MANAGING FUNGICIDE RESISTANCE: BARLEY POWDERY MILDEW

FACT SHEET

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

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Barley powdery mildew

KEY POINTS

- The barley powdery mildew pathogen has a very high fungicide resistance risk.
- Resistance to Group 3 DMIs and Group 11 QoIs has been reported in several countries.
- Field resistance to some Group 3 DMIs has been detected in barley crops in Western Australia.
- Samples from New South Wales, Queensland, Victoria and Tasmania have shown resistance to some Group 3 DMI fungicides in laboratory tests.
- Careful use and rotation of available fungicides will lessen the spread of resistance in the barley powdery mildew pathogen.
- Agronomic practices that minimise disease pressure reduce the need to apply fungicides.
- Good management will help protect the long-term efficacy of current fungicides.

Photo: GRDC.

Barley powdery mildew is caused by the fungal pathogen *Blumeria graminis* f. sp. *hordei* and is an important disease of barley, especially in Australia's western and northern growing regions. It also has the potential to be very damaging in the southern region during conducive seasons.

Field examples of *Blumeria graminis* f. sp. *hordei* exhibiting fungicide resistance and reduced sensitivity to some Group 3 DMI fungicides have been reported in WA. Laboratory tests have confirmed the presence of a mutation associated with resistance and reduced sensitivity to some Group 3 fungicides in several growing regions of Australia.

Careful management of fungicide use and disease pressure is essential to maintain the efficacy of fungicides as a tool for controlling barley powdery mildew.

Fungicide resistance in barley powdery mildew

As the barley powdery mildew pathogen's short cycle means resistant strains emerge frequently, it is considered a high risk for development of fungicide resistance.

Indications of fungicide resistance include:

- Resistance to the Group 3 fungicide tebuconazole (e.g. Folicur®) has been detected in Western Australia; along with reduced sensitivity to the Group 3 fungicides propiconazole (e.g. Tilt®) and flutriafol (e.g. Intake®, Impact®) in Western Australia.

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- *In vitro* laboratory testing has detected the same mutation that confers reduced sensitivity and resistance to the above Group 3 chemical actives in isolates collected from paddocks in New South Wales, Queensland, Tasmania and Victoria.

Overseas, barley powdery mildew has developed resistance to Group 11 strobilurin fungicides (e.g. Amistar Xtra®), Group 5 morpholine fungicides (e.g. Prosper®) and Group 13 Aza-napthalene fungicides (e.g. Legend®).

Managing fungicide resistance

It is important to recognise that fungicide resistance is a numbers game. As a pathogen population increases, so does the number of mutant individuals with natural resistance to a fungicide.

As a result, when fungicides are used for disease control they are best applied against a small pathogen population. That way, a smaller number of resistant individuals will be present to survive the fungicide application and they will remain vulnerable to other competitive pressures in the ecosystem.

Keeping the pathogen population low can be achieved by taking all possible agronomic steps to minimise disease pressure (see *Non-chemical controls* below). Applying fungicide that coincides with the first sign of infection under disease conducive conditions and the crop reaching its key growth stages, is a useful strategy aimed at reducing fungicide resistance selection pressure.

A compromised fungicide will only control sensitive individuals while the resistant strains within the population continue to flourish.

Fungicide usage recommendations for barley

Planning of fungicide rotations needs to consider all fungal pathogens that may be present in the crop. Otherwise, the fungicide treatment for one pathogen may select resistance in another.

Careful fungicide use will minimise the risk of fungicide resistance developing in barley powdery mildew in Australia and help ensure the longevity of the available chemical protections.

Fungicide resistance terminology

When a pathogen is effectively controlled by a fungicide, it is defined as sensitive to that fungicide. As fungicide resistance develops, that sensitive status can change to:

- **REDUCED SENSITIVITY**

  When a fungicide application does not work optimally but does not completely fail.

  This may not be noticeable at field level, or the grower may find previously experienced levels of control require higher chemical concentrations up to the maximum label rate. Reduced sensitivity must be confirmed through specialised laboratory testing.

- **RESISTANCE**

  When a fungicide fails to provide disease control in the field at the maximum label rate.

  Resistance must be confirmed by laboratory testing and be clearly linked to a loss of control when using the fungicide correctly in the field.

- **LAB DETECTION**

  A measurable loss of sensitivity can often be detected in laboratory *in vitro* tests before or independent of any loss of fungicide efficacy in the field. Laboratory testing can indicate a high risk of resistance or reduced sensitivity developing in the field.

Advice to barley growers includes:

- **Minimise** use **of Group 3** fungicides that are known to have reduced effectiveness due to resistance. The need to increase the application rate to achieve a previously experienced level of disease control is often an early indication of compromised efficacy.
- **Rotate Group 3** fungicide actives within and across seasons. In other words, do not use the same Group 3 active ingredient (e.g. propiconazole, tebuconazole) twice in succession.
- **Avoid** more than two applications of products containing a **Group 3** active in the same growing season.
- **Group 11** fungicides should be used as a preventive, rather than curative control and should be rotated with effective **Group 3** products.
- **Group 5, 7**, **11** or **13** products should not be applied more than twice in a growing season, either alone or in mixtures. This includes in-furrow or seed treatments, as well as subsequent foliar sprays. (Combined seed and in-furrow treatments count as one application.)

- **Groups 7** and/or **11** products must not be used in two consecutive applications, including in-furrow treatments. For example, if a **Group 11 + 4** fungicide is applied in-furrow at planting, the first foliar fungicide spray must not contain a **Group 11** active.
- **Group 13** products should be used in mixture with an effective partner fungicide or used in rotation with a fungicide of a different activity group. When barley powdery mildew is already established in the crop, this partner should be with a suitable curative fungicide. Group 13 fungicides should only be used as a protective treatment when applied unmixed.

