Grape Sour Rot Biology and Management Digital Media Educational Series

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Justification:

Sour rot management is one of the most critical and wide-spread bunch rot issues in European-style wine grapes on the East Coast. When surveyed, vineyard managers in North Carolina, indicated that sour rot was a top reoccurring issue, but management information and resources are severely lacking on the topic. When asked how they would like to see educational materials disseminated, on-line resources ranked highest. Grape-growers' primary request was for video and webinar resources, followed by educational pdf's and web bulletins. The overall objective of this project is to provide growers and extension agents with sour rot management information for the Southeast in the form of webinar videos, an educational pdf, and sour rot web page.

Objectives:

- Develop a video series on Grape Sour Rot Biology and Management
- Develop a 2-page pdf handout on Grape Sour Rot

- Develop a long web-bulletin (hosted at UGA, VT, and NCSU) on Grape Sour Rot

Outline of Outcomes:

Product	Content	Progress	Outreach
Video Webinar Series	2 videos: 1) Titled "Sour Rot: Causes, Concerns, and Coping Strategies" Presented by Dr. Sara Villani. Fruit Fly Slides provided by Dr. Hannah Burrack 2) Titled "Cultural Practices: Sour Rot Management" Presented by Dr. Mark Hoffman	Both videos have been recorded and closed captioned for the hearing impaired. December 27, 2021 editing completed. Videos were posted on NC State Extension YouTube Channel on February 28, 2022.	NCSU YouTube Channel where videos are stored and shared from: Video 1: https://youtu.be/B2s78qqN_mk Video 2: https://youtu.be/6sQVOyX0NNs
3-page Sour Rot Management Guide for the Southeast	Pdf handout on Sour Rot Management for the Southeast that contains the following information: 1) What is Sour Rot? 2) Symptoms and Signs 3) Cultivar Susceptibility Table 4) Cultural Control 5) Chemical Control	Management Guide has been developed by Dr. Sara Villani, Dr. Mark Hoffman, and Karen Blaedow and reviewed by the following co-PI(s): Dr. Phil Brannen, Dr. Tremain Hatch, Dr. Mizuho Nita, and Dr. Megan Hall prior to printing and distribution.	Management Guide for Sour Rot in North Carolina became an official NC State Extension Publication on May 11, 2022. It is available for download and in color print. https://content.ces.ncsu.edu/management-guide-for-sour-rot-in-north-carolina
Web Bulletin	A sour rot web page will be developed to serve as a one stop shop for on-line resources: Video Series, downloadable	Webinar videos and handout have been vetted by co-PIs updated resources were used to create	Web page has been developed that has embedded video series, downloadable Management Guide for Sour Rot in North Carolina as well as additional sour rot resources found in the region.

	Sour Rot Management Guide, University of GA Sour Rot Fact Sheet, Southeast Regional Bunch Grape Integrated Management Guide, Viticulture Management Poster	sour rot resources web page.	https://henderson.ces.ncsu.edu/2022/05/nc-state-sour-rot-management-resources-for-vineyard-managers/ https://grapes.ces.ncsu.edu/resources-muscadine/bunch-grapes/#sour-rot

Potential Impact:

Providing growers and extension agents with the best practices for sour rot management has the potential to lessen the negative economic impacts from reduction in yields and quality caused by sour rot. These educational resources can guide growers to plant less susceptible cultivars, use cultural controls when applicable, and the importance of IPM for overall vineyard health.

Since May 11, 2022 the on-line publication has been downloaded 70 times. The video webinar series has been viewed 36 times and currently has 37 subscribers. Colored prints of the 3-page management guide were distributed to growers at the 2022 Grape Grower's School and Pruning Workshop held at Saint Paul Mountain Vineyards in NC on March 4, 2022 and additional copies will be available for distribution in 2023 at the NC Winegrower's Association Annual Conference.

Final 3-Page Publication:

Management Guide for Sour Rot in the Southeastern, US

NC STATE EXTENSION

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What is Sour Rot?

Sour rot of grapes frequently leads to loss of grapes in North Carolina, and has rapidly emerged as a key threat to grape production in the wet, humid grape production regions of the southeastern United States. *Often initial berry damage is the cause for the development of sour rot.* A combination of invasion by ethanol-producing yeasts and acetic acid bacteria (AAB), fruit flies, and damaged berry skins have been recognized as required agents or conditions for sour rot occurrence. Due to their propensity to crack or break during late-season rains and their greater susceptibility to insect damage, thin skinned cultivars such as 'Riesling' tend to be more susceptible to sour rot. Besides heavy rains and insect damage, wounds can also be caused by hail, wind, bird feeding, mechanical cracks, or invasions by fungal pathogens. The disease also tends to be more severe on cultivars and clones of cultivars that have compact clusters since compaction promotes a more wet and humid microclimate. There are no grape cultivars or clones with resistance to sour rot. Site selection, cultivar selection, canopy management, as well as chemical control are the most important methods to manage sour rot in the vineyard. The first disease symptoms can appear any time between veraison and harvest, usually when fruit brix levels reach or exceed 14-15, and daytime temperatures are warm (66-77F). It is important to understand that many preventative steps can be taken to reduce the risk of sour rot before such Brix level. However, several cultivars (Table 1) are more prone to sour rot than others, and preventative measures will not always mitigate damage. Sour rot results ultimately in a reduction in yield, and a crop that is unsuitable for winemaking.

