

# Managing powdery mildew in NSW vineyards

Peter A Magarey

Magarey Plant Pathology, Loxton SA 5333  
[pmagarey@riverland.net.au](mailto:pmagarey@riverland.net.au)

Photos in this section: P A Magarey

Like elsewhere in Australia, powdery mildew progresses in NSW vineyards more or less independent of the weather. Though in some regions, temperature and humidity may at times be limiting the disease, it is, in the main, driven by the amount of inoculum (spores) inherited from last season.

It is a 'two-season' disease and although the disease is common across NSW, by applying knowledge of disease epidemiology (i.e. how and when the disease spreads) and of the need for well-timed sprays applied with effective spray coverage, good control of this persistent disease can be achieved.

## What does powdery mildew look like?

Powdery mildew begins as flagshoots (Figure 1). These are shoots that grow from buds infected last season. Flagshoots are stunted and bear up-curved leaves often with the white powdery growth visible on the leaves. Powdery mildew shows on younger leaves as irregular yellow blotches best seen on the upper surfaces and, on varieties like Chardonnay, with associated browning of the smallest (tertiary) veinlets on the under sides (Figure 2). The blotches soon show the typical white mildew as spots expand and merge across both surfaces of leaves. Eventually the whole surface is covered (Figure 1).

To see young mildew spots clearly, angle the leaf into the light; this makes the fungal sporulation more visible.

Powdery mildew is a 'green' disease: like downy mildew, it only infects green parts of the vine. Older tissue that has changed colour is no longer susceptible. So, for instance, green shoots can be infected whereas browned canes cannot.

Distinguish the two mildews on leaves by the more irregular-shaped yellow blotches of young powdery mildew on leaves and its grey-white fungal growth on both sides of the leaves, the foliage and fruit. Contrast this with the distinctive circular oilspots of downy mildew and the fresh white down that forms in warm humid conditions only on the underside of the spots.

## Powdery mildew life cycle

Only spores from grapevines infect vines. Spores from mildew on roses, cucumbers, melons etc do not infect grapevines. Also, in early-season, this inoculum moves usually much less than 200–300 m which means that the spores that most influence your vineyard in early-season, come from *your* vineyard – and **you** can control this source.

Powdery mildew develops from two sources of inoculum. **First: infected buds** – these carry the disease from last season (Season 1) when they were infected in the first 2–3 weeks of their exposure on last season's shoots. This season (Season 2), the mature buds emerge, producing diseased shoots called 'flag shoots' (Figure 1). The fungus on these produce spores (conidia) that spread disease to adjacent foliage.

**Second: cleistothecia** – these form late last season as fruiting bodies of the fungus (Figure 3). If the conditions are right, these release another spore-type called ascospores. If, this season,  $\geq 2.5$  mm precipitation occurs while the temperature is  $> 10^{\circ}\text{C}$ , the ascospores will be released. If unprotected green tissue is present nearby at that time, the ascospores will help spread the disease. Infection from either spore-types lead to new leaf spots on foliage and bunches every 7–10 days after infection.



Figure 1: Powdery mildew shows as grey-white 'mildew' on any green tissue. Left: A flagshoot with stunted growth and up-curved leaves covered in part with mildew. Right: Severely infected Chardonnay leaf showing ash-grey growth on the surface [© Western Australian Agricultural Authority].

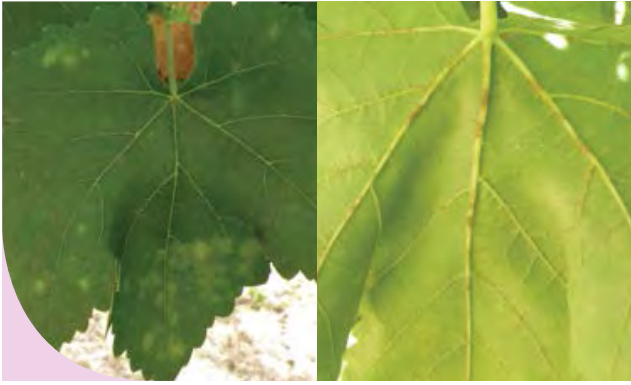


Figure 2: Powdery mildew infection. Left: Yellow-green blotches where early powdery mildew infection has occurred. Right: Veins on the underside of the leaf can turn brown when infected. [© Western Australian Agricultural Authority].