In addition:

- **Western Australian growers** should not use tebuconazole-based fungicides to control barley powdery mildew. This Group 3 active is no longer effective against barley powdery mildew in Western Australia.
- **Western Australian growers** should avoid using stand-alone products containing propiconazole or flutriafol for control of any disease in barley (e.g. net blotches), as this will favour further selection of resistant pathogen strains within the WA barley powdery mildew population.

Finally, it is always important to follow the AFREN 'Fungicide Resistance Five' recommendations for fungicide use. These guidelines can be applied to all crops and pathogens, regardless of their formal fungicide resistance status, to reduce the chances of resistance developing

Non-chemical controls

Barley powdery mildew is favoured by susceptible barley varieties growing in mild and humid weather (15° to 22° Celsius, relative humidity > 75%), with a dense crop canopy, high nitrogen levels, good soil moisture profiles and extended periods of damp, humid conditions under the canopy.

Severe infections can occur in winter during both early and later stages of crop growth and can cause significant yield loss in crops with high yield potential.

The Fungicide Resistance Five!

1. **Avoid susceptible crop varieties**
2. **Rotate crops – use time & distance to reduce disease carry-over**
3. **Use non-chemical control methods to reduce disease pressure**
4. **Spray only if necessary & apply strategically**
5. **Rotate & mix fungicides / MoA groups**

Blumeria graminis f. sp. *hordei* survives on barley stubble and volunteer barley plants. Spores can be spread to crops by the wind. The pathogen is crop specific and only infects barley, not wheat or other grain crops.

Management practices to help reduce disease pressure and spread include:

- **Planting less susceptible barley varieties**
  This is the most effective step for managing barley powdery mildew. Any level of genetic resistance to barley powdery mildew will help slow rates of infection in the crop and reduce reliance on fungicides to manage the disease. Avoid growing SVS and VS barley varieties in disease-prone areas.
- **Inoculum management**
  Controlling volunteer barley plants during fallow periods and reducing infected barley stubble loads through grazing, rolling, etc. will reduce the volume of spores spreading into an adjacent or subsequent barley crop.
- **Practicing good crop rotation**
  A program of crop rotation creates a dynamic host environment that helps reduce inoculum levels from year to year. Rotating non-susceptible barley varieties can also provide a more dynamic host environment, forcing the pathogen to adapt rather than prosper.
- **Avoiding early planting**
  Later planting can delay plant growth until after the initial warm and damp period of early winter that favours barley powdery mildew. This is important as infection of young plants can lead to increased losses at maturity. Later sown crops also tend to develop smaller canopies, which are less conducive to powdery mildew infection. However, delayed sowing can have an associated yield penalty in some environments and growers need to consider their risks.
- **Careful nitrogen management**
  Excess nitrogen can favour disease development by promoting a dense, closed crop canopy. Nitrogen applications should be budgeted to measured soil N levels and target yield, so they are optimised for the growing purpose.
- **Encouraging air circulation**
  Actions that help increase airflow into the crop canopy can help lower the relative humidity. This can include wider row spacing, reduced plant populations (without compromising yield potential) and, in mixed farming systems, grazing by livestock to reduce and open up the crop canopy.
- **Taking region-wide action**
  Resistant powdery mildew spores can spread easily. It is worth talking with neighbours and working together for integrated, area-wide fungicide resistance management practices.

FREQUENTLY ASKED QUESTIONS

How does fungicide resistance develop?

Fungicide resistance occurs when fungicide resistant strains of a pathogen dominate the whole pathogen population. Fungicide resistant strains are 'selected for' by applications of the fungicide. That is, the non-resistant strains are controlled by the fungicide allowing the resistant strains to proliferate.

For more on the causes and effects of fungicide resistance, read the AFREN Fact Sheet How Fungicide Resistance Develops.

How do I know if I have a fungicide resistant disease in my crop?

If a fungicide application fails to provide adequate control of the disease, or if the lower range of application rates on the label for a fungicide must be steadily increased from application to application, there is cause for concern.

You should keep an accurate record of every fungicide application – including dates, times, weather conditions, application rates, crop growth stage and notes of any evidence of a disease being present.

What should I look for?

It is important to inspect the crop after every fungicide application to confirm whether the expected level of control has been achieved.

If the disease is still present or increasing, review records of the application for reasons why it may have failed. If there is no obvious cause, consult an expert and consider having samples of the infected crop tested for fungicide resistance.

Who do I contact?

Contact your agronomist or adviser and have them review the crop and your fungicide application records. If they suspect fungicide resistance, they will be able to arrange further investigation, sample collection and lab analysis.

Alternatively, you can visit the AFREN website About page for details of fungicide resistance experts in your region.

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USEFUL RESOURCES

Australian Fungicide Resistance Extension Network (AFREN)
Dedicated site for the latest Fungicide Resistance information, reference materials, case studies, grower survey and news.
afren.com.au

AFREN Fungicide Resistance Information Guide
Comprehensive guide to fungicide resistance issues, instances and management – including details of fungicide Mode of Action groups, chemical actives and diseases by crop. Prepared by AFREN and published by the GRDC.
afren.com.au/resources#FRManagementGuide

GRDC Fungicide Resistance In Barley Fact Sheet

GRDC Fungicides In Australia Fact Sheet

GRDC How Fungicide Resistance Develops Fact Sheet

afren.com.au/resources#factsheets

REFERENCES

The content in this Fact Sheet is based on the content and sources included in the AFREN Guide **Fungicide Resistance Management in Australian Grain Crops.** See 'Useful Resources' above.

MORE INFORMATION

Australian Fungicide Resistance Extension Network
afren.com.au

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