Figure 1. Common Sour Rot Symptoms and similar looking diseases in North Carolina: (left to right) Sour rot on Riesling, Fruit Flies on Sour rot grapes (see arrows). Botrytis Bunch Rot on Merlot, Ripe Rot on Chardonnay and Bitter Rot.

Symptoms and Signs

The most obvious indication that sour rot is present is the smell of acetic acid (vinegar) coming from a cluster. Berries usually appear deflated and are a mauvetan in color, and symptoms often appear "patchy" within a cluster (Figure 1) While signs of the bacteria and yeast pathogens associated with sour rot are not normally present, secondary invading fungi or other fungal pathogens such as *Botrytis cinerea* (causal pathogen of gray mold) or *Colletotrichum* spp. (causal pathogen of ripe rot), may colonize the infected and degrading fruit and produce salmon, gray, or tan spore masses. Berries may leak due to general berry decay. Fruit flies, attracted to the acetic acid produced by berries, are often present in berries with sour rot. It is important to understand that sour rot management begins before the smell can be detected. Mitigating the disease once the smell is detected in a vineyard is a very challenging endeavor, and often the vineyard manager and winemaker decide to harvest the remaining grapes before more damage can be observed. Experienced vineyard managers know the cultivars that tend to show sour rot in their vineyards and act preventative, e.g. with special attention to canopy management and insect control. In Table 1, we list a variety of cultivars, highlighting in red cultivars that tend to frequently show sour rot in North Carolina.

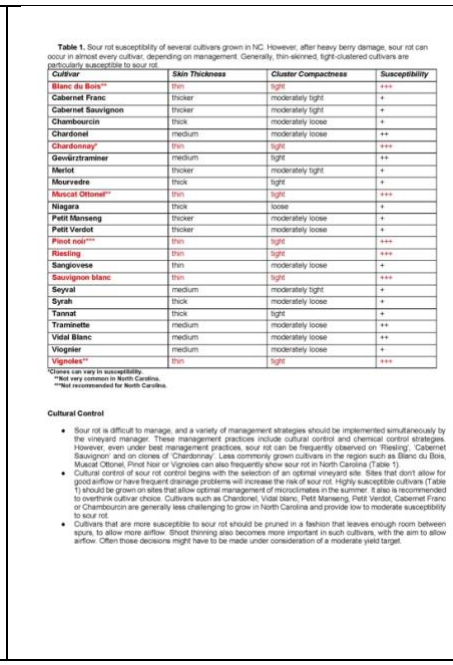


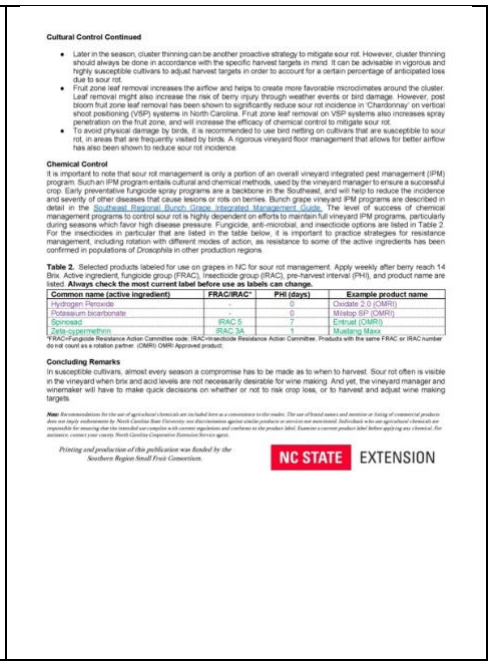
Table 1. Sour rot susceptibility of several cultivars grown in NC. However, after heavy berry damage, sour rot can occur in almost every cultivar, depending on management. Generally, thin-skinned, tight-clustered cultivars are particularly susceptible to sour rot.

Cultivar	*Skin Thickness*	*Cluster Compactness*	*Susceptibility*
Blanc du Bois**	thin	tight	+++
Cabernet Franc	thicker	moderately tight	+
Cabernet Sauvignon	thicker	moderately tight	+
Chambourcin	thick	moderately loose	+
Chardonel	medium	moderately loose	++
Chardonnay*	thin	tight	+++
Gewürztraminer	medium	tight	++
Merlot	thicker	moderately tight	+
Mourvedre	thick	tight	+
Muscat Ottonel**	thin	tight	+++
Niagara	thick	loose	+
Petit Manseng	thicker	moderately loose	+
Petit Verdot	thicker	moderately loose	+
Pinot noir***	thin	tight	+++
Riesling	thin	tight	+++
Sangiovese	thin	moderately loose	+
Sauvignon blanc	thin	tight	+++
Seyval	medium	moderately tight	+
Syrah	thick	moderately loose	+
Tannat	thick	tight	+
Traminette	medium	moderately loose	++
Vidal Blanc	medium	moderately loose	++
Viognier	medium	moderately loose	+
Vignoles**	thin	tight	+++

*Clones can vary in susceptibility.
**Not very common in North Carolina.
***Not recommended for North Carolina.

