MICHIGAN
Grape facts

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Managing botrytis bunch rot

Gray mold or bunch rot can cause serious yield loss but there are a variety of tools that can be used to protect grapes.

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Key messages

- **Avoidance** – Avoid cluster damage from other pests such as insects, birds and other grape diseases.
- **Exclusion** – Exclude the pathogen by harvesting in a timely fashion and increasing canopy airflow.
- **Resistance** – Choose resistant varieties when possible.
- **Protection** – Protect flowers and clusters with fungicides when the infection risk is high.
- **Eradication** – Eradicate old canes and clusters each season.

Pathogen

Botrytis cinerea

Kingdom: Fungi

Division: Ascomycota

Class: Leotiomycetes

Asexual form: *Botrytis cinerea*

Sexual form: *Botryotinia fuckeliana* or also known as *Botryotinia cinerea*

Introduction

Botrytis cinerea, or the causal agent of gray mold and bunch rot, is one of the most important pathogens of grapes worldwide. *B. cinerea* is a necrotrophic fungus that attacks and infects all different parts of the grape vines; however, fruit rot is the most problematic. Botrytis bunch rot infection can cause huge economic losses in grape production due to the preharvest infection in the field (Figure 1), which leads to reduced yield and postharvest losses during storage. Warm and wet weather (59 to 68 degrees Fahrenheit; 15 to 20 degrees Celsius, at least 90% humidity) are inducive to *B. cinerea* infection and spread.

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Figure 1. Botrytis bunch rot caused by *Botrytis cinerea* (cv. Riesling).

Disease symptoms

In early spring, infected buds and young shoots will turn brown, while in late spring, V-shaped, large, irregular brown areas appear on the leaves (Figure 2A). Grape inflorescences may appear blighted when infected but flower infection mostly remains quiescent until veraison (Figure 2B). At veraison and beyond, the fungus infects the clusters directly from the skin or through wounds caused by various factors including bird claws or feeding, insects or rain cracks.

Infected berries can dry out in arid conditions while in wet weather, infected berries are covered with grayish mold. This mold contains fluffy mycelia and millions of spores or conidia. As infection proceeds,

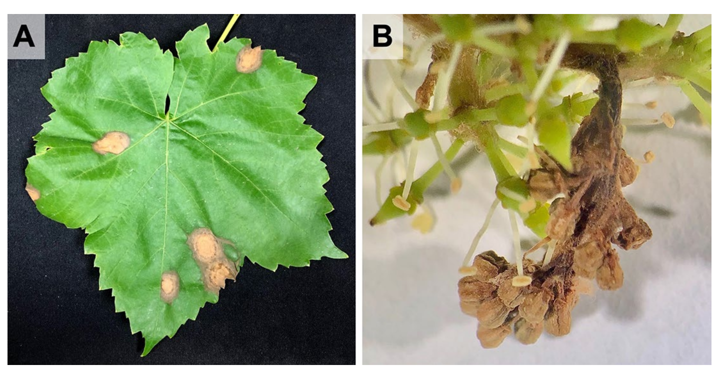

Figure 2. *Botrytis cinerea* infection on A. leaves (photo by Florent Trouillas, UC Davis) and B. an inflorescence (photo by Timothy Miles, MSU).

