FACT SHEET JANUARY 2010

Botrytis Management

Author: Katherine J. Evans
Tasmanian Institute of Agricultural Science
University of Tasmania

INNOVATORS NETWORK

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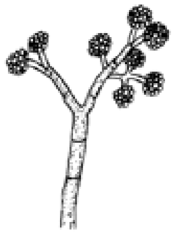
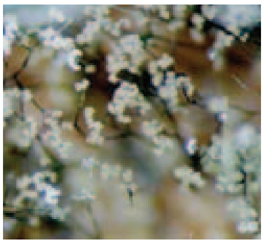
Botrytis bunch rot, or 'botrytis', is a weather-driven disease that can cause significant loss of grape yield and quality, even after application of a full program of fungicides. This factsheet describes how botrytis develops, critical control points and integrated measures needed for high risk situations.

Sources of infection

Botrytis is caused by the common environmental fungus, *Botrytis cinerea*. Botrytis spores are almost always present in vineyards. Important sources of spores that initiate infections in grapevines are described below.



Clusters of colourless or grey spores (conidia) are borne on branched dark stalks



Spores (conidia) are dispersed to grape tissue by air currents, rain splash or insects such as light brown apple moth (LBAM)

Wounded berries provide an easy entry point for botrytis

Spores constitute the grey mould seen on rotting berries

Important sources of spores

Previous season	Current season
infected cane debris, bunch remnants, tendrils, leaf petioles & blades	infected, damaged leaves decaying floral parts: caps, aborted berries, rotting berries

How does botrytis invade grape tissue?

Botrytis infects grapevine tissue via wounds and natural openings, including microfissures in the berry skin and wounds made by insects, powdery mildew, berry splitting, loose pedicels or other physical damage. Spore germination is stimulated by sugars and amino acids exuded from ripening berries. The fungus secretes enzymes to kill plant tissue in advance of its colonisation and then absorbs nutrients from dead tissue. Any decaying grape tissue, especially damaged leaves, dead floral parts and ripe berries, is a prime target for botrytis colonisation and subsequent spore production. How then, can the first infections of fruit occur in green flowers and green, hard berries?

Latent infection in flowers and immature berries

When the cap lifts off a flower, there is a natural spore trap in the gap between the ovary and the torus (Figure 1). A band of necrotic (brown) tissue at the tip of the torus is exposed, providing an entry point for botrytis. After entry, fungal growth is stopped by a high concentration of antifungal compounds. The fungus then rests is a quiet state (latent) and then resumes growth when the developing berry begins to soften. At this time, the concentration of antifungal compounds begins to decline, allowing botrytis to colonise the berry and cause symptoms of rot.

Capfall is the first opportunity for latent infections to become established, although latent infections may occur at any stage during berry development. It is not known what makes the fungus re-grow in the grape berry after latency and not all latent infections lead to a rotten berry. The proportion of latent infections resulting in botrytis symptoms is correlated to the duration of high relative humidity.

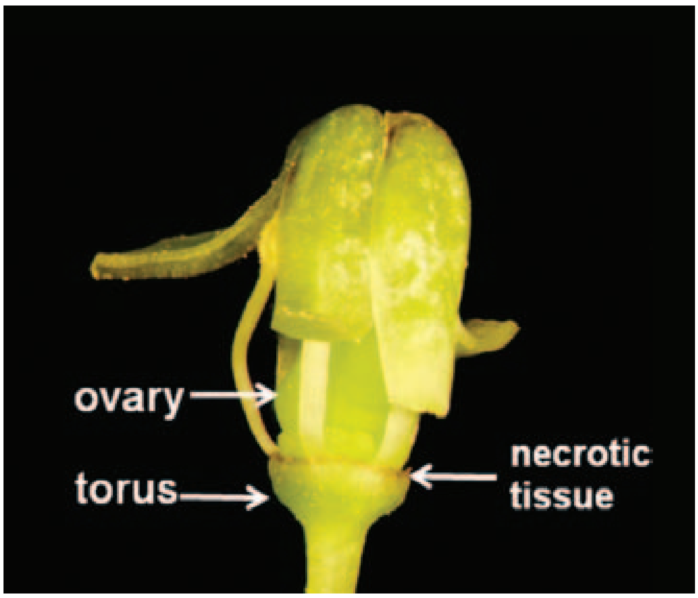


Figure 1. As the cap lifts off the flower, a ring of brown tissue provides an entry point for botrytis. (Photo: M. Longbottom, University of Adelaide)

Symptom development and types of epidemic

After 'latent' botrytis resumes its invasion of a grape berry, it can then spread from berry to berry, often rapidly in compact bunches of thin-skinned varieties. Botrytis also spreads rapidly from bunch to bunch in crowded fruit zones.

