Agriculture Notes

Organic Farming: Managing grapevine downy mildew

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Introduction

Grapevine downy mildew is a potentially devastating disease caused by the fungus *Plasmopara viticola*. This fungus can infect all green parts of the vine, although the symptoms are usually observed on leaves and bunches.

Figure 1. Severe crop loss can result from uncontrolled downy mildew infections.

Specific wetness (rainfall or irrigation) and temperature conditions are required for downy mildew infection and spread. In vineyards, or years, where these conditions do not occur, control of downy mildew is not required. Under favorable conditions however, uncontrolled downy mildew develops very rapidly and can cause defoliation and total crop loss.

Primary infection - the beginning

Downy mildew overwinters as tough spore-bearing bodies in old leaf material on the vineyard floor and in the topsoil. Primary infection occurs when these bodies are wet and release spores which are splashed onto the vine foliage where they germinate. The conditions required for this are:

- 10mm or more of rainfall and/or overhead irrigation together with a temperature of 10°C or more, over a 24 hour period (commonly referred to as 10:10:24 conditions); and
- rain or irrigation towards the end of that 24 hour period, followed by several hours of leaf wetness.

The symptoms of downy mildew primary infection are small yellowish oilspots which grow rapidly on new foliage. Oilspots are red on some varieties.

Secondary infection - the spread

The disease spreads through secondary infections on warm, wet nights, when the temperature is 13°C or more, and several hours of leaf wetness occur around dawn.

Under these conditions the fungus produces white downy patches of spores on the underside of the oilspots. These spores can then spread the disease very rapidly.

Figure 2. Downy mildew is named after the white downy appearance created by the development of spores prior to secondary infections.

Management techniques

Monitoring

By monitoring for the specific weather conditions required for downy mildew infection, growers can pinpoint the time of primary infections and fine-tune their management accordingly.

Monitoring is particularly valuable for organic growers who can minimise their use of fungicides by confirming when protection from infection is required, and importantly, when it is not required.

Monitoring for 10:10:24 events is done most simply with a rain gauge and maximum/minimum thermometer, together with observation of the rainfall pattern (e.g. did it rain late

in the 24 hour period ?) and foliage wetness (e.g. were leaves still wet a couple of hours after the late rainfall ?).

If 10:10:24 conditions are not detected using this method, it is very unlikely that a primary infection occurred.

If 10:10:24 conditions did eventuate, then a primary infection may have occurred. This can only be confirmed by the appearance of oilspots or the use of automated weather stations and computerised disease simulators, such as those operated by disease alert services in some districts. Where these services are available, organic growers should use them fully to optimise the timing of sprays and minimise the application of unnecessary treatments.

The need for early season treatments for downy mildew depends on the grower's approach to risk management. Given 10:10:24 conditions, the risk of infection is considered very low if shoots are less than 10cm in length. This relates to the small amount of foliage across the vineyard, available to receive infective spores splashed up from the vineyard floor. Once shoot growth exceeds 10cm, the risk of infection during 10:10:24 conditions is considered high enough to warrant treatment.

Figure 3. Typical downy mildew oilspots.

The appearance of oilspots is proof that primary infection has occurred. Oilspots usually develop within five to 12 days after the infection event, with the longer times applying during the cooler (earlier) part of the season.

Details of monitoring techniques and a manual method of calculating oilspot timing are presented in the grapevine Diseases and Pests book (Nicholas et al. 1994).

Suspicious symptoms can be confirmed as downy mildew oilspots by a simple sporulation test. In this test, white downy patches of spores will develop overnight on infected vine material when sealed in a moistened plastic bag and kept in darkness overnight at about 20^{o}C. Development of this white downy growth in the bag confirms the presence of oilspots resulting from primary infection. Development of the downy growth in the vineyard confirms that downy mildew secondary infection has occurred.

Cultural management

Limited options exist for cultural management of downy mildew. As with other foliage diseases, the maintenance of open canopies will encourage the rapid drying of wet foliage by improving airflow through the canopy.

The risk of infection may be reduced in some cases by careful irrigation management to ensure that overhead irrigation and rainfall do not coincide. This will avoid situations where rainfall and irrigation together create suitable conditions for infection, whereas separately they would not have provided the required intensity of precipitation or duration of leaf wetness.

Similarly, infection conditions can be created on vines at the junction of different irrigation blocks, if they receive water from two sequential overhead irrigation shifts.

