Key Information

- Botrytis bunch rot infections can occur during bloom and/or ripening.
- Botrytis bunch rot is favored by wet conditions during moderate (60–77°F) temperature periods.
- Canopy manipulation that increases air circulation, light penetration, and spray penetration into the fruit zone, especially around flowering, can help reduce Botrytis bunch rot.
- A fungicide program, when combined with canopy manipulation, is sometimes necessary to manage Botrytis bunch rot during dry growing seasons, but is essential during wet growing seasons.
- Botrytis cinerea can quickly develop resistance to fungicides, so proper selection of materials, rates, and use patterns are critical to preventing control failures. Cultural practices that reduce disease pressure also reduce resistance development.

Introduction

Botrytis bunch rot (BBR) of grapes is caused by the fungus Botrytis cinerea. BBR symptoms are typified by a fuzzy, gray fungal growth on ripening and mature grape berries (Fig. 1). Infections often first appear as a single berry exhibiting symptoms, but under favorable weather conditions, BBR can spread throughout the cluster. While BBR is a sporadic problem in eastern Washington vineyards, and generally limited to years characterized by wet conditions during bloom and harvest, BBR has the potential to be very destructive. The potential for severe losses on a regular basis is greater in the cool and humid climate of western Washington.

Biology and Disease Development

In order to effectively manage BBR, it is important to understand the biology of the pathogen and epidemiology of the disease (Fig. 2). Botrytis cinerea grows on many plant species and decaying plant matter. At a practical level, there is nothing that can be done to exclude it from a vineyard. However, it is a relatively weak pathogen on grapes, infecting tissue through wounds or natural openings. Common wounds occur from hail, mechanical damage, insect feeding, splitting of grapes during ripening, and diffuse powdery mildew infections. It often infects from an established base of dead or dying tissue, making flower debris, dying stamens, flower cap scars, and other plant debris important sources of inoculum for berry infection.

Classic BBR symptoms on a cluster can result from two different infection types occurring at two different times of the season. The first is BBR resulting from early season infections that remain latent (hidden) until the end of the season. Once the fruit begins to soften and accumulate sugar, BBR can become reactivated, and rot berries. The second is BBR that results from late-season (véraison and later) infections of injured and/or ripening fruit, and subsequent spread to abutting berries within a cluster. While the latter often appears to be the more commonly manifested expression of the disease (often accompanied by insect and animal feeding, or late season rain events), latent infections can be extremely destructive, especially when not expressed until storage or in the fresh market. Often, BBR symptoms seen at the end of the season are the expression of latent infections that occurred between bloom and cluster closure.

Botrytis cinerea thrives under high humidity (90%+), and can grow and infect when temperatures are between
35 and 90°F, but thrives at temperatures between 60 and 77°F. Free moisture is also favorable for infection. Flower infection can occur with as little as 1.5 hours of continuous leaf wetness, whereas mature fruit infection requires a wetting duration of 14 hours.

**Cultural Practices for Disease Management**

*Botrytis cinerea* can grow under a wide range of conditions, but disease pressure is greatest in the cool, damp conditions created in dense grape canopies. Therefore, any form of canopy manipulation that increases sunlight penetration and air circulation into the canopy, and especially the fruit zone, will help in the management of BBR. This can be done through shoot thinning, canopy vigor management (controlled nitrogen application or deficit irrigation), or the physical removal of leaves above and below the fruit clusters. In Washington vineyards, removal of one leaf below and up to two above the cluster is generally sufficient to achieve the desired benefit.

Leaf removal has proven to be a very effective way to manage BBR outbreaks. In California, leaf removal at fruit set provided better control of BBR than a standard fungicide program. Leaf removal improves spray penetration of the canopy, deposition on clusters, and air circulation around clusters. Improving air circulation during bloom is also important, as this is the period of development during which grape clusters are particularly prone to establishment of latent infections. In more humid climates (e.g., western Washington), leaf pulling improves BBR management, but may not provide complete control.