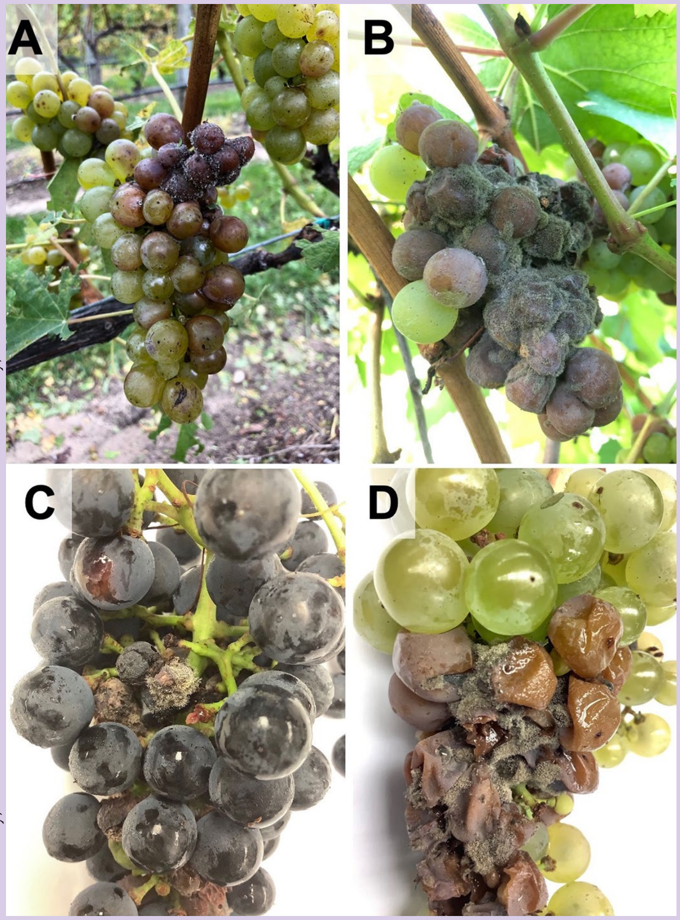

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Figure 3. *Botrytis cinerea* infection and gray mold or bunch rot on grape berries of different cultivars; A. Riesling, B. Vignoles, C. Chancellor and D. Niagara.

berries tend to rupture. Infection commonly occurs in the center of the cluster from which the disease spreads from berry to another until *B. cinerea* infects the whole cluster (Figures 3 and 4). Compact clusters are more vulnerable to infection by *B. cinerea*.

In addition, powdery mildew fruit infection can induce fruit cracking, which forms convenient conditions for *B. cinerea* infection. Infected berries change in color where white grapes become brown while purple grapes become reddish (Figure 4).

Disease cycle

The fungus survives the winter in vineyards as mycelium or sclerotia (small, black structures) in mummified berries and other infected plant parts. In spring during wet, humid and warm weather, the primary inoculum of conidia is produced from the different sources of winter survival structures. Conidia dispersal is primarily by wind but also water splash, insects, animals or mechanical practices can serve as secondary factors for fungal spread. Once conidia deposit on plant parts, they remain quiescent if conditions are not favorable for infections.

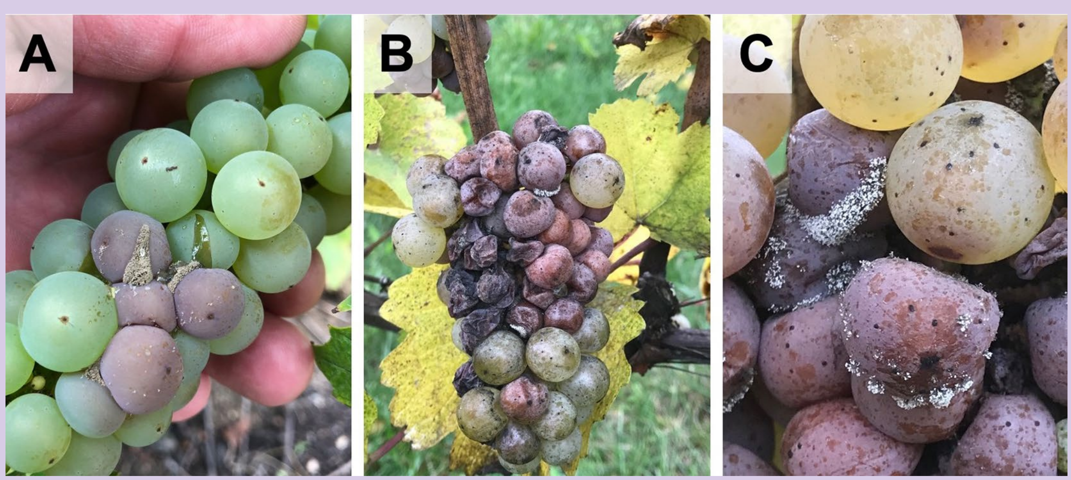
Conidia germination and infection occur once climate conditions become favorable, where temperatures are between 32 to 86 F (0 to 30 C) and humidity is high. Disease outbreaks can occur when grapes receive extended continuous wet periods of 15 hours or more and temperatures are within 59 to 68 F (15 to 20 C). The pathogen colonizes different vegetative plant parts, which serve as secondary inoculum to inflorescences at flowering time.

During bloom, young clusters are highly susceptible to infection and infection may become active when fruit ripens or remains quiescent and spread during postharvest. Infected flower parts provide inoculum to adjacent clusters where the fungus enters directly from berries skin or through wounds. Sporulation on symptomatic berries serves as secondary inoculum for the disease during the season. Typically, when conidia infect fresh wounds, berries become necrotic and sporulate after one week, serving as new inoculum source for the remainder of the season.

Management

Fruit rot caused by *B. cinerea* appears in the field more visibly close to harvest, but use control strategies to prevent the disease early in the season. An integrated pest management strategy that includes cultural and chemical control will provide the best control of *B. cinerea*.

Figure 4. *Botrytis cinerea* sporulation is influenced by A. cracking and splitting (cv. Aurore) and B-C. the location of sporulation within the cluster (cv. Riesling).