Figure 3: Left: Bunch of grapes with severe infection of powdery mildew. Right: Scarring of berries where growth of powdery mildew has occurred on the skin surface. [© Western Australian Agricultural Authority].

Note: In the main, powdery mildew spreads from diseased buds that were allowed to be infected in your vines last season. This leads to infection of the leaves this season and the spores from these leaf infections are the ones that infect your berries this season

## The disease cycle

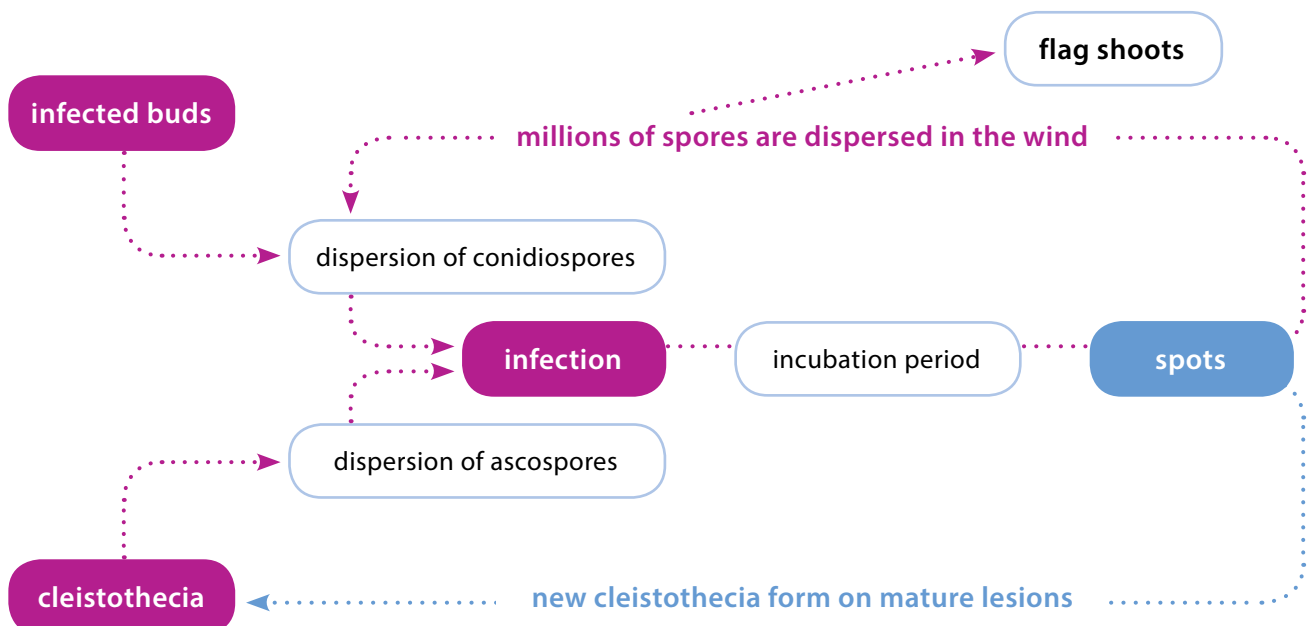


Figure 4. In Australian viticulture, powdery mildew develops from infected buds and sometimes, also from cleistothecia. Both lead to the production of new infection sites in the canopy from where the disease spreads steadily.

## What 'drives' powdery mildew?

Although powdery mildew has considerable capacity to multiply, it only spreads slowly and steadily. It increases in incidence and severity even in dry conditions, often growing unnoticed in shaded parts of the canopy. Optimum temperature for growth is 20°C to 28°C. While powdery mildew is thought to be retarded by temperatures > 40°C, in practice, it thrives in the optimum night temperatures that follow hot days. This is because of the longer duration of favourable rather than unfavourable temperature.

