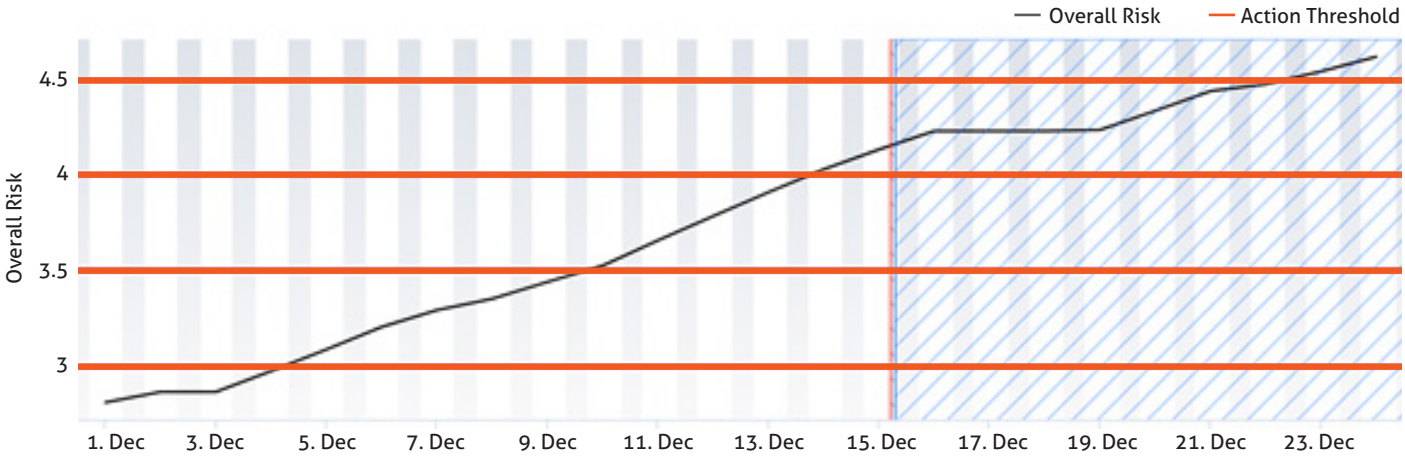
For example, in species where infection is not confirmed or seldom seen in the natural environment, monitoring for symptoms of disease may be a more appropriate action than routine use of fungicides. Myrtle rust infection is seldom seen on mature mānuka in the natural environment and it may not be necessary to routinely spray this species with a fungicide. Young mānuka could be more susceptible and a fungicide spray could be protective for vulnerable new growth in seedlings.

Prevention with Fungicides



Myrtle rust is difficult to control but the severity of infection and its spread can be reduced via fungicide application.

Use the Myrtle Rust Cumulative Risk model to forecast when the risk (the plotted line) is expected to cross an action threshold (orange horizontal lines).

Eg. in this example using the Pukekohe weather station, the risk is expected to cross an action threshold again on the 22nd of December and it is advisable to apply a preventative fungicide by this date to protect vulnerable new growth in susceptible species.

In conditions where the Cumulative risk is rising very sharply, it may be necessary to spray frequently to protect new plant growth. If the number of days between action thresholds is less than a week, spray weekly only. See NZPPI Prevention with Fungicides Protocol for more information.

Scroll down to look at the forecast weather conditions to identify weather conditions suitable for fungicide spraying. Avoid spraying fungicides during windy conditions, onto a wet canopy or during rain. Allow for at least 4 hours drying time post-spraying.

Symptoms on White Climbing Rātā. Credit: Department of Conservation, Te Papa Atawhai.

Record a fungicide application in the climate model

You can include custom labels in the graph (eg. spray applications - date of application and product). Click on Manage Sprays and type notes into the labels section. Click on the box to tick "Show labels" on the graph and click "Update".

Sharing and Exporting Event Summaries

You can share the graph using the Share function [Share]. An Event Summary Table is included at the bottom of the page, summarising all of the risk indices for the selected period.