Photos: Timothy Miles, MSU

Table 1. Cultivars that are less susceptible to botrytis bunch rot.			
Slightly susceptible		**Moderately susceptible**	
Alpenglow	Alwood	Alden	Auxerrois
Beta	Bluebell	Barbera	Baco Noir
Cabernet Franc	Caco	Brianna	Buffalo
Cabernet Sauvignon	Catawba	Canadice	Chambourcin
Captivator	Cascade	Chardonel	Concord Seedless
Cayuga White	Chancellor	Edelweiss	Esprit
Colobel	Concord	Frontenac	Frontenac Gris
Corot Noir	Cynthiana (Norton)	Geneva Red - 7	Gruner Veltliner
DeChaunac	Delaware	Horizon	Interlaken
Dutchess	Einset Seedless	Lakemont	Landot 4511
Foch	Fredonia	Merlot	Moore's Diamond
Glenora	Himrod	Muscat Ottonel	New York Muscat
Isabella	Ives	Petit Syrah	Pinot gris
Jupiter	Kay Gray	Pinot blanc	Rougeon
King of the North	La Crescent	Sangiovese	Seneca
Limberger	Louise Swenson	St. Croix	St. Pepin
Marechal Foch	Marquette	St. Vincent	Suffolk red
Mars	Melody	Swenson red	Valiant
Neptune	Niagara	Van Buren	
Noiret	NY76.0844.24	Zinfandel	
NY81.0315.17	Petit Manseng		
Prairie Star	Ravat 34		
Reliance	Rosette		
Sabrevois	Sheridan		
Steuben	Sunbelt		
Swenson white	Traminette		
Valvin muscat	Vanessa		
Ventura	Verdelet		
Videl blanc	Villard blanc		
Villard noir	Vincent		
Worden			

Cultural control practices aim at managing the canopy and making less conducive climate for the pathogen development. These cultural control strategies could be choosing planting sites that are well-drained, pruning out old canes and clusters from a field before the season begins, planning row spacing and row orientation to favor good air movement, and using overhead irrigation during mornings to allow for leaves and fruit to dry during the day. Additionally, using cultivars that are resistant or less susceptible to the disease is an important management tool. No resistant cultivars are available; however, less susceptible cultivars to bunch rot are available (Table 1).

In fields with a history of *B. cinerea* infection and in areas with climates that are highly conducive for bunch rot, chemical control is essential to be combined with cultural practices. With an open canopy, better fungicide spray coverage and thus better disease control can be achieved. Fungicide spray program from mid-bloom to harvest should prevent disease spread and infection of leaves, flowers and fruit.

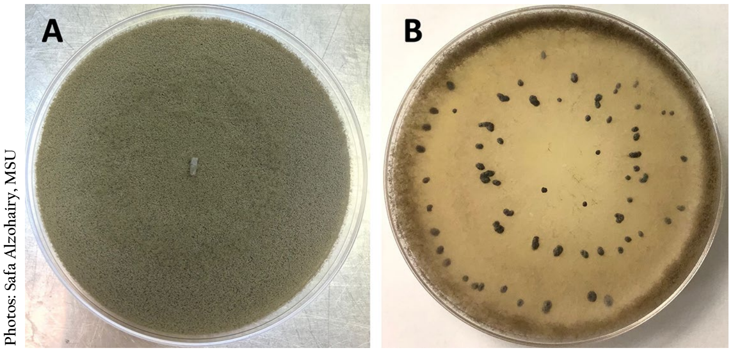
Several fungicide classes are available to control *B. cinerea* including dicarboxamides (FRAC 2), succinate dehydrogenase inhibitors (FRAC 7), aninilopyrimidines (FRAC 9), quinone outside inhibitors (FRAC 11), phenylpyrroles (FRAC 12) and hydroxyanilides (FRAC 17). The proper use of fungicides is critical for the sustainability of these products as *B. cinerea* is a fungus with high genetic variability with a high risk of developing resistance to fungicides. Petri dish bioassays with *B. cinerea* have facilitated research into fungicide resistance to many of the above-mentioned modes of actions and resistance has been reported in several grape growing regions including Michigan (Figure 5).

To reduce the development of resistance:

1) **Do not** make more than two applications per season of a specific FRAC code,

2) **Do not** make two consecutive applications of a specific FRAC code, and

3) **Rotate** with unrelated fungicides in a different FRAC code that have efficacy against bunch rot.



Photos: Safa Alzohairy, MSU

Figure 5. *Botrytis cinerea* culture on clarified 20% V8 media. A. 10-day old culture with gray mold sporulation. B. 21-day old culture showing overwintering black structures (sclerotia).

June 2020