

BARLEY POWDERY MILDEW FACT SHEET

NORTHERN REGION

BARLEY POWDERY MILDEW CONTROL STRATEGIES

A combination of resistant varieties, good plant health and effective fungicides is required to prevent economic losses from powdery mildew outbreaks in barley.

KEY POINTS

- ▶ Barley powdery mildew is a windborne fungal disease that survives between seasons on stubble, plant residues and occasionally barley volunteers.
- ▶ New strains of powdery mildew have been detected on commercial barley varieties previously considered resistant.
- ▶ High disease levels can reduce yield by five to 15 per cent.
- ▶ Before sowing, consider the varietal resistance rating and be aware of disease risk on-farm.
- ▶ If using a barley variety with a resistance rating less than Resistant (R), consider treating with a fungicide at seeding.
- ▶ Monitor at-risk crops from early tillering, then every seven to 10 days.
- ▶ If powdery mildew is detected, apply an appropriate fungicide immediately, based on varietal resistance level, growth stage, severity of infection and likely future weather conditions.
- ▶ Seed or in-furrow fungicide treatments can provide good early-season protection.
- ▶ Repeated applications of the same fungicide group increases the risk of fungicide resistance developing.



PHOTO: QUEENSLAND DAF

High powdery mildew disease levels can reduce barley crop yields by five to 15 per cent.

Disease life cycle

Barley powdery mildew is a fungal disease caused by *Blumeria graminis* f.sp. *hordei* and is specific to barley and barley grass.

Infections appear as white fluffy patches on the leaf surface. These colonies produce windborne spores that spread the disease during the growing season.

Mildew that over-summeres on stubble releases a different type of spore under cool, wet conditions during autumn to infect the new crop. The disease can increase rapidly from early tillering.

The fungus consumes carbohydrates needed by the plant for grain filling.

Severe early infections of susceptible varieties can result in costly yield losses

due to smaller grain size and tiller abortion. This can lead to downgrading of the crop to feed quality.

Disease conditions

Most infection occurs during early crop growth in autumn and winter. The disease tends to diminish as crops age and temperatures rise.

Powdery mildew infections will develop more readily if the following conditions are present:

- ▶ infection in the previous season's barley crop resulting in fungus carrying over on stubble;
- ▶ infected barley volunteers, which produce inoculum early in the season;
- ▶ susceptible varieties;

- ▶ cool, wet conditions, which activate the release of stubble-borne spores;
- ▶ mild temperatures (15°C to 22°C);
- ▶ high humidity (in excess of 70 per cent) – note that free water is not needed for infection;
- ▶ low light intensity;
- ▶ high nitrogen nutrition; and
- ▶ dense crop canopies.

Growers should assess risk using up-to-date varietal resistance ratings, as these may change from one season to the next.

Before sowing

Although powdery mildew spores are readily carried by wind, growers can evaluate the risk of powdery mildew in a paddock before sowing.

Factors to consider include:

- ▶ the paddock's recent crop history;
- ▶ powdery mildew in recent barley crops;
- ▶ infected crop residues in the field; and
- ▶ infection in nearby, early-sown crops.

Choose the best barley variety

Fungicides can control powdery mildew, but the best way to minimise losses and slow or prevent the development of fungicide resistance is to plant resistant varieties.

However, the resistance ratings of varieties can change so growers and advisers need to keep their information up to date. Researchers have recently found new strains of powdery mildew able to infect commercial varieties of barley previously considered resistant.

Laboratory studies have identified strains that infected the varieties Shepherd[Ⓛ], Grout[Ⓛ] and Navigator[Ⓛ]. Each variety carries a different resistance gene.

In field observations in 2013, mildew was present in most crops of Shepherd[Ⓛ], but was not detected in Grout[Ⓛ]. Navigator[Ⓛ] appeared susceptible (S) in field plots.

Shepherd[Ⓛ] is now classified as moderately susceptible to susceptible (MS–S) while Grout[Ⓛ] maintains its status of resistant (R).

Fairview[Ⓛ], Hindmarsh[Ⓛ], Mackay[Ⓛ], Oxford, Buloke[Ⓛ] and Scope[Ⓛ] have good levels of

TABLE 1 Powdery mildew resistance ratings for barley varieties.

Variety	2013 resistance rating
Buloke [Ⓛ]	Resistant (R)
Commander [Ⓛ]	Moderately resistant to Moderately susceptible (MR–MS)
Fairview [Ⓛ]	Resistant (R)
Fitzroy [Ⓛ]	Susceptible (S)
Gairdner [Ⓛ]	Susceptible (S)
Grange [Ⓛ]	Resistant (R)
Grimmett	Susceptible (S)
Grout [Ⓛ]	Resistant (R)
Henley	Resistant (R)
Hindmarsh [Ⓛ]	Moderately susceptible (MS)
Mackay [Ⓛ]	Moderately resistant (MR)
Navigator [Ⓛ]	Susceptible (S) ^P
Oxford	Resistant (R)
Scope [Ⓛ]	Resistant (R)
Shepherd [Ⓛ]	Moderately susceptible to susceptible (MS–S)
SY Rattler [Ⓛ]	Resistant (R)
Westminster [Ⓛ]	Resistant (R)

P = Provisional

TABLE 2 Indicative costs per hectare to buy and apply fungicides to control barley powdery mildew.