Powdery mildew produces about twice as many spores at relative humidity (RH) > 40% than at lesser RH and is killed by exposure UV light. Canopies open to airflow and UV light therefore have less risk of disease while dense, shaded canopies provide a favourable microclimate.

A simple sequence of events occurs in unsprayed vineyards: fruit infection for this season (Season 2) comes from leaf inoculum this season. Leaf inoculum (conidia) this season comes mostly from flag shoots and flag shoot inoculum comes from bud infection last season (Season 1). These buds are infected by the disease not controlled in your vineyard last season. So, if you control bud infection and cleistothecia from Season 1, you reduce the potential for leaf and fruit infection in Season 2.

## Epi-seasons

As discussed, powdery mildew is a 'two-season' disease. Infected buds and cleistothecia develop in Season 1 producing the inoculum which 'drives' the disease epidemic in Season 2. These two growing

seasons constitute the 'season of the epidemic', that is, the 'epi-season' of powdery mildew. Because most the inoculum does not carry into Season 3, the powdery mildew epi-season covers a rolling window of two growing seasons (Figure 6).

## Legacy/inheritance

As a result, the powdery mildew inoculum produced in Season 1 that survives over winter becomes a legacy you inherited in your vineyard from Season 1. It is this inoculum that triggers infection in Season 2. The 'legacy/inheritance' factor from within your vineyard is the main factor that influences initial levels of powdery mildew disease and in turn, the level of difficulty you face to achieve good control of powdery mildew each season. Thus, the level of powdery mildew that you inherit in Season 2 depends on how much disease you allowed to develop in Season 1.

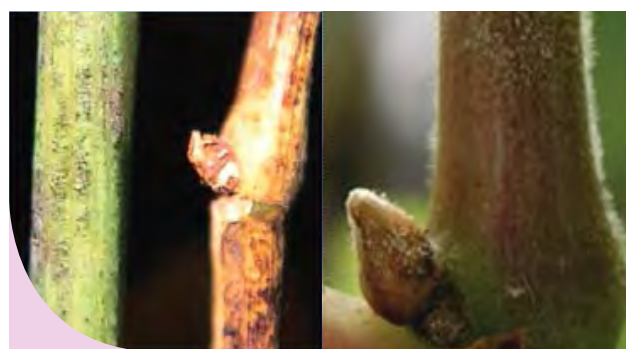


Figure 5. Buds are infected when young and show the white mildew growth (right). This develops greasy blotches on shoots, and reddish blotches on canes (left). Some of these mature buds carry powdery mildew on the inside. As these buds burst (forming flagshoots in spring), the new epidemic begins.

