BARLEY NET FORM NET BLOTCH GROUP 11 (QOI) FUNGICIDE RESISTANCE FACT SHEET

GRDC GRAINS RESEARCH & DEVELOPMENT CORPORATION

SOUTHERN AND WESTERN REGIONS
APRIL 2024

Resistance update and management advice

KEY POINTS

- **Researchers have detected a mutation affecting Group 11 (QoI) fungicides in net form net blotch (NFNB) in barley samples collected from the Yorke Peninsula, South Australia**
- **The *F129L* mutation has been widely reported internationally but this is the first detection in Australia**
- **Researchers consider it highly probable that the mutation is present in other NFNB populations within Australia**
- **This mutation has not been associated with paddock fungicide failure**
- **Resistance and/or reduced sensitivity to several Group 3 (DMI) and Group 7 (SDHI) fungicides have also been detected in NFNB populations, meaning fungicide options are now severely limited**
- **Growers should use agronomic strategies to minimise disease pressure, including planting less susceptible varieties, rotating crops, and managing stubble and green bridge weeds to reduce inoculum**

Photo: © GRDC.

Researchers at BASF Germany have detected the *F129L* mutation in net form net blotch (NFNB) on barley samples collected on the Yorke Peninsula of SA during spring 2022

Introduction

NFNB is an important disease of barley and can cause significant yield losses. There have been numerous previous detections of reduced sensitivity or resistance to Group 3 (DMI) and Group 7 (SDHI) fungicides in Australian NFNB.

The presence of the *F129L* mutation affecting Group 11 (QoI) fungicides has not been previously associated with paddock fungicide failure. However, the discovery means all three major fungicide Mode of Action (MOA) groups are now compromised in barley, limiting the options for chemical control of NFNB outbreaks.

F129L mutation of NFNB

Group 11 fungicides, also known as quinone outside inhibitors (QoI), are single-site MOA constituents that inhibit energy production in fungi.

This MOA group includes the fungicides Azoxystrobin and Pyraclostrobin.

The *F129L* mutation of NFNB has been widely reported overseas and is known to reduce the effectiveness of quinone outside inhibitors on *Pyrenophora teres* f. *teres*, the causal pathogen of NFNB.

Although this is the first laboratory detection of the mutation in Australia, overseas experience indicates that the *F129L* mutation does not lead to full QoI resistance in NFNB.

For these reasons, researchers believe it is highly probable that the mutation is currently undetected in other NFNB populations within Australia.

This laboratory detection of the *F129L* mutation means Group 3, Group 7 and Group 11 fungicides are all compromised to some extent for NFNB. It is essential that growers make comprehensive use of agronomic strategies to minimise disease pressure in barley crops and follow best practice fungicide usage management to avoid encouraging the further development of resistance in their district.

Refer to Useful Resource on page 4 for more details.

Barley NFNB

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

Inoculum survives between seasons on infected stubble and crop debris. In spring, fungal fruiting bodies release spores, which are spread by wind and rain splashes to the lower leaves of nearby barley plants. Under moist conditions, spores from lesions on the living plants can cause further infection.

Infection damages or kills the leaves prematurely and causes reduced seed weight. The number of ears and the number of grains per ear can also be reduced.

Severe infections can cause 20 to 50 per cent yield loss and a significant reduction in grain quality.

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 a paddock 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 paddock 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 paddock.

- **LABORATORY 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 paddock. Laboratory testing can indicate a high risk of resistance or reduced sensitivity developing in the paddock.

Regional responsibility

On-farm strategies to reduce fungicide resistance work best when all growers within a district follow best practices. NFNB spores are wind-borne and spread easily, making area-wide fungicide resistance management and integrated disease management essential for reducing the development and spread of resistant strains.

Non-chemical controls

Careful agronomic management is essential for reducing NFNB disease pressure and preserving the effectiveness of fungicides.

Management practices to help reduce disease pressure and spread include:

- **Planting less susceptible barley varieties.**
  Any degree of genetic resistance to NFNB will help slow the rate of disease development within a crop. This, in turn, reduces the reliance on fungicides for managing the disease. Avoid SVS and VS varieties in disease-prone areas.
- **Inoculum management.**
  NFNB has a broad alternative host range including cereals and awnless brome grass. Eliminating volunteer hosts and stubble management practices will reduce the volume of spores spreading into an adjacent or subsequent barley crop.
- **Practising 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. Later sown crops tend to develop smaller canopies, which are less conducive to fungal disease development. 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, which will reduce disease conduciveness. 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 runaway infections.

Fungicide resistance risk management

It is always important to follow the AFREN Principles (see graphic, next page) for reducing disease pressure and fungicide resistance risk. These guidelines can be applied to all crops and pathogens, regardless of their formal fungicide resistance status, to reduce the chances of resistance developing.

Photo: © GRDC.