Application	Active ingredient/s	Cost range (\$)
Up-front treatments (cost is to treat 100kg of seed)		
Flowable liquids	Fluquinconazole	15.33 – 22.96
	Flutriafol + cypermethrin	2.20
	Triadimenol + cypermethrin	2.47 – 3.71
	Triadimenol + imidacloprid	11.45
	Triadimenol + triflumuron	2.37 – 3.54
Powders	Flutriafol + cypermethrin	2.20
	Triadimenol + cypermethrin	7.79
	Triadimenol + triflumuron	4.38
In-furrow	Flutriafol	2.86 – 12.74
	Triadimefon	3.80
Foliar fungicides (cost is per litre)		
	Azoxystrobin + cyproconazole	20.95 – 41.89
	Epoxiconazole	6.85
	Flutriafol	4.35 – 8.71
	Propiconazole	2.10 – 8.75
	Propiconazole + cyproconazole	5.46 – 18.18
	Prothioconazole + tebuconazole	10.36 – 20.71
	Pyraclostrobin + epoxiconazole	19.75 – 39.50
	Tebuconazole	2.42 – 4.85
	Tebuconazole + flutriafol	3.00 – 6.00
	Triadimefon	2.76 – 6.30

SOURCE: WINTER CROP VARIETY SOWING GUIDE, NSW DPI, MARCH 2013

resistance to mildew and are not likely to require the use of fungicide.

The varieties Grange[Ⓛ], Henley, Westminster[Ⓛ] and SY Rattler[Ⓛ] have a gene that confers even higher levels of resistance (Table 1).

Monitor the crop

Varieties rated moderately susceptible (MS) or worse should be monitored for powdery mildew every seven to 10 days during the growth stages prone to infection, that is, from early tillering to stem elongation.

Treatment

If powdery mildew is detected in varieties rated MS or S between tillering and stem elongation, consider applying an appropriate fungicide immediately.

Yield losses can be significant if an early infection is not properly controlled.

In crops with a yield potential of more than three tonnes per hectare, such losses would usually justify the cost of fungicide control, however, timing is crucial.

Applying fungicide after growth stage 33 is unlikely to provide an economic benefit.

Use a dose of fungicide that gives the best economic return, but always use recommended label rates. Your adviser can assist with these calculations.

Fungicide action

Fungicides applied before spores settle on a leaf kill the fungus in the early stages of infection, so no colonies develop.

If applied after infection, fungicides kill mildew colonies, often leaving brown to black blotches where the fungus was.

This means late application still reduces the effective leaf area the plant can use for photosynthesis, even though the disease has been arrested.

Powdery mildew can be controlled with several fungicides. Fungicides are more efficient as protectants than eradicants, so apply them before the disease becomes established.

Most registered fungicides are either Group 3 DMIs (demethylation inhibitors) or Group 11 Qols (quinone outside inhibitors).

Fungicide options

Growers can choose to use:

- ▶ up-front treatments where fungicide is applied to fertiliser or to the seed;
- ▶ foliar sprays with fungicides from chemical Group 3 (DMIs); or
- ▶ foliar sprays with fungicides from chemical Group 11 (Qols) in mixtures with Group 3 (DMIs).

Up-front treatments can see crops through their most vulnerable stages because they

can give protection for six to 12 weeks from sowing.

However, some seed treatments (for example, triadimenol) may shorten coleoptile length and cause emergence problems.

Foliar sprays are effective at low rates when applied at the correct time.

Some growers apply flutriafol in-furrow or as a spray. However, overuse of flutriafol in Western Australia has contributed to the development of fungicide resistance issues and this option is not recommended as routine practice in the northern region.

In Western Australia the situation is the same with tebuconazole, and it is no longer effective in the treatment of powdery mildew there. Growers are advised to look for alternative products for powdery mildew control.

Use a QoI mix for one (but no more) treatment in a season.

Cost of treatment

Applying fungicide may be cost effective if conditions favour development of powdery mildew. For susceptible varieties, applying fungicide is necessary to reduce yield losses.

Costs of buying and applying fungicide vary depending on choice of fungicide and rate of application. Indicative costs (per hectare) are shown in Table 2.

In addition to the products shown in Table 2, a new foliar fungicide, containing propiconazole and tebuconazole is now available. It has a cost range of \$6.75 to \$13.50 per hectare and is registered in all states for the control of barley powdery mildew in cereals.



RICHARD OLIVER, CURTIN UNIVERSITY

Triazole resistance in powdery mildew means that barley growers should not use tebuconazole alone, flutriafol, triadimefon or triadimenol if powdery mildew is the target disease or if there is a likelihood of it occurring in the season.