Date	Overall Risk Accumulation	Average Temp (°C)	Total Rainfall (mm)	High RH Hours	Infection Risk	Spore Risk	Latent Periods
Wed, Dec 15 2021	**4.1**	**18.2**	**3.1**	**12.0**	**0.8**	**0.8**	**7.7**
Thu, Dec 16 2021	**4.2**	**18.0**	**3.2**	**10.0**	**0.8**	**0.8**	**7.8**
Fri, Dec 17 2021	**4.2**	**-**	**0.0**	**0.0**	**0.0**	**0.7**	**8.5**
Sat, Dec 18 2021	**4.2**	**-**	**0.0**	**0.0**	**0.0**	**0.7**	**8.7**
Sun, Dec 19 2021	**4.2**	**15.1**	**0.0**	**8.0**	**0.1**	**0.7**	**8.5**
Mon, Dec 20 2021	**4.3**	**17.9**	**0.9**	**10.0**	**0.7**	**0.8**	**7.4**
Tue, Dec 21 2021	**4.4**	**18.0**	**5.1**	**10.0**	**0.8**	**0.9**	**7.3**
Wed, Dec 22 2021	**4.5**	**17.1**	**0.7**	**7.0**	**0.3**	**0.8**	**7.5**
Thu, Dec 23 2021	**4.5**	**17.6**	**2.4**	**8.0**	**0.5**	**0.9**	**7.3**
Fri, Dec 24 2021	**4.6**	**18.1**	**4.0**	**8.0**	**0.6**	**0.9**	**7.2**

This can be exported via the [Export Event Summary] button at the bottom of the button at the bottom of the page.

Non-chemical control in the nursery

Plant producers can minimise the severity of rust using cultural controls. Spores need only 4 – 6 hours of leaf wetness to germinate and infect young, new growth during warm temperatures. Place susceptible species in the windiest part of the nursery to minimise humidity and prolonged leaf wetness.

Time irrigation early in the day to help wash overnight spores away and allow foliage to dry before humidity increases again in the evening. If possible, irrigate using drippers rather than overhead sprinklers to reduce both wetness duration and infection risk.

Avoid trimming, fertilising or potting susceptible species during warmer spring and summer periods to avoid a flush of new growth during risky periods.

Myrtle Rust Daily Risk

The processes and environmental parameters that drive myrtle rust risk are represented by three risk indices: infection risk, latent period and sporulation.

The Daily Risk model can help the practitioner understand how risk changes according to the relative humidity and temperature.

Setting up the Daily Risk graph:

1. A default weather **Station** is provided. Click on the blue arrowhead and select a map pin closest to your plant nursery site. You can scroll out the map to make it larger and move it around the screen.
2. Select the **Start and Stop Dates** to show the period of interest. It is recommended that you select a Stop Date at least 7 – 10 days ahead to see the forecast information to understand how the climate factors will influence risk.

Symptoms on ramarama *(Lophomyrtus bullata)*.
Credit: Department of Conservation, Te Papa Atawhai.

Interpreting the Graph and risk indices

Process	Risk definition	Weather dependence
Infection	• Likelihood that living spores blowing on the wind will land on plants, germinate and infect vulnerable host plants	• Hourly air temperature • Hours of high relative humidity per day • Hourly solar radiation (small influence)
Latent period	• Time from infection by spores to new spore-producing pustules • Risk output is an instantaneous daily value of number of days at the current temperature	• Daily mean air temperature • Decreases with increasing temperature • Minimum is about 6 days at 18-27°C
Sporulation	• Likelihood that new spores from erupted pustules are available to spread to new infection sites	• Daily mean air temperature • Spore production increases with increasing temperature up to about 20 °C

The risk is greatest during periods of high relative humidity and warm temperatures.

Infection and sporulation risk have relative values of 0-1, whereas latent period is number of days. Each risk index is divided into five categories.

Daily infection and sporulation risk:	
Index value	**Risk category**
0.0 – 0.2	Very low
0.2 – 0.4	Low
0.4 – 0.6	Moderate
0.6 – 0.8	High
0.8 – 1.0	Very high

On days where there is an infection risk greater than 0.5, a substantial proportion of spores in the environment will be able to infect vulnerable plants.

Daily latent period value *(Shortest possible latent period about 6 days.)*	
Index value (days)	**Risk category**
Above 50	Very low
30 – 50	Low
15 – 30	Moderate
10 – 15	High
Below 10	Very high

In the winter months, the latent period can be up to 60 days which means you are not likely to see myrtle rust in the nursery even if plants are continuing to grow.

Give us your feedback!

NZPPI is making this Weather & Disease Platform available to improve the suite of tools for plant producers to manage disease in the nursery environment.

We are already planning improvements to the Myrtle Rust Climate Tool for the 2022/23 myrtle rust season, including improvements to the Cumulative Risk model which takes into account the management actions to reduce risk (eg, application of fungicides).

If you have any suggestions for improvement, please email them to office@nzppi.co.nz.

The weather based myrtle rust risk model algorithms and decision rules used in the online NZPPI Plant Disease Management Platform were developed by The New Zealand Institute of Plant & Food Research Ltd (PFR) to provide information on the risk of myrtle rust occurring in susceptible myrtle species and the suggested timing of fungicide sprays to mitigate that risk. Factors other from those used in the risk calculations may influence myrtle rust development and PFR accepts no liability for any myrtle rust occurrence, costs incurred or harm arising from the use of these algorithms and decision rules.