



Farmnote

Management of barley powdery mildew in the face of fungicide resistance

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Key messages:

- Powdery mildew of barley is specific to barley; it does not infect other crops.
- Barley powdery mildew isolates with reduced sensitivity to the triazole fungicide tebuconazole have been detected in Western Australia.
- Cross resistance to other older triazole fungicides such as propiconazole and triadimefon can be expected.
- Fungicides containing newer triazole ingredients such as epoxiconazole and prothioconazole remain effective as do fungicides containing the strobilurin ingredients azoxystrobin and pyraclostrobin.
- Effective fungicides should be applied as protectants to maximise efficacy.
- Compromised fungicides will have reduced efficacy, including poorer disease control with shorter periods of protection.
- Follow all label recommendations regarding maximum dose rates, number of applications, fungicide rotation and application methods

Barley powdery mildew resistance detection in WA

Growers from high disease risk regions have reported increasingly severe levels of barley powdery mildew in susceptible varieties and a subsequent decline in control from triazole fungicides. Triazole fungicides belong to the demethylation-inhibiting (DMI) fungicide group.

GRDC funded research undertaken by Professor Richard Oliver in 2009 found that some isolates of powdery mildew collected from different locations around the south-west of Western Australia showed reduced sensitivity to the fungicide tebuconazole. Tebuconazole is an older generation triazole fungicide. In the same tests Prof. Oliver found that the powdery isolates with reduced sensitivity to tebuconazole were still sensitive to the newer generation triazole epoxiconazole.

DNA sequencing of the fungicide resistant isolates of powdery mildew show they have mutation in

the Cyp51 gene which is known to be associated with reduced sensitivity in DMI fungicides. This mutation is present in fungicide resistant powdery mildew found in Europe and the UK. Further testing from the same region in 2010 found that all powdery mildew isolates collected exhibited this mutation.

What fungicides are affected?

Fungicides containing the compromised triazole ingredient tebuconazole will have reduced efficacy and are not recommended for powdery mildew control. Based on evidence from Europe it is expected that cross resistance within the DMI group could occur. Older generation triazoles such as propiconazole, triadimefon and flutriafol could therefore be less effective than growers anticipate and should be considered as potentially compromised fungicides.

Important disclaimer

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Table 1. **DMI and strobilurin fungicide active ingredients registered for application in WA barley crops A**

Active Ingredient	Example products	Resistance Status ^A
Tebuconazole	Folicur®	Compromised
Triadimenol	Baytan®	Potentially compromised
Triadimefon	Triadimefon 125, Slingshot®	Potentially compromised
Propiconazole	Bumper®, Tilt ®, Throttle®	Potentially compromised
Flutriafol	Impact®, Intake® Combi	Potentially compromised
Fluquinconazole	Jockey stayer®	Unknown ^B
Cyproconazole (+propiconazole)	Tilt Xtra®	Unknown ^B
Epoxiconazole	Opus®	Uncompromised
Prothioconazole (+tebuconazole)	Prosaro®	Uncompromised
Azoxystrobin (+cyproconazole)	Amistar Xtra®	High risk (+unknown)
Pyraclostrobin (+epoxiconazole)	Opera®	High risk (+uncompromised)

A: Adapted from Oliver et al (2011)

B: No current evidence of reduced field efficacy

Not all DMI fungicides are currently affected by this mutation. The newer generation DMI triazoles, including epoxiconazole and prothioconazole, still remain effective.

The status of other active ingredients such as fluquinconazole and cyproconazole is unknown, however at this time reduced field efficacy in these fungicides has not been seen in DAFWA field trials or reported by growers.

Strobilurin fungicides containing azoxystrobin or pyraclostrobin also remain effective. Strobilurins belong to the QoL inhibiting group of fungicides. As they are a different chemistry group to the DMI fungicides they are affected by a different resistance mechanism. Despite this, the strobilurin class of fungicides is at a high risk of developing resistance. Resistance to strobilurins in a range of diseases is found around the world. To reduce that risk strobilurin based fungicides should be applied as protectants prior to significant levels of disease developing. They should not be applied in crops where high levels of active powdery mildew are already present.