Barley powdery mildew infections appear as white fluffy patches on the leaf surface. These colonies produce windborne spores that spread the disease during the growing season. Infection can increase rapidly from early tillering onwards.

PHOTO: RYAN FOWLER, QUEENSLAND DAFF

When should fungicide be applied?

Plant parts that contribute most to yield in barley are the first two leaves below the flag leaf (F-1 and F-2), the flag leaf sheath and the head.

In the northern region, high levels of powdery mildew are rarely seen on these plant parts.

In susceptible varieties, apply fungicide when mildew is first detected. This could be any time between early tillering and the start of stem elongation (GS31).

If late treatment is needed, a second spray could be applied about one month later.

Two applications will help protect against early infections and upper crop canopy infections, respectively.

The second application may only be necessary if susceptible varieties have been sown.

Report the infection

Powdery mildew in crops of Shepherd[®], Grout[®] and Navigator[®] is of interest to researchers from the Queensland Department of Agriculture, Fisheries and Forestry, and the New South Wales Department of Primary Industries who are monitoring the spread of strains that can attack these varieties.

To report infected crops, contact one of the people listed under More Information.

Fungicide resistance in the north

Repeated use of the same fungicide for powdery mildew control has the potential to create widespread fungicide resistance.

Powdery mildew populations with resistance to triadimefon, triadimenol, flutriafol and tebuconazole have been detected in WA.

Preliminary tests indicate there may be some resistance in eastern Australia.

In 2012, an isolate of powdery mildew from the northern region had reduced sensitivity to DMI fungicides.

Growers should avoid the use of 'weaker' DMI fungicides (triadimenol, triadimefon, flutriafol and tebuconazole) for control of barley diseases.

Growers should consider using:

- ▶ newer triazole fungicides such as:
 - Opus[®] (epoxiconazole only);
- ▶ products that combine Group 3 DMIs such as:
 - Prostaro[®] (prothioconazole + tebuconazole), note that tebuconazole is recommended only in a mixture;
 - Tilt Xtra[®] (propiconazole + cyproconazole); and
 - Cogito[®] (propiconazole + tebuconazole); or
- ▶ a mix of Group 3 DMIs and Group 11 QoIs such as:
 - Amistar Xtra[®] (azoxystrobin + cyproconazole); and
 - Opera[®] (pyraclostrobin + epoxiconazole).

Reduce risk with good stewardship

Do not apply fungicides if powdery mildew is not detected. 'Insurance' sprays only add to the risk of fungicide resistance developing.

Management practices can reduce risk to some degree, but are no substitute for effective varietal resistance. Growers can reduce disease pressure by:

- ▶ rotating barley crops with non-hosts such as wheat, legumes, oilseeds or summer crops;
- ▶ avoiding sowing barley on barley;
- ▶ maintaining clean fallows; and
- ▶ sowing resistant or moderately resistant varieties.

FREQUENTLY ASKED QUESTIONS

Why are some fungicides still working and not others?

Powdery mildew has many features that contribute to the eventual development of fungicide resistance. Triazole fungicides work by inhibiting an enzyme called Cyp51. Resistance occurs when one or more mutations are selected by the fungicide and accumulate within the Cyp51 gene. All samples examined from eastern Australia already have one of these mutations due to the continued use of triazole fungicides. A single further mutation seen in WA significantly affects the performance of all triazoles. The field efficacy of tebuconazole, flutriafol and triadimenol has been severely affected by the second mutation. Other triazole fungicides (for example, propiconazole, prothioconazole and cyproconazole) are used at a dose that has a greater safety margin, however, their continued use is expected to select for further mutations as seen in Europe. Reducing reliance on fungicides will help extend the effective life of remaining products.

Last year I sprayed Opus® on my barley and it did not control powdery mildew. Why not?

Once a barley crop has been badly infected, any fungicide will struggle to rescue the crop. The message is: keep ahead of the disease, use resistant varieties and be timely with fungicides.

Can I use tebuconazole to control other barley diseases?

Yes. So far no other barley disease has confirmed resistance to any fungicide (in Australia), including tebuconazole. If there is little or no risk of powdery mildew infection, select the fungicide that is best suited to the management of the disease threat; that includes any older Group 3 DMI products.

USEFUL RESOURCES

GRDC Disease Links – Barley Powdery Mildew

www.grdc.com.au/Resources/Links-Pages/DiseaseLinks#B_Powdery_mildew

Managing cereal fungicide use Fact Sheet

www.grdc.com.au/Resources/Factsheets/2013/05/Cereal-fungicides

Foliar applications of fungicides and insecticides Fact Sheet

www.grdc.com.au/Resources/Factsheets/2012/03/Foliar-Applications-of-Fungicides-and-Insecticides

Fungicide timing Fact Sheet

www.grdc.com.au/Resources/Factsheets/2009/07/Fungicide-Timing-Fact-Sheet

Queensland DAFF Barley planting guide

www.tinyurl.com/DAFFbarleyplanting

NSW DPI Winter crop variety sowing guide

www.tinyurl.com/NSWDPIwintersowing

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