Managing blueberry rust in a cooler climate

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Blueberry rust is a plant disease caused by the fungus *Thekopsora minima* and is currently confined to a small number of properties in Victoria and Tasmania but is endemic in NSW and QLD. Preventing blueberry rust infection in the Southern States is key to limiting the spread of this disease. The critical steps in preventing blueberry rust infection include good farm biosecurity and applying crop management practices that reduce the risk of infection.

Disease cycle

Conifer hemlocks *(Tsuga spp.)* are the alternate hosts that the rust requires to complete its sexual life cycle in colder climates. These species are uncommon in Australia. In mild climates such as Australia's the rust can survive, solely on blueberries, by continuous reinfection with asexual spores *(urediniospores)*.

Survival

Blueberry rust fungus survives primarily in infected leaves and can exist exclusively on blueberries from season to season, especially if blueberries retain their leaves over winter. In the evergreen system, where leaves are continuously present on the plant, DNA analysis has shown that asymptomatic leaves can be infected with *Thekopsora minima* throughout the year. When conditions become conducive (warm, moist), the fungus is stimulated to form pustules and sporulates to reinfect.

Infected leaf debris on the orchard floor is unlikely to be a major source of inoculum as spore survival is generally less than six weeks, depending on agronomic and environmental factors practiced in the orchard. Sporulation could be initiated from infected leaves two weeks after leaves were placed on the orchard floor, but after this, too many other fungi are present on the leaves to effectively distinguish the rust fungus. DNA could not be detected in infected leaf samples placed on the orchard floor after six weeks.

First infection

The rust fungus, *Thekopsora minima*, is biotrophic. That means it will only infect living plant tissues. Spores require moisture for germination and infection. Infection can begin at any plant growth stage from when the leaves first emerge if moisture is present on the leaves. Younger leaves are more susceptible. Older leaves are more difficult for the fungus to penetrate as the cuticle becomes thicker.

Latent period

Following infection, the fungus colonises the leaf. The period of time between infection and the appearance of symptoms is known as the latent period. The length of the latent period is largely dependent on temperature but is generally between 10 and 21 days. At 20°C pustules begin to appear on infected leaves after 10 days. After this time, the small yellow lesions appear on the upper surface of the leaf, wherever infection has taken place.

Spread

Spores produced in pustules on leaves are the main infective propagule of blueberry rust in evergreen production systems. Rain, water-splash, air currents, insects and humans can spread spores to infect new plant tissues. Pustules will continue to develop and spores are released as long as conditions are favourable and many cycles of infection can occur in a given production season.