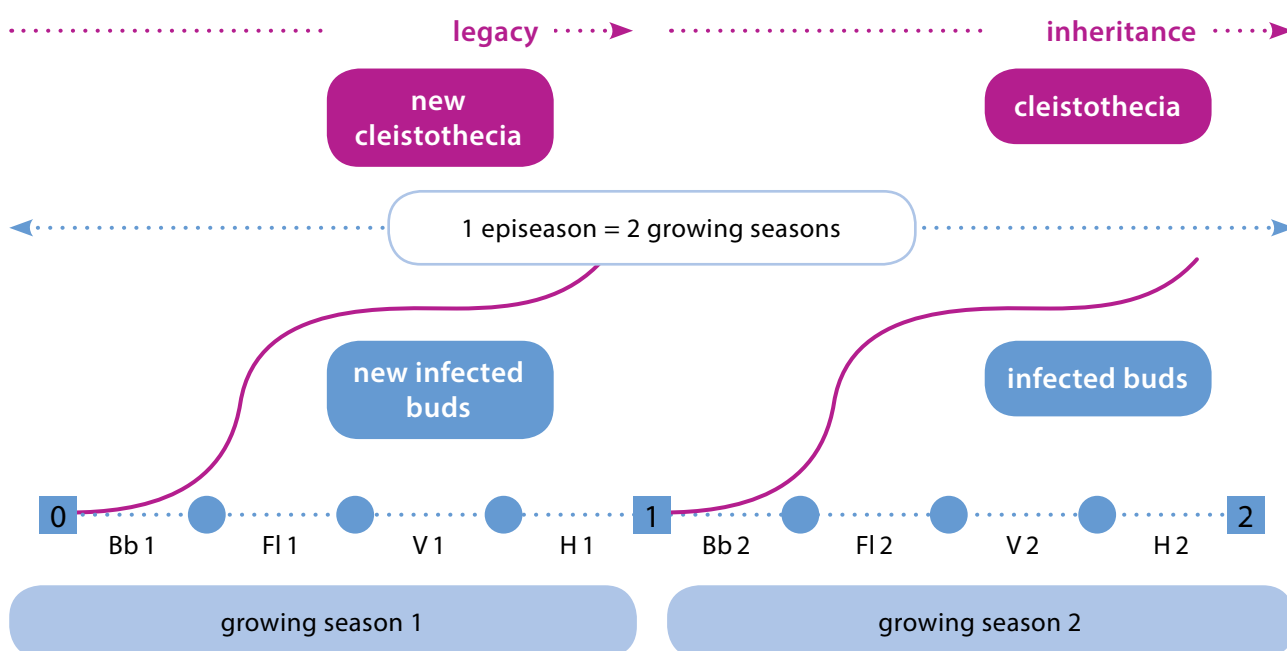


Figure 6: The factors that influence the development within powdery mildew's 'season of epidemic' (an epi-season). This period encompasses two growing seasons (Bb1 – Lf2) where Bb – budburst, Fl – flowering, V – veraison, H – harvest and Lf – leaf fall, in Seasons 1 and 2 respectively. The white graph lines for each season are simplistic disease progress curves for an unsprayed vineyard. The 'legacy/inheritance factor' for over-wintering inoculum 'drives' the powdery mildew epidemic and determines initial levels of disease each season. In consequence, it determines the difficulty to control powdery mildew in the second growing season.

## Managing powdery mildew

It is critical for the best control of powdery mildew to apply sprays as soon as the inoculum is active in the vineyard. As discussed, this occurs from bud-burst onward. This is in the early (slower) stages of the disease epidemic (the 'lag phase' of disease development) (Figure 7) – before powdery mildew spores swamp the vineyard. Once disease controls have 'got behind' and the disease has 'got ahead', it is very difficult to 'catch up'!

In former days, recommendations were to 'spray on either side of flowering'. This approach usually starts spraying in earnest at a time too late to control the level of leaf infection and it is too late to reduce the amount of carry-over inoculum for next season.