Figure 2 summarises botrytis development, noting that the time at which symptoms appear varies and can occur weeks or months after establishment of latent infections. Even though severity at harvest various enormously among seasons and regions, the increase in disease severity after symptom appearance shows distinct patterns that allow prediction of the future course of the epidemic. Prediction models, under development, can aid decisions about in-season management and harvest date.

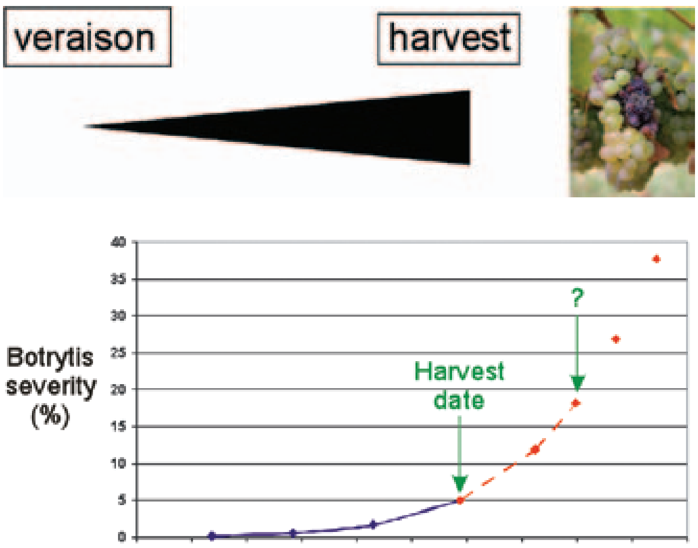


Figure 2. Illustration of the change in botrytis severity between veraison and harvest when weather favours the disease. Disease severity can increase by 1-2% per day near harvest, highlighting the importance of harvest date as a management tool.

Factors that promote botrytis development

Table 1 summarises the main pathogen, vine and environmental factors that are correlated to botrytis severity at harvest. The key weather variables are temperature and the duration of surface wetness, provided by rain, fog, dew or mist. Free water is needed for the spore to germinate and high relative humidity may be sufficient to cause condensation of water inside tissues such as flowers. Temperature determines how fast infection occurs, with the optimum temperature in the range 18-21°C. Longer wetness periods are needed to achieve the same level of infection at sub-optimum temperatures. The interaction between the temperature and duration of surface wetness on botrytis infection is described by the Broome or Bacchus models (Broome et al. 1995; Kim *et al.* 2007).

Table 1. Main factors correlated to botrytis severity at harvest. Unless indicated, increasing levels of a factor promote more botrytis.

Pathogen factors
Botrytis severity in the previous season and the amount of botrytis carried over to the next season (eg. on bunch remnants)
Amount of spores in the vicinity of susceptible grapevine tissue (eg. infected trash caught in grape bunch)
Vine factors
Highly susceptible varieties with thin skins
Variety susceptibility to berry splitting & loose pedicels
Berry sugar content
Bunch compactness
Bunch crowding
Grape yield per vine
Excessive vigour
Leaf layer number in fruiting zone
Environmental factors
Temperature, relative humidity and wind speed in the fruiting zone that determine the duration of surface moisture
The interval (days) between veraison & harvest
Agents (eg. LBAM or powdery mildew) or conditions that induce wounds in berries
Winter pruning & trellis system that influence shoot vigour and canopy density
Irrigation, shelter belts or large bodies of water that influence fruit zone microclimate
Irrigation that influences shoot vigour or berry size (bunch compactness)
Nutrition that influences shoot vigour or berry skin integrity

Botrytis risk is highest in thin-skinned varieties with compact bunches in humid canopies carrying high crop loads

CRITICAL CONTROL POINTS

There are four critical control points for managing botrytis. Each control point is listed with potential management measures, some of which may only apply to certain regions and/or grape varieties. Selection of a management measure will depend on objectives for grape yield and quality, plus the cost of control in relation to the price of grapes.

Reduce spore load

- Consistent and effective botrytis management to reduce carryover of botrytis from one season to the next.
- Microbial decomposition of vine debris that reduces spore production by botrytis.