Avoiding areas of wet soil in the vineyard, like those caused by poor infiltration, poor drainage or leaking outlets may also help reduce the risk of infection. Continually wet soil is very likely to contain infective downy mildew spores at all times. These are ready to initiate an infection as soon as rainfall or overhead irrigation occurs, without the usual extended period of wetness.

It is also thought that while the level of downy mildew inoculum may drop to very low after a number of dry seasons, wet areas of soil can allow the infection cycle to continue, thus maintaining concentrated pockets of inoculum within the vineyard.

Fungicides

The only fungicides effective against downy mildew and currently allowable under organic standards are based on copper hydroxide and copper sulphate. These sprays only protect vines against new downy mildew infections. They do not eradicate existing infections and are not systemic. For these reasons, spray coverage must be very thorough to protect vines.

Because of increasing concerns about the environmental effects of copper, its use in organic agriculture is becoming more restricted.

At present, the Australian organic standards allow a maximum of 8kg/Ha of copper to be applied annually.

To minimise the use of copper on organic vineyards, growers should use disease alert services or their own weather monitoring to indicate the times when protective sprays are actually required, rather than relying on a calendar-based spray schedule.

International research efforts are seeking alternatives to copper as an agricultural input. For downy mildew control, the alternatives being investigated include plant extracts, biological control with other micro-organisms, and substances that trigger the vines' natural immune system (a response referred to as Systemic Acquired Resistance). To date, none of these alternative approaches have provided economically effective control of downy mildew.

Fungicide management

The most efficient way to protect vines from downy mildew is to apply a protectant fungicide just before a potential infection period or an eradicant fungicide just after a confirmed infection period. This approach is more

efficient in time, energy and resources than the regular application of fungicides used to maintain a full-time protective cover on the vines. It also has less environmental impact.

As mentioned above, the only organically acceptable fungicides registered for downy mildew control are protectant in action. No eradicant fungicides are currently available to organic producers.

Early season control

The risk of downy mildew infection very early in the season is low because of the small amount of susceptible leaf and stem tissue in the vineyard. For this reason, fungicide treatments for downy mildew are usually not recommended until shoots are about 10cm long.

Some risk management strategies

Conservative: Growers should ensure their vines have a protective cover of allowable copper fungicide - before each rainfall and/or irrigation event that is likely to create suitable conditions for infection. To achieve this, growers need to make good use of weather forecast services where these are available.

Higher risk: Growers may wait for confirmation of a primary infection period, then be prepared to ensure that a thorough cover spray of allowable copper fungicide is applied before each subsequent rainfall and/or irrigation event that is likely to create suitable conditions for infection. Accurate confirmation of primary infection requires the use of a disease prediction service based on vineyard weather data.

This strategy will not prevent development of oilspots from the first primary infection. It is intended to prevent spores from these oilspots creating further infections, in the event that secondary infection conditions occur.

It is important to note that for this higher risk approach to succeed, growers must be able to guarantee availability of spray equipment and access to the vineyard when needed.

The higher risk approach is more applicable to districts where very few infection events occur in some seasons (eg. dry districts). The benefit of this strategy is that in seasons when no primary infection events occur, applications of copper can be avoided altogether.

Additional information sources

- CRCV Viticulture Research to Practice® 'Integrated Pest Management' workshops
  CRC for Viticulture
  Box 154
  Glen Osmond SA 5064
  Tel: 61 8 8303 9405 Fax: 61 8 8303 9449
  email info@crcv.com.au
  Internet: www.crcv.com.au/education/rtp
- Madge, D. (1995). *Organic Agriculture: Getting Started* Agmedia ISBN 0730664333.
  (General introduction to organic agriculture).
- Magarey, P.A., MacGregor, A.M., Wachtel, M.F. and Kelly, M.C. (1999). *The Australian and New Zealand Field Guide to Diseases, Pests and Disorders of Grapes*. Winetitles, Adelaide, S.A.
  ISBN 1 875130 33 0.
- Nicholas, P.R., Magarey, P.A. and Wachtel, M.F. (1994). *Diseases and pests. Grape Production Series No. 1*. Winetitles, Adelaide, South Australia.
  ISBN 1 875130 15 2.
- Organic Federation of Australia (OFA)
  PO Box 166, Oakleigh South, VIC 3167
  Tel: 1300 657 435
  email:info@ofa.org.au Internet: www.ofa.org.au
  (Australia's peak organic industry organisation).

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