If you are in the process of vineyard establishment and weather conditions are conducive for BBR development in your location, selecting variety clones with loose cluster architecture is advised. Loose cluster architecture reduces the risk of trapping flower debris within the cluster as it closes, reduces the likelihood of berry splitting due to cluster pressure during ripening, and allows better fungicide penetration into the cluster. Compact clusters (touching berries) favor within-cluster spread of rot (Fig. 3).
While eliminating Botrytis from a vineyard is nearly impossible, removing inoculum sources around the fruit zone can potentially reduce disease development. *Botrytis cinerea* can overwinter as sclerotia (small, durable fungal structures) in mummified clusters or rachises (Fig. 4). Therefore, removing these clusters and rachises during winter pruning may help improve management.

Research has shown that inconspicuous (diffuse) colonies of the grape powdery mildew pathogen (*Erysiphe necator*) can predispose grapes to BBR (Fig. 5). Rigorous control of powdery mildew within the window of maximum berry susceptibility (immediate prebloom to 3 weeks postbloom) will prevent these inconspicuous colonies from becoming established and providing a base for further damage due to BBR.

**Botrytis Bunch Rot vs. Sour Rot**

Botrytis bunch rot can sometimes be confused with sour (or summer) rot because both diseases display rot symptoms at similar times in the vineyard and the color of infected fruit (before leaking or fungal sporulation) is the same. The major differences between the two are: (i) sour rot tends to be a “wet” rot (fungal sporulation is not seen), (ii) the sour rotting cluster tends to smell like acetic acid (vinegar), and (iii) sour rot is often accompanied by noticeable populations of fruit flies. Sour rot is caused by an assortment of endogenous yeasts and bacteria (e.g., *Acetobacter*). Like *Botrytis cinerea*, these microorganisms typically invade open wounds in the berries and disease development is favored by prolonged periods of high humidity or surface wetness. In addition, fruit are prone to sour rot development after the start of véraison.

**Fungicide Programs for Botrytis Bunch Rot**

Cultural practices such as proper canopy management and leaf pulling are the first line of defense against BBR, and not only enhance chemical control, but are critical to the very sustainability of chemical control (see comments on resistance below).

Because of an overlap in the timing of grapevine susceptibility to powdery mildew and BBR, and because powdery mildew can predispose clusters to BBR, the use
of dual-control fungicides from bloom to bunch closure is recommended. Recommend label rates often differ for the two diseases. Use the highest labeled rate provided for control of both. Combining these materials with wettable sulfur (low resistance risk) is recommended to improve control and lessen the risk of fungicide resistance development to powdery mildew.

Managing Fungicide Resistance Development

Botrytis cinerea can and has developed resistance to many commonly used fungicides, but the extent of this resistance has not been documented in Washington state. This process is accelerated when proper resistance management guidelines are not followed. Always follow label instructions on the maximum applications per site/year and the number of sequential applications. The Fungicide Resistance Action Committee (FRAC) has developed resistance management guidelines for anilopyrimidine fungicides (AP or FRAC Group 9 compounds; cyprodinil and pyrimethanil) which vary according to treatment regimen: in areas such as eastern Washington where only two Botrytis-specific fungicide treatments may be necessary after véraison, the AP class should be utilized only once. In areas where up to six BBR-specific applications are made, the AP class can be used twice. The hydroyxanilide (FRAC Group 17) class (fenhexamid) can be used up to three times per season and is a logical choice for alternation with AP compounds. Some of the formulations are prefabricated mixes of different active ingredients; ensure that you are aware of the active ingredients and their target organisms or diseases.

Rotating formulations is not the same as rotating fungicide classes or FRAC groups, and many of these new formulations contain fungicides in the same chemical class. Do not use rates below the minimum specified on the label and do not practice other rate-reducing practices such as alternate row spraying. Botrytis sprays applied at véraison or later generally perform best when applied using relatively high volumes of water—up to 100 gallons per acre. Monitor weather conditions and spray using the shortest interval if conditions are conducive for BBR infection to prevent population build-up between sprays. Fungicides are ineffective for managing sour rot.

Literature