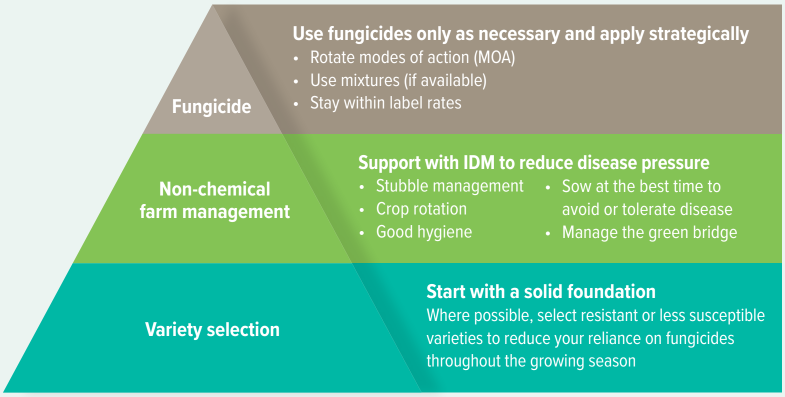
Net form net blotch lesions on a barley leaf.

AFREN PRINCIPLES

The Fungicide Resistance Five provides a creed to follow.

The Fungicide Resistance Five
1 Avoid susceptible crop varieties
2 Rotate crops – use time and distance to reduce disease carryover
3 Use non-chemical control methods to reduce disease pressure
4 Spray only if necessary and apply strategically
5 Rotate and mix fungicides/MOA groups

Growers should seek to provide a strong and reliable foundation of resistant or less susceptible crop varieties, supported by non-chemical integrated disease management (IDM) that can be complemented by strategic and responsible use of fungicides.



FREQUENTLY ASKED QUESTIONS

What other fungicide MOA groups are compromised for NFNB?

Fungicide resistance or reduced sensitivity has been detected in many NFNB populations across the Western and Southern cropping regions of Australia since 2013, including:

- **Group 3 (DMI):**
  - Resistance to propiconazole (for example, branded Tilt®), prothioconazole (for example, Prosaro®) and tebuconazole (for example, Folicur®, Raxil®) has been detected in the Albany, Esperance and Kwinana West port zones of WA since 2016.
  - Resistance to propiconazole and tebuconazole was detected in isolates from the Wimmera region of Victoria in 2019.
  - Reduced sensitivity to epoxiconazole (for example, Opus®), propiconazole, prothioconazole and tebuconazole has been confirmed in several parts of WA since 2013 and SA since 2019.
- **Group 7 (SDHI):**
  - Resistance to fluxapyroxad (Systiva®) has been confirmed on the Yorke Peninsula, SA, in the 2019 growing season.
  - Reduced sensitivity to fluxapyroxad has also been reported in the Eyre Peninsula and Kybybolite regions of SA in the 2019 growing season.
  - Resistance and reduced sensitivity to fluxapyroxad has been detected in Victoria in 2021.
  - Reduced sensitivity to fluxapyroxad has been detected in the South Stirling region of WA in 2021.
- **Dual Group 3 and Group 7 resistance:**
  - NFNB isolates with both reduced sensitivity to Group 3 fungicides (for example, tebuconazole, propiconazole, prothioconazole, epoxiconazole) and resistance to Group 7 (fluxapyroxad) have been detected on the Yorke Peninsula of SA.
  - Laboratory tests of samples from the Yorke Peninsula have also detected full resistance to both tebuconazole and fluxapyroxad, but this dual resistance is yet to be linked to a paddock case.

How does fungicide resistance develop?

Fungicide resistance occurs when naturally resistant strains of a pathogen come to dominate the pathogen population in a paddock or region. Repeated applications of the same fungicide will control the non-resistant population but allow these resistant strains to thrive.

For more on the causes and effects of fungicide resistance, read the GRDC AFREN Fact Sheet 'How fungicide resistance develops' (see Useful Resources).

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

If a fungicide application fails to exhibit full control of the disease, or if the application rate for a fungicide must be steadily increased from application to application, there is cause for concern.

Who do I contact?

Contact your agronomist or adviser and have them review the crop and your fungicide application records. Alternatively, you can visit the AFREN website 'About' page (afren.com.au/about/) for details of fungicide resistance experts in your region.

Photo: Linda Thomson.

Heavy net form net blotch infection, including damage to important upper leaves.

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

GRDC Fact Sheet *Managing fungicide resistance: net form net blotch*
afren.com.au/wp-content/uploads/2022/06/AFREN-Net-form-net-blotch-Fact-Sheet_Jun22_FA_online.pdf

GRDC Fact Sheet *Fungicide resistance in barley crops: causes, management and mitigation strategies*
afren.com.au/wp-content/uploads/2022/01/Fungicide-resistance-in-Barley-Fact-Sheet.pdf

GRDC Fact Sheet *Fungicides and fungicide resistance*
afren.com.au/wp-content/uploads/2022/03/5542-AFREN-FR-in-Aust-Fact-Sheet_FA_online.pdf

GRDC Fact Sheet *Understanding how fungicide resistance develops in cropping systems*
afren.com.au/wp-content/uploads/2022/03/5542-AFREN-Fungicide-Resistance-Fact-Sheet_FA_online.pdf

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

MORE INFORMATION

Australian Fungicide Resistance Extension Network afren.com.au

GRDC CODE

CUR2302-002RTX

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') and the BASF Crop Solutions Australia announcement at crop-solutions.basf.com.au/node/6821.

ACKNOWLEDGEMENTS

Project partners: Centre for Crop and Disease Management (CCDM) Curtin University, Centre for Crop Health (CCH) University of Southern Queensland, Australian Cereal Rust Control Program (ACRCP) University of Sydney, 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.

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