Figure 1. Blueberry rust life cycle. Image credit: Rosalie Daniel, NSW DPI

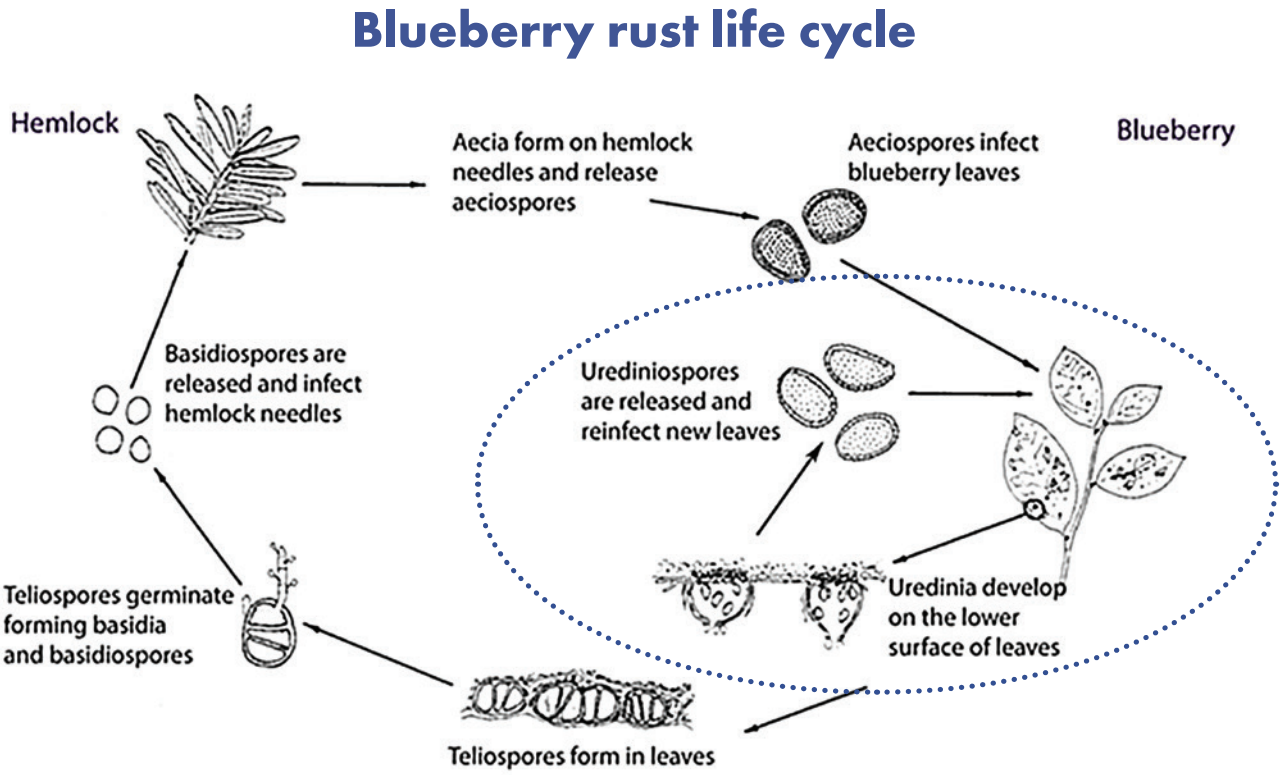

Figure 2. Rust first appears as small pale-bright yellow lesions on the upper surface of infected leaves. Photo credit: Rosalie Daniel, NSW DPI
Figure 3 a & b. The fungus erupts through the leaf underside surface & small pustules containing spores form. Photo credit: Rosalie Daniel, NSW DPI
Figure 4. Progressive rust symptoms on leaves. Photo credit: Melinda Simpson, NSW DPI

The disease cycle (Figure 1) continues as long as conditions are favourable (warm, moist) and susceptible foliage is available to infect. Initially only a few pustules may be present, but as the season progresses, if control measures are not adequate, then rust urediniospore numbers can increase significantly, and the rust spreads throughout the orchard.

Symptoms

Although rust symptoms are most obvious on leaves when red-brown lesions are visible on the upper surface, and corresponding yellow pustules can be seen on the corresponding lower surface, infection takes place much earlier.

Leaves

Rust first appears as small pale-bright yellow lesions on the upper surface of infected leaves (Figure 2). On the underside of the leaf, the fungus erupts through the surface and small pustules containing spores form (Figure 3). As the disease progresses, the lesions become red to brown in colour and may increase in size, coalescing when disease is severe (Figure 4). The spores are powdery when touched, and when there are many, they may be seen to float with air currents or wind. The infected tissue within the lesion becomes darker as it dies, reducing photosynthetic capacity of the leaf. When disease pressure is high, defoliation may occur.

Shoots

Lesions containing spores have been observed on twigs and *Thekopsora minima* DNA has been extracted from these twigs. It is likely that infected shoots play a role in the survival of the fungus.

Fruit

Lesions develop on ripening fruit (Figure 5) when disease pressure is high. Rust lesions can reduce the marketability of ripe berries. It is likely that infection takes place during flowering. Fungal DNA corresponding to *T. minima* has been detected in flowers and ripening asymptomatic fruit.