How widespread is the problem?

Isolates tested by Prof. Oliver have come predominantly from the south coastal and higher rainfall western areas of the Great Southern. The sensitivity of powdery mildew in the central, eastern and northern wheatbelt has not been determined. As powdery mildew produces massive numbers of airborne spores it is possible that low concentrations of the resistant isolates may be present across the central, eastern and northern wheatbelt.

Integrated management of powdery mildew in 2011

Reduce reliance on fungicides by implementing an integrated disease management approach:

- Reduce the proportion of area sown to barley varieties rated VS or S to powdery mildew. Where possible utilise varieties with better resistance which may not require fungicides for powdery mildew management (Table 2). The majority of malting varieties are rated as S to powdery mildew, therefore the decision to switch to an MR or R rated malt or feed variety should be based on: market price and demand, availability and cost of fungicides which are still effective against powdery mildew, the seasonal outlook and the capacity to implement other in-crop integrated management strategies. Buloke, which is rated MR, has the best level of resistance among current malting varieties.
- Control volunteer barley prior to seeding, particularly of susceptible varieties, this will reduce inoculum of powdery mildew (and leaf rust) carried into the season.
- Avoid sowing back into barley stubble from highly infected crops, mildew is carried as fruiting bodies on infested stubble.
- Avoid growing extremely dense canopies. Dense canopies make it difficult to get adequate penetration of the fungicide and foster ideal conditions for powdery mildew development. Management practices which enhance canopy size include high rates of nitrogen at or just after seeding. Grazing crops before stem elongation can reduce canopy size and may reduce disease pressure without affecting crop yield.
- Balance crop nutrition, particularly ensuring adequate potassium.

Fungicide management of powdery mildew in 2011

High disease pressure regions: high-medium rainfall, VS-S varieties, historically frequent fungicide usage required for powdery mildew management (eg. South Coast)

- Seed or fertiliser applied fungicides
 - In-furrow or seed dressing fungicides containing flutriafol, fluquinconazole, or triadimenol are an effective method to delay the onset of powdery mildew. They often reduce the number of foliar fungicide applications required.
 - If reduced efficacy of flutriafol in-furrow has been observed locally, then the length of protection provided by this product is likely to continue to decline, requiring alternative approaches or increased rates (observe label instructions) to maintain length of protection.
- Foliar fungicides:
 - In these areas, using fluquinconazole seed dressing or a foliar spray at disease onset may be worth considering. The resistance status of fluquinconazole is unknown; however recent DAFWA field trials indicate that its efficacy does not appear to have been compromised.
 - The compromised triazole ingredient tebuconazole will have reduced efficacy and is not recommended for powdery mildew control.
 - The potentially compromised triazole ingredients triadimefon and propiconazole may have reduced efficacy and are not recommended for powdery mildew control in high disease risk areas.
 - The newer generation triazole fungicides like Opus® (epoxiconazole) and Prostaro® (prothioconazole + tebuconazole) should

Table 2. Resistance of barley varieties to powdery mildew and other diseases and nematodes which affect barley performance in Western Australia

