# Barley disease update 2023

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**GRDC code**

National Variety Disease Screening (NVT)
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DAQ2106-007: Disease surveillance and related diagnostics for the Australian grains industry within the northern region

**Take home messages**

- Epidemic leaf rust levels in 2022 barley crops – high inoculum loads possible in 2023
- Low levels of both net blotches in 2022 – will be present in barley stubble
- Do not plant barley into barley stubble
- Management strategies for foliar diseases includes resistant varieties, crop rotation, seed treatment, regular crop monitoring and timely fungicide application
- Resistance to fungicides has previously been reported in powdery mildew, both net blotch pathogens and more recently in the leaf rust pathogen of both barley and wheat
- Fungicide resistance development should be managed by using an Integrated Disease Management (IDM) strategy.

**Background**

The seasonal outlook for 2023 is forecast to bring below median rainfall and possible drier and hotter spring and summer conditions. Epidemic levels of barley leaf rust observed in susceptible varieties in 2022, could result in the presence of high inoculum loads early in the 2023 cropping season. Both the net blotches were present at low levels in 2022 crops; however, where barley is planted into barley stubble from last season, this could cause infection early in the growing season. Spot form net blotch has been observed in early barley crops planted into barley stubble in QLD.

**Leaf rust**

Leaf rust of barley is widely distributed and a common disease in all Australian barley-growing regions. It is considered one of the five major barley diseases in Australia and can significantly reduce grain yield and quality, with yield losses in excess of 50% reported under experimental conditions. Leaf rust was widespread in Queensland in 2016, but due to the prolonged drought conditions, was only present at very low levels until 2021. Since then, environmental conditions favourable for disease establishment and spread have led to an increase in leaf rust inoculum, with epidemic levels observed in susceptible varieties in 2022.

A new pathotype of leaf rust (5457P+), virulent on *Rph3* was identified in eastern Australia in 2009 (Cereal Rust Report 2009, Vol 7, Issue 5). This virulence is present in all major production areas. The emergence of this pathotype had a major impact on not only production, but also on barley breeding as it rendered a large portion of elite breeding material susceptible. Many current commercial varieties are still reliant on *Rph3* (Cereal Rust Report 2020, Vol 17, Issue 1).

In the presence of a green bridge, the pathogen can survive over summer and be present at high levels early in the growing season. Leaf rust is favoured by moist conditions with temperatures ranging between 15°C and 22°C.

The disease is caused by the obligate parasite, *Puccinia hordei.* It can be identified by small circular to oval pustules on upper leaf surfaces. It can also develop on leaf sheaths later in the season. As the crop matures, pustules turn dark, producing black teliospores. Rust spreads by means of airborne spores, able to travel long distances. The pathogen spreads rapidly when conditions are favourable and large areas are planted to susceptible varieties, resulting in the development of epidemics. High inoculum levels put pressure on major resistance genes and can lead to the development of new, more virulent pathotypes.

Large areas sown to S to VS varieties across a range of environments almost ensures that leaf rust will be a problem in some regions contributing to high inoculum levels causing epidemics, whilst adding selection pressure on the pathogen to mutate and acquire new virulences.

**Net blotch**

Net blotches exist as one of two forms, net form net blotch (*Pyrenophora teres* f. *teres*) or spot form net blotch (*P. teres* f. *maculata*). They are stubble-borne diseases where primary infection is derived from barley crop stubble. Net form net blotch (NFNB) can also be seed-borne. Spot form net blotch (SFNB) however, has not been shown to be seed-borne.

Net blotches are economically important diseases in most barley growing regions in the world. Yield loss associated with NFNB generally range between 10% and 40%. However, losses in excess of 60% have been reported in QLD and up to 70% in South Australia on susceptible varieties under epidemic conditions. Yield loss due to SFNB is not well documented; but has been reported up to 44% in WA.

The spore morphology of the two forms is very similar, hence symptom expression is used to distinguish between the two forms. At early stages of disease development, it can be difficult to distinguish between the two forms. Both diseases start off as small black-brown spots. In net form net blotch, they elongate into a distinctive net-like pattern. In spot form lesions enlarge into round to oval shapes with an often darker centre surrounded by a chlorotic margin.

The net blotch pathogens, in particular the net form net blotch pathogen is very variable and can frequently overcome resistance in varieties. It is well known that they adapt and increase virulence on varieties grown over large areas.