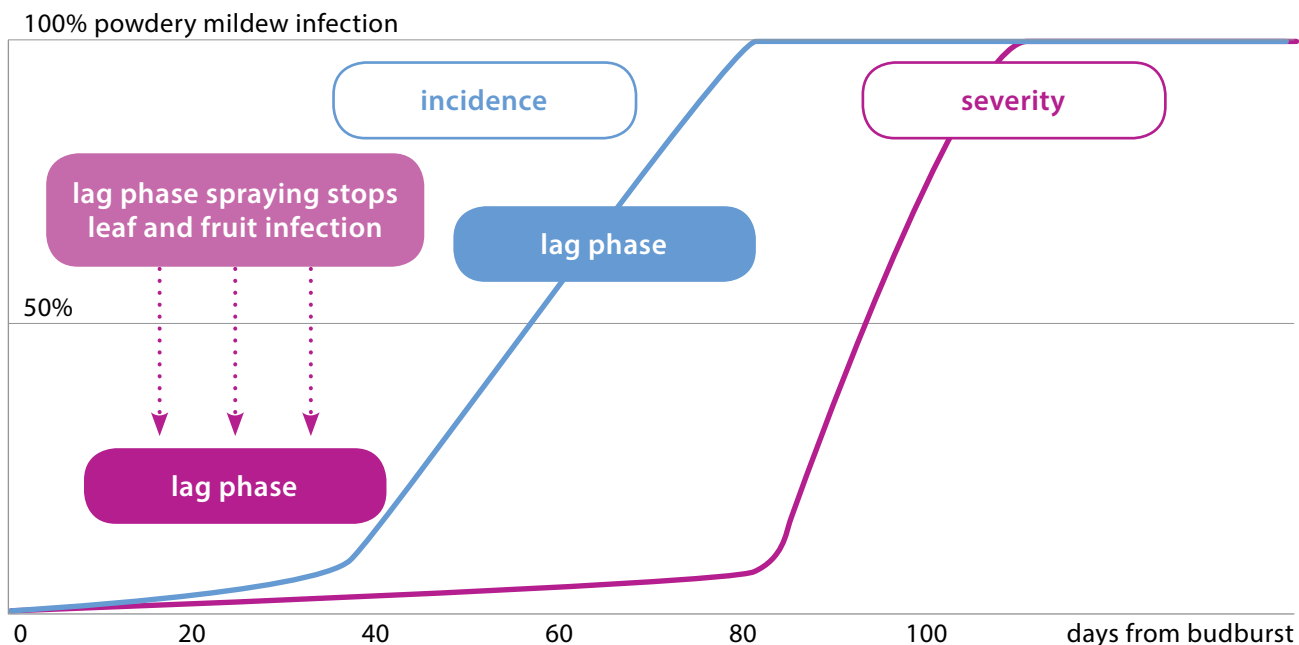


Figure 7: Graph illustrating the increase in incidence and severity of grapevine powdery mildew in a typical unsprayed inland Australian vineyard. Disease incidence increases significantly at around Day 40 from budburst at Day 0, and severity increases at about Day 80. The principle of 'lag phase control' is to apply fungicides while initial inoculum levels are low and more manageable, and sufficiently early in the epi-season to prevent the development of over-wintering inoculum for Season 2.

To control the disease effectively, use:

- » lag phase control, and
- » knowledge of epi-seasons.

### What does this mean for me?

**Spraying in the lag phase** aligns sprays to early season – to a time when spore loads are lowest, when the disease is easiest to control with minimum risk of resistance to fungicides and with maximum reduction of disease carry-over to the next season.

Note: For the most effective control of powdery mildew in your vineyard begin spraying early-season in the first 40 days after budburst – this translates to spraying at weeks 2, 4, and 6 after budburst. For best results, monitor the growth of the foliage and spray accordingly.

Spraying in the light of the **knowledge of the epi-season** for powdery mildew leads to spraying when the mildew fungus is most likely to be active in your vineyard and when it is most active in infecting buds that will carry the fungus over winter and into the next season. Happily, this coincides exactly with lag season spraying!

As a result, the best time to control powdery mildew in your vineyard is to begin just after budburst – when there is sufficient foliage growth (2–3 leaves at EL 7–9). Spray again when the shoots have expanded sufficiently for more new growth to be exposed and again a third time soon after. Continue spraying until you are confident that the disease is under control. Check this by monitoring the canopy closely for early signs of powdery mildew.

**The rule of thumb: the Three T's of good spray application:** Type, Timing and Technique. Like three links in a chain, ensure each factor in spraying is of good quality for quality control. The main cause of failure in vineyards sprayed at optimum spray timing is ineffective spray coverage. Sulphur is an effective fungicide against powdery mildew. If this product is not effective in cooler conditions this indicates signals a less than optimum spray coverage. This is because sulphur works well as a 'contact fungicide' even if its fumigant activity is reduced at temperatures below 17 °C.