Variety	Powdery Mildew	Scald	Net Type Net Blotch	Spot Type Net Blotch	BYDV	Barley Leaf Rust	P.neglectus root lesion nematode	Cereal Cyst Nematode
Baudin A	S	MR-MS	S	S	MR	S	MR	S
Barque A	R	MR	MS	MR-MS	MR-MS	S	MR	R
Buloke A	MR	MS	MS	MS	MR-MS	S	R-MR	S
Capstan A	MS	MS	MS	MS	S	S	MR	R
Commander A	MS	S-MS	S	MS	-	S-VS	-	R
Dash A	R	R	MR-MS	S	S	R	R-MR	R
Doolup	S	VS	S	S	MR-MS	S	MR	R
Fitzgerald A	S	MS	MS	S	MR	S	R-MR	-
Fleet A	MR-MS	MS	MR-MS	MS	MR-MSp	MR	R-MR	R
Gairdner A	MS	MR-MS	MR-MS	S	MR	S	MR	S
Hamelin A	S	S	S	S	VS	S	R-MR	S
Hannan A	S	MR	S	S	S	S	R-MR	-
Hindmarsh A	MS	MR-MS	MS	S	S	S	MR	R
Lockyer A	MS	MR-MS	MR-MS	S	S	S	R-MR	-
Maritime A	S	MS	MR	MS	S	S	R-MR	R
Molloy	MS	S	S	S	MR-MSp	S	R-MR	S
Mundah	S	S	MS	S	S	S	MR	S
O'Connor	S	S	S	S	VS	S	R-MR	-
Onslow	S	S	MS	S	MR-MS	S	-	S
Oxford A	R	MS	MR	S	MRp	R	-	S
Roe A	MS	MS-S	MS	S	MS	S	R-MR	-
Schooner	S	MS	MR-MS	S	MS	S	MR	S
Scope A	MR	MS	MR-MS	MS	-	S	-	S
Stirling	S	S	S	S-MS	MR-MS	S	MR-MS	S
Vlamingh A	S	MR	MR-MS	S	MS	S	MS	S
Yagan	MR-MS	VS	MR-MS	S	S	S	MR	-
Yarra A	S	S	MS	S	S	MSp	R-MR	R

VS = very susceptible, S = susceptible, MS = moderately susceptible, MR-MS = intermediate, MR = moderately resistant, R = resistant, p = provisional rating only. All barley varieties with a CCN resistance score are tolerant of CCN. Disease data provided by the Sanjiv Gupta and Jason Bradley and nematode data by Vivien Vanstone, DAFWA.

have uncompromised activity against powdery mildew.

- Fungicides containing both a strobilurin and a triazole product including Amistar Xtra® (azoxystrobin + cyproconazole) and Opera® (epoxiconazole + pyraclostrobin) should have uncompromised activity against powdery mildew.
- For greatest efficacy, fungicides should be applied before significant levels of disease establish in crop. Use the fungicide to protect the crop rather than attempt to recover the crop. Monitor crops regularly for presence of disease and utilise fungicides to allow maximum disease control and maintain effective green leaf area.
- Strobilurin products are protectant chemicals and should not be applied to heavily infected crops. In multiple spray programs use strobilurins in rotation with one of the uncompromised DMI, to minimise potential pressure on this chemistry.
- Product choice, rate and water volume used should reflect the range and time of onset of the diseases to be managed and the density of the canopy.
- It is important to read the product label. When repeated applications are required observe restrictions on maximum dose rates and applications.

Lower disease pressure regions: medium-low rainfall, less frequent fungicide use for powdery mildew

- If mildew has not been a regular focus of disease management in previous seasons then the risk of decreased sensitivity in compromised DMI products will be less:
 - Use appropriate fungicides to manage disease threats present within the cropping system.
 - If repeated applications of fungicide are required within the season then utilise

uncompromised fungicides as part of rotation of products.

- Apply fungicides according to the label directions and restrictions.

Management of other diseases

- At present, fungicide resistance in other barley diseases has not been reported in WA.
- In the absence of powdery mildew, utilise the fungicide product (including older DMI) best suited to management of the disease threat present (according to label recommendations).
- Smut and bunt seed dressing fungicides are predominantly DMI, benefits of delayed mildew infection will be reduced but they should still be used for management of loose and covered smut.

References

Oliver et al. (2011). 'Managing fungicide resistance in broad acre cropping in Australia'. GRDC Grains Research Adviser Update, Adelaide, 2011. http://www.grdc.com.au/director/events/researchupdates?item_id=C13F2CCD0DF0838ED195B4C05D522FD5&pageNumber=4.

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