Cultural Control

- Sour rot is difficult to manage, and a variety of management strategies should be implemented simultaneously by the vineyard manager. These management practices include cultural control and chemical control strategies. However, even under best management practices, sour rot can be frequently observed on 'Riesling', 'Cabernet Sauvignon' and on clones of 'Chardonnay'. Less commonly grown cultivars in the region such as Blanc du Bois, Muscat Ottonel, Pinot Noir or Vignoles can also frequently show sour rot in North Carolina (Table 1)
- Cultural control of sour rot control begins with the selection of an optimal vineyard site. Sites that don't allow for good airflow or have frequent drainage problems will increase the risk of sour rot. Highly susceptible cultivars (Table 1) should be grown on sites that allow optimal management of microclimates in the summer. It also is recommended to overthink cultivar choice. Cultivars such as Chardonel, Vidal blanc, Petit Manseng, Petit Verdot, Cabernet Franc or Chambourcin are generally less challenging to grow in North Carolina and provide low to moderate susceptibility to sour rot.
- Cultivars that are more susceptible to sour rot should be pruned in a fashion that leaves enough room between spurs, to allow more airflow. Shoot thinning also becomes more important in such cultivars, with the aim to allow airflow. Often those decisions might have to be made under consideration of a moderate yield target.



Cultural Control Continued

- Later in the season, cluster thinning can be another proactive strategy to mitigate sour rot. However, cluster thinning should always be done in accordance with the specific harvest targets in mind. It can be advisable in vigorous and highly susceptible cultivars to adjust harvest targets in order to account for a certain percentage of anticipated loss due to sour rot.
- Fruit zone leaf removal increases the airflow and helps to create more favorable microclimates around the cluster. Leaf removal might also increase the risk of berry injury through weather events or bird damage. However, post bloom fruit zone leaf removal has been shown to significantly reduce sour rot incidence in Chardonnay on vertical shoot positioning (VSP) systems in North Carolina. Fruit zone leaf removal on VSP systems also increases spray penetration on the fruit zone, and will increase the efficacy of chemical control to mitigate sour rot.
- To avoid physical damage by birds, it is recommended to use bird netting on cultivars that are susceptible to sour rot, in areas that are frequently visited by birds. A rigorous vineyard floor management that allows for better airflow has also been shown to reduce sour rot incidence.

Chemical Control

It is important to note that sour rot management is only a portion of an overall vineyard integrated pest management (IPM) program. Such an IPM program entails cultural and chemical methods, used by the vineyard manager to ensure a successful crop. Early preventative fungicide spray programs are a backbone in the Southeast, and will help to reduce the incidence and severity of other diseases that cause lesions or rots on berries. Bunch grape vineyard IPM programs are described in detail in the Southeast Regional Bunch Grape Integrated Management Guide. The level of success of chemical management programs to control sour rot is highly dependent on efforts to maintain full vineyard IPM programs, particularly during seasons which favor high disease pressure. Fungicide, anti-microbial, and insecticide options are listed in Table 2. For the insecticides in particular that are listed in the table below, it is important to practice strategies for resistance management, including rotation with different modes of action, as resistance to some of the active ingredients has been confirmed in populations of *Drosophila* in other production regions.

Table 2. Selected products labeled for use on grapes in NC for sour rot management. Apply weekly after berry reach 14 Brix. Active ingredient, fungicide group (FRAC), insecticide group (IRAC), pre-harvest interval (PHI), and product name are listed. **Always check the most current label before use as labels can change.**

Common name (active ingredient)	FRAC/IRAC*	PHI (days)	Example product name
Hydrogen Peroxide		0	Oxidate 2.0 (OMRI)
Potassium bicarbonate		0	Milstop SP (OMRI)
Spinosad	IRAC 5	7	Entrust (OMRI)
Zeta-cypermethrin	IRAC 3A	1	Mustang Maxx

*FRAC=Fungicide Resistance Action Committee code; IRAC=Insecticide Resistance Action Committee. Products with the same FRAC or IRAC number do not count as a rotation partner. (OMRI) OMRI Approved product.

Concluding Remarks

In susceptible cultivars, almost every season a compromise has to be made as to when to harvest. Sour rot often is visible in the vineyard when brix and acid levels are not necessarily desirable for wine making. And yet, the vineyard manager and winemaker will have to make quick decisions on whether or not to risk crop loss, or to harvest and adjust wine making targets.

Note: Recommendations for the use of agricultural chemicals are included here as a convenience to the reader. The use of brand names and mention or listing of commercial products does not imply endorsement by North Carolina State University nor discrimination against similar products or services not mentioned. Individuals who use agricultural chemicals are responsible for ensuring that the intended use complies with current regulations and conforms to the product label. Examine a current product label before applying any chemical. For assistance, contact your county North Carolina Cooperative Extension Service agent.

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