**Powdery mildew**

Powdery mildew (*Blumeria graminis* f. sp. *hordei*) is synonymous with barley cultivation in the northern region and often appears early in the growing season. It prefers mild and humid conditions and can be seen as white, fluffy mycelia growth on leaves and leaf sheaths. It generally does not persist once conditions turn to warm and dry. Hence, in Queensland yield loss is usually less than 15%.

Powdery mildew survives between crops on volunteer barley and on barley stubble. Older fungal colonies become dull grey and produce small, black fruiting bodies (cleistothecia). When cleistothecia mature and conditions are favourable, they release ascospores to infect the new crop. These soon produce conidia (asexual spores) that spread the disease within and between crops.

Unless a variety is very susceptible to powdery mildew and conditions are very favourable for disease development, it is unlikely that the disease will progress to upper leaves of adult plants. In 2022, environmental conditions remained favourable until late in the season, resulting in very high infection levels in susceptible varieties.

The powdery mildew fungus can evolve rapidly and can form new races/pathotypes that infect previously resistant varieties. In Australia, varieties such as Commander(ϕ), Compass(ϕ), La Trobe(ϕ) and Shepherd(ϕ) were all resistant when released; but changes in the powdery mildew population have rendered these susceptible. Continuous monitoring of the powdery mildew population provides knowledge on the virulences in the Australian barley powdery mildew population. This information

guides the breeders when choosing resistance sources and facilitates screening of breeding material with new, relevant virulences.

**Fungicides - resistance risk and timing**

The development of resistance and reduced sensitivity to fungicides is an increasing problem in many pathogens. Without intervention, more fungicides are likely to become ineffective.

Fungicides are essential in cropping and are used almost routinely in barley crops. The choice of fungicide is determined by registration, efficacy, availability and price.

The risk of developing fungicide resistance varies between mode of action (MoA) groups, fungal pathogens and environments. Repeated use of fungicides with the same MoA selects for individuals in the fungal population with reduced sensitivity to the fungicide. Higher disease pressure indicates larger pathogen populations and increased probability of developing resistance to fungicides.

In Australia, fungicide resistance and reduced sensitivity in barley pathogens have been identified to date in powdery mildew, spot form net blotch and net form net blotch. Most recently fungicide insensitivity has been reported in leaf rust of both barley and wheat in Australia (Cereal Rust Report 2022, Vol 19, Issue 3). This will have a major impact on the management of leaf rust epidemics in cereal crops in future.

Fungicide resistance can be managed using an integrated disease management (IDM) strategy to reduce disease pressure and reliance on fungicides. This includes:

- Resistant varieties
- Crop rotation
- Clean seed
- Managing green bridge
- Stubble management
- Use fungicides only when necessary and apply strategically
- Rotate and mix fungicide MoA groups
- Monitor regularly for disease - fungicides are more effective at lower disease levels.

**Conclusion**

Barley foliar pathogens cause devastating yield and quality loss worldwide. Research has proven that the more susceptible a variety, the bigger the yield and quality loss resulting from disease. The most economic and environmentally friendly means of controlling disease is by growing a high-yielding well-adapted resistant variety. It has been proven that growing varieties with some level of resistance can limit yield and quality loss. The most up-to-date disease ratings are available on the NVT website (https://nvt.grdc.com.au/nvt-disease-ratings).

Thus, growing a susceptible variety increases risk and requires dedicated effort towards persistent monitoring and decision making. The presence of a green bridge will present an opportunity for many pathogens to survive and be present at high levels early in the growing season. Planting barley on barley will increase the risk and disease pressure of stubble-borne pathogens and may aid the survival of fungicide resistant individuals.

The epidemiology of the pathogen, the biology of the host and environmental conditions all impact disease management. Foliar fungicides are very effective but need to be applied early in the epidemic as disease can increase rapidly. The use of an integrated disease management approach will not only limit the development of fungicide resistance but will also reduce economic input and support sustainable farming.

**References and Further reading**

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Australian Fungicide Resistance Extension Network (AFREN): https://afren.com.au/resources.

Cereal Rust Reports: https://www.sydney.edu.au/science/our-research/research-areas/life-and-environmental-sciences/cereal-rust-research/rust-reports.html

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