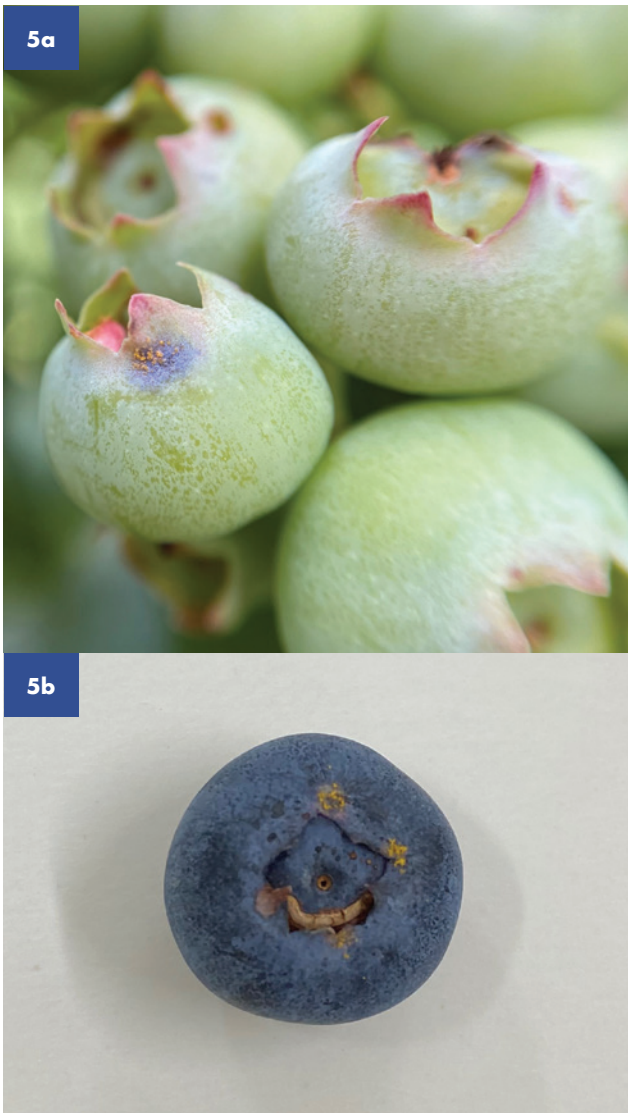

Figure 5 a & b. Rust on green fruit and ripe fruit.
Photo credit: Melinda Simpson, NSW DPI

Managing the disease

Management of blueberry rust requires an integrated approach, including scouting of orchards to detect early infections, monitoring of weather conditions to identify conditions conducive to the infection and the development of disease symptoms, cultural measures and targeted application of fungicidal sprays.

Rainfall or moisture for leaf wetness along with warm temperatures are required for infection to take place. Spores of Thekopsora minima germinate at temperatures between 5 and 30˚C under 100% relative humidity, but optimum growth occurs at 15– 25˚C. Blueberry rust requires at least 7 hours of leaf wetness to infect at 24˚C.

Hygiene

Blueberry rust spores are easily spread through various means, but it's important to ensure that spread due to human activity is minimised.
Actions you can take include:

- Change your clothes after leaving an area with host plant material or use disposable overalls. Wash your clothes before wearing them again.
- After working with host plant materials, disinfect any benches or other equipment (including tools and gloves) with suitable products. Wipe electronic items, such as mobile phones and GPS units, with a disinfectant cloth, or use them in a plastic bag and wash or dispose of the bag before moving to another property.
- Ensure the cargo bay of any vehicle used to transport blueberry rust host materials is disinfected after delivery of a consignment.
- Do not move infected plants off your property.
- Dispose of infected material by burning or burial.

Biosecurity

Instigate farm biosecurity measures which will prevent the introduction, establishment and spread of blueberry rust. These measures may include:

- Source plants from reputable suppliers who themselves are taking measures to manage blueberry rust. Do not propagate from infected plants.
- Inspect new blueberry plants prior to unloading and planting on your property.
- Ensure staff are educated in the identification of the disease, which may include signage & posters.
- Limit the access of people onto your property.
- Ensure all visitors, contractors and tradesmen implement hygiene protocols and limit their movement on the property.
- Disinfect equipment that moves on & off your property.
- When working crops, do not share staff between healthy and infected crops.
- Ensure staff work from healthy parts of a crop to diseased parts to reduce spread of the rust.
- Restrict movement of vehicles around on the property.

Chemical management

Fungicides permitted for use on blueberries are registered with Australian Pesticides and Veterinary Medicines Authority (APVMA). Fungicides permitted for blueberry rust control include:

- PER13958 Mancozeb (Mancozeb) GROUP M3
- PER14309 Bravo (Chlorothalonil) GROUP M5
- PER14740 Tilt (Propiconazole) GROUP 3
- PER82601 Delan (Dithianon) GROUP M9
- PER82986 Pristine (Boscalid /Pyraclostrobin) suppression only GROUP 7 / 11

All products listed belong to different chemical groups. Rotating fungicides with different chemical groupings helps to prevent the development of fungicide resistance.

Organically-approved fungicides

- PER84176 Copper GROUP M1

New research to evaluate other fungicide options has been funded by the Tasmanian Government via the Agricultural Innovation Fund.

Key points

- Implement Biosecure Best Practices: "Come Clean, Go Clean".
- Source clean, disease-free planting material when establishing new blocks or orchards. Be aware that fungicides can mask symptoms
- Minimise or eliminate inoculum carry over from season to season, for example when pruning, remove infected plant parts and dispose of by burning or burying. By reducing the carry-over of inoculum, there is less inoculum to start new infection the following production season.
- Prune to open the canopy. This will promote ventilation and more rapid drying of the foliage, reducing the length of time that leaves remain wet and conditions favourable for rust infection. Opening the canopy can also assist in improving contact and penetration of sprays.
- Crop protectants can only be effective when they are applied at the right rate, in the right conditions, with suitable equipment to get good coverage
- Monitor weather conditions to identify potential infection events.
- Optimise the spray timing by evaluating the prevailing of environmental conditions and blueberry physiology for infection potential.
- Monitor temperature, rainfall, relative humidity and leaf wetness.

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