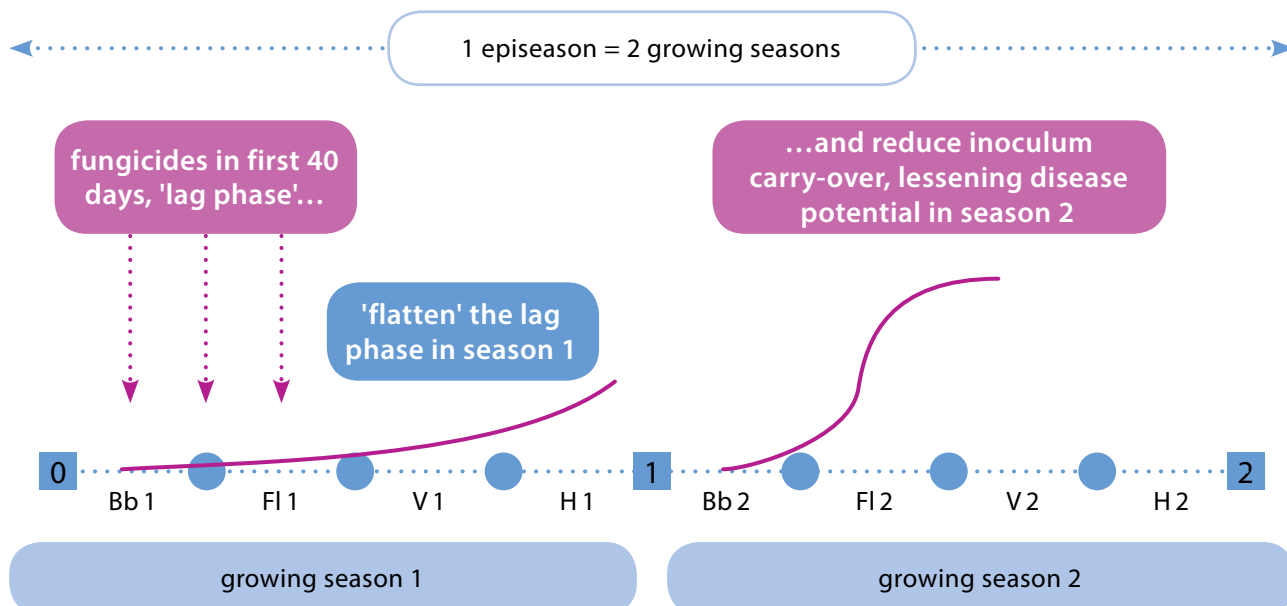


Figure 8: Diagram illustrating that fungicide applications (-----) early in an epi-season (i.e. early in Season 1), have potential to disrupt the progress of the powdery mildew epidemic in that season and to reduce the level of inoculum that carries disease to Season 2. This reduces the disease potential in Season 2, improving control of disease in the long-term with fewer sprays. [Note: Bb – budburst, Fl – flowering, V – veraison, H – harvest and Lf – leaf fall, in Seasons 1 and 2 respectively. The white graph lines for each season are simplistic disease progress curves for that season.]

Note: Most powdery mildew controls fail for want of effective spray coverage. Be sure to check the set up of your sprayer and adjust water rates to changes in canopy volume as the season progresses.

An understanding of the epi-season concept in relation to powdery mildew in your vineyard will lead to the strategy of improving the control of powdery mildew by concerted action to reduce the level of disease this season as a first step to reducing the disease levels next season. By successive seasons of spraying early-season the levels of carry-over inoculum will be reduced and vineyard reservoirs of the disease will be significantly reduced. In this way, instead of spraying 8-10 or more times in a growing season effective control can be achieved by as few as four or less sprays per season!

Nicholas, P.R., Magarey, P.A. and Wachtel, M.F. (Eds). (1994) *Diseases and Pests, Vol. 1. Grape Production Series*, Winetitles, Adelaide, South Australia, 106 pp. See Downy mildew. Ch. 5, pp 5–11. ISBN 1-875130-15-2. This is an easy-read manual on vineyard diseases and pests and their control.

Magarey, P.A. et al. (1999). *The Australian and New Zealand Field Guide to Diseases, Pests and Disorders of Grapes*. This is a companion to *Diseases and Pests*, Grape Production Series No.1., Winetitles, Adelaide, South Australia. 108 pp. ISBN 1 875130 33 0. (634.82), to help you correctly diagnose the symptoms of disease.

Magarey, P.A. (March 2010). *Managing Powdery Mildew, (Doing it better!)*. GWRDC Innovators Network Module INO906. Fact Sheet. 6 pp. [www.gwrdc.com.au](http://www.gwrdc.com.au)

See [www.growcare.com.au](http://www.growcare.com.au) for access to **GrowCare®** and for **Disease Diagnosis®** – the latter is an online module of the Field Guide (above). It allows you to diagnose vineyard symptoms from the tractor seat!