Reduce flower & fruit infection

- Avoid planting highly susceptible varieties in low lying areas with poor air drainage or next to large bodies of water.
- Orientate rows for good airflow down the rows.
- Protective fungicides can be applied at key crop stages.
    - Critical application times for protective fungicides are at 80% capfall and again at pre-bunch closure, the last opportunity for good coverage inside the bunch.
    - If botrytis risk is high, fungicides can also be applied at veraison and pre-harvest, if disease severity is still low and there are no restrictions on the fungicide selected.
    - If the flowering period is extended, then spray before it rains.
    - Pay attention to spray coverage of the inflorescence.
    - Implement a fungicide resistance management strategy and pay attention to maximum residue limits and withholding periods. Refer to the latest edition of '*Agrochemicals registered for use in Australian viticulture*' (see reference list below).
- Minimise berry wounding by controlling LBAM and powdery mildew well.
- Reduce excessive vigour by reviewing vine balance, trellis type, extent of lateral growth, fertiliser & water inputs, plus potential to plant competitive inter-row crops.
- Remove leaves around bunches when leaf layer number is high and fruit exposure is suboptimal.
    - aim to achieve the desired canopy density and fruit exposure without the need to remove leaves.
    - check that the timing, location and extent of leaf removal has no undesirable effects on juice quality or the level of sunburn.

Limit re-growth of latent infections

- Lower humidity in the fruiting zone by canopy management and by preventing pooling of water in wheel ruts.
- Prevent excessive soil moisture through adequate drainage, vineyard floor management and appropriate irrigation.

Limit disease spread

- Monitor botrytis development and harvest early if botrytis risk is high.
- Minimal pruned vines with average or higher than normal bunch number can have smaller, less compact bunches that are dispersed through a more open outer canopy, relative to mechanical hedging or cane pruned vines.
- Reduce bunch crowding by measuring and managing yield potential.

Integrated botrytis management

Integrated botrytis management is about manipulating the bunch zone microclimate for reduced humidity and rapid drying of wet bunches. There are many ways that this can be achieved for the same end result. Moreover, open canopies can improve spray coverage and reduce reliance on fungicides. Fungicides can provide significant additional control when timed well. Severe restriction on late season fungicide use makes canopy management all the more important. Figure 4 illustrates the integration of management measures needed to deal with high risk situations. Prediction systems and biosuppressants are still under development.

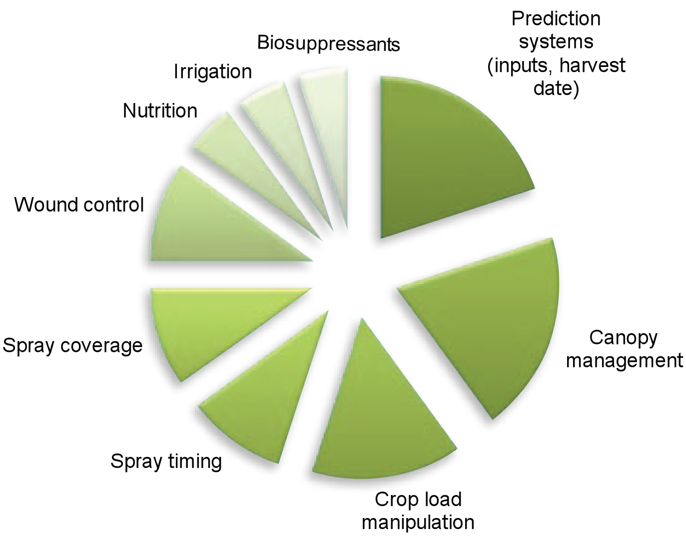


Figure 3. Multiple control measures are needed when botrytis risk is high. Based on the concept of P.A.G. Elmer (pers. comm.)

ACTION POINTS

The following 'actions' can aid selection of cost-effective control measures for a particular site:

1. Measure botrytis severity at harvest objectively and obtain winery feedback on the impact of the botrytis level on wine making.
2. Establish a systematic process at each crop stage to identify site-specific factors contributing to botrytis risk.
3. Set targets for acceptable botrytis control (zero tolerance or less than 5% severity?). If these targets cannot be met consistently in particular areas of a block, then review management or consider removing vines or changing grape variety.
4. Implement cost-effective control measures that address the key factors that increase botrytis risk at a particular site.

Production of high quality grapes to target yields requires appropriate canopy management and judicious use of inputs for vine balance. These viticultural practices alone will contribute significantly to the management of botrytis bunch rot.

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GWRDC Innovators Network
67 Greenhill Road Wayville SA 5034
PO Box 221 Goodwood SA 5034
Telephone (08) 8273 0500
Facsimile (08) 8373 6608
Email gwrdc@gwrdc.com.au
Website www.gwrdc.com.au