MANAGING FUNGICIDE RESISTANCE: SPOT FORM NET BLOTCH OF BARLEY FACT SHEET

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

SOUTHERN AND WESTERN REGIONS
JUNE 2022

Spot form net blotch (SFNB)

KEY POINTS

- SFNB has repeatedly developed fungicide resistance under barley-on-barley rotations.
- The pathogen has developed resistance and/or reduced sensitivity to several formulations containing Group 3 (DMI) and Group 7 (SDHI) fungicides.
- Researchers have also detected a hybrid barley net blotch that is resistant to some Group 3 (DMI) fungicides.
- Careful use and rotation of available fungicides will lessen the spread of resistance in net blotches.
- Agronomic practices that minimise disease pressure reduce the need to apply fungicides.
- Good management will help protect the long-term viability of current fungicides.

Photo: © Evan Collis Photography.

Spot form net blotch is an important disease of barley across all growing regions of Australia. It can be especially damaging in southern regions during wetter seasons. It is also favoured by early sowing, sowing barley into barley stubble, or cropping systems with a high inclusion of barley in rotations.

Introduction

Numerous cases of fungicide resistance or reduced sensitivity in SFNB have been detected in locations across the Western and Southern growing regions, with several Group 3 (DMI) and Group 7 (SDHI) fungicides being affected.

Australian researchers have also detected the evolution of a hybrid barley net blotch that is resistant to some Group 3 (DMI) fungicide products.

Fungicide resistance in spot form net blotch

The causal pathogen of spot form net blotch, *Pyrenophora teres* f. *maculata*, has demonstrated an ability to develop strains with reduced sensitivity or resistance to fungicides when repeatedly exposed to a single product or Mode of Action group.

The disease has exhibited:

- Resistance to the Group 3 (DMI) fungicides epoxiconazole (branded Opus®, etc.), propiconazole (Tilt®, etc.), and tebuconazole (Folicur®, etc.) in the Albany and Esperance port zones of Western Australia since 2017. Since then, the same mutations associated with this resistance have been found to be widespread in WA. However, no field examples of resistance have been reported.
- Resistance and reduced sensitivity to Group 7 (SDHI) fungicides (brand names Systiva®, etc.) in the Kwinana West port zone of WA since 2020.

P Level 4, 4 National Circuit, Barton ACT 2600 | PO Box 5367, Kingston ACT 2604
T +61 2 6166 4500 **F** +61 2 6166 4599 **E** grdc@grdc.com.au

Spot form net blotch.

- Reduced sensitivity to the Group 3 fungicides epoxiconazole, propiconazole, prothioconazole and tebuconazole in the Esperance and Kwinana West port zones of WA since 2016.
- Mutations associated with reduced sensitivity to some Group 3 fungicides in WA have also been detected in isolates collected from SA and Victoria during 2011 and 2014. However, no field examples of reduced fungicide performance have been reported.
- Isolates carrying mutations associated with both reduced sensitivity to Group 3 fungicides epoxiconazole, propiconazole, prothioconazole and tebuconazole, and reduced sensitivity and resistance to fluxapyroxad, have been collected from the Cunderdin district of the Kwinana West port zone, WA, during 2020 and 2021.

Overseas, net blotches have exhibited reduced sensitivity to Group 3, 7 and 11 fungicides in Europe. Resistance to Group 3 fungicides has been detected in New Zealand and reduced sensitivity to Group 3 and 11 fungicides has also been reported from Canada.

Fungicide resistant hybrid

Australian researchers have identified a barley net blotch hybrid that is resistant to the Group 3 (DMI) fungicides propiconazole and tebuconazole.

The hybrid was detected in samples collected during 2017 from the Albany and Esperance port zones of WA, where it was particularly aggressive on the barley variety Oxford.

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.

Laboratory studies showed that isolates of this hybrid have multiple gene mutations derived from both the spot and net form net blotch pathogens.

This highlights how readily and extensively barley net blotch pathogens can adapt to repeated fungicide exposure. The risk of pathogens developing such complex resistance adaptations must be managed through robust Integrated Disease Management and fungicide usage strategies.

Managing fungicide resistance

It is important to recognise that fungicide use, and the development of fungicide resistance, is a numbers game. That is, as the pathogen population increases, so does the likelihood and frequency of naturally resistant strains being present.

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

As a result, it is best to use fungicides against a small pathogen population. That way, only a small number of resistant individuals will be present to survive the fungicide application and they will remain vulnerable to other competitive pressures in the agri-ecosystem.

Keeping the pathogen population low can be achieved by taking all possible agronomic steps to minimise disease pressure (see *Non-chemical controls* below) and by applying fungicide at the first sign of infection once the crop has reached its key growth stages.

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 encourage resistance in another.

Careful fungicide use will minimise the risk of fungicide resistance developing in SFNB and help ensure the longevity of the available chemical protections.

Advice to barley growers includes:

- **Minimise** use **of Group 7** fungicides as both seed treatments and foliar sprays within a growing season. In areas where resistance or reduced sensitivity to this Mode of Action Group has already been reported, do not use Group 7 fungicides to control SFNB.

- **Minimise** the use **of Group 3** products that are known to have a compromised resistance status. Avoid using tebuconazole, propiconazole and epoxiconazole as stand-alone products in barley for any disease, so that their application does not indirectly promote fungicide resistance in SFNB that may also be present.
- **Avoid** more than three applications of products containing a **Group 3** active in the same growing season. If possible, reduce this to only one or two applications per growing season in regions where Group 3 resistance has been reported in the past.
- **Rotate Group 3** fungicide actives within and across seasons. In other words, do not use the same Group 3 product twice in succession.
- **Avoid** applying products containing **Group 7** and **Group 11** chemistries more than once per growing season. This includes in-furrow or seed treatments with foliar activity, as well as subsequent foliar sprays. (Combined seed and in-furrow treatments count as one application.)

In addition:

- **WA growers** should avoid using products containing propiconazole or tebuconazole as standalone products for control of any disease in barley, as this will favour the selection of resistant pathogen strains.

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

SFNB is typically favoured by susceptible hosts, early sowing, mild weather (15-25°C) and extended periods of leaf wetness.

It survives on infected stubble and is common in cropping systems where barley is sown into barley stubble or there is a high inclusion of barley in rotation.

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**

Spores are produced on infected stubble and spread to new barley crops on the wind and via rain splashes. Although spores can be carried some distance by wind, the highest disease pressure is on crops sown directly into barley stubble.

Infection causes oval brown spots which can join together into blotches. The disease can cause entire leaves to turn yellow and die back.

Severe infections can lead to shrivelled grain and cause yield losses of 10-45 per cent.

Careful management of fungicide use and disease pressure is essential to maintain the viability of Group 3 fungicides as a tool for controlling SFNB.

Management practices to help reduce disease pressure and spread include:

- **Planting less susceptible barley varieties.**
  Any level of genetic resistance to SFNB will help slow the rate of pathogen and disease development within a crop. This, in turn, reduces the reliance on fungicides to manage the disease. Avoid growing SVS and VS wheat varieties in disease-prone areas.
- **Inoculum management.**
  Eliminating volunteer barley plants during fallow periods and managing stubble 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.
- **Time of sowing.**
  Early sowing can favour disease development during the initial warm and damp period of late autumn to early winter. Infection of young plants can also lead to increased losses at maturity. However, delayed sowing can have an associated yield penalty in some environments and growers need to consider their risks.
- **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 canopy. Grazing of early sown crops up to the hollow stem stage can also remove leaves that were infected early, helping to prevent run away infections.
- **Taking region-wide action.**
  As SFNB spores are wind-borne, area-wide fungicide resistance management and Integrated Disease Management can help reduce the development and spread of resistant strains.

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 GRDC/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.

ACKNOWLEDGEMENTS

Project partners: Centre for Crop and Disease Management (CCDM) Curtin University, Centre for Crop Health (CCH) University of Southern Queensland, The University of Melbourne, Marcroft Grains Pathology, FAR Australia, NSW Department of Primary Industries, Queensland Department of Agriculture and Fisheries (DAF), South Australian Research and Development Institute (SARDI), Agriculture Victoria (AgVic), Department of Primary Industries and Regional Development WA (DPIRD), Independent Consultants Australia Network (ICAN) and AgCommunicators.

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/#management-guide

GRDC Fungicide Resistance In Wheat Fact Sheet

GRDC Fungicides In Australia Fact Sheet

GRDC How Fungicide Resistance Develops Fact Sheet

afren.com.au/resources/#fact-sheets

MORE INFORMATION

Australian Fungicide Resistance Extension Network afren.com.au

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.

GRDC RESEARCH CODE

CUR1905-001SAX