Grape Sour Rot

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UNIVERSITY OF GEORGIA EXTENSION

Introduction

Although the grape sour rot disease complex can occur in drier climates, sour rot tends to be especially problematic during wine grape ripening in wet, humid regions. Browning and disintegrating berries and the aroma of vinegar (acetic acid) are a few symptoms that characterize grape sour rot. Sour rot ultimately results in crop yield reduction as damaged berries often "shatter," or fall off the clusters. Sorting out clusters with sour rot that are not suitable for winemaking causes a further reduction in return revenues as less wine is produced. Although it has only recently been a topic of defined research, sour rot is a prominent concern in Eastern U.S. vineyards as: (1) it is consistently observed in vineyards, particularly in white-berried cultivars; and (2) questions remain about how to best manage it, particularly with the threat of insecticide resistance development in targeted fruit flies (Loeb and Walter-Peterson, 2019).

The mechanism of infection and role that multiple causal organisms play in sour rot etiology are not fully understood. However, grape sour rot has been described by Hall *et al*. (2018a) as a disease that only exists in the presence of damaged fruit, ethanol-producing yeast (*Metschnikowia* species, *Pichia* species, and *Saccharomyces* sp.), acetic acid bacteria (*Acetobacter* sp. and *Gluconobacter* species) (AAB), and *Drosophila* species (fruit flies). Sour rot infections appear to be a function of AAB, yeast, and fruit flies on damaged grape berries that encourages disease progression throughout the entire cluster as ripening progresses. Secondary or simultaneous invasion from fungal pathogens like *Botrytis cinerea* can be observed in sour-rotted clusters (Figure 1).

Figure 1. *Drosophila* species (left) and *Botrytis* bunch rot (right) on sour rot infected clusters. Note the fungal growth, which is not part of the sour rot complex but exacerbates the damage.

Left photo: Wendy McFadden-Smith, OMAFRA

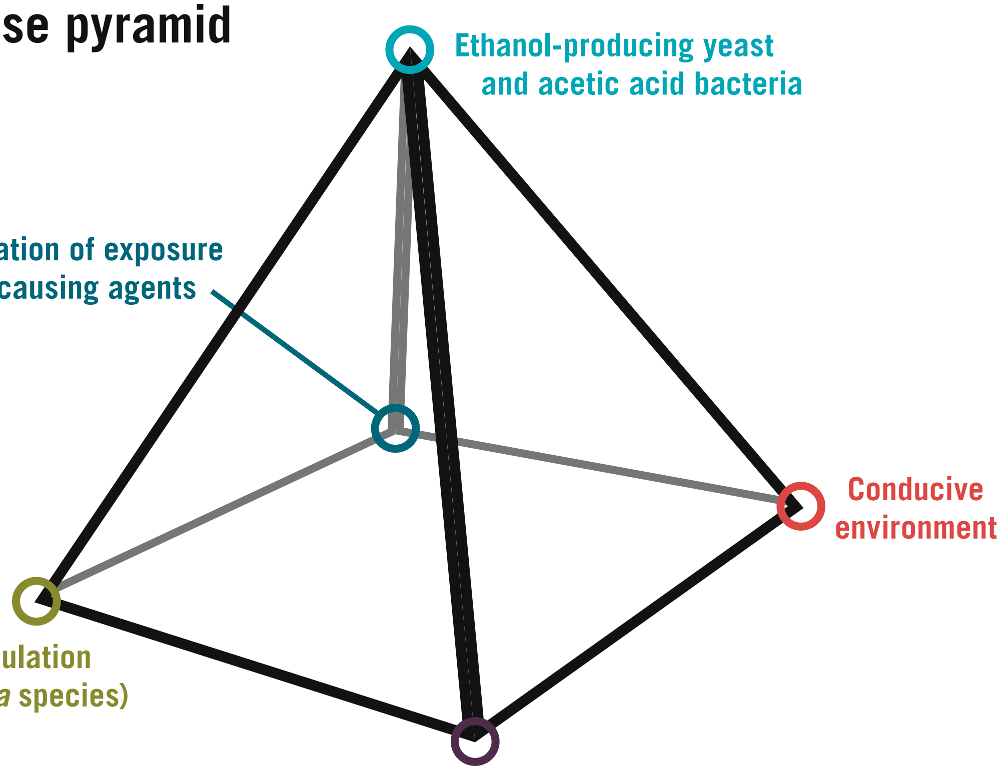

Figure 2. The sour rot disease pyramid portrays the disease-causing agents that researchers currently believe cause grape sour rot. The pyramid's points include susceptible grapevine berries, a *Drosophila* species vector, an ethanol-producing yeast, AAB, a conducive environment for pathogens, and time and duration of exposure to the disease-causing agents.

Range and causal conditions

Grape sour rot is especially prevalent in wet, humid environments, like those observed in the Eastern U.S. All four of the major disease components (damaged fruit, yeast, bacteria, and fruit flies) are often present in Eastern U.S. vineyards. The sour rot disease pyramid (Figure 2) portrays the disease-causing agents that are currently understood to cause grape sour rot. Sour rot symptoms generally begin when berries are around 15 Brix (Figure 3) and daily temperatures are at least 68 °F (Hall *et al.* 2018a). The disease infiltrates through damaged berry skins (Figure 4). Thin-skinned, tight-clustered cultivars (e.g., 'Vignoles', 'Sauvignon blanc', 'Blanc du Bois') are at the greatest risk when compared to those that are thick skinned and loose clustered (e.g, 'Petit Manseng' and 'Petit Verdot'), although field observations of 'Chardonnay' suggest that clones can vary in their susceptibility to sour rot, possibly related to cluster morphology. Due to the ease with which insects can penetrate thin-skinned cultivars, these cultivars experience greater insect damage, which can manifest in increased sour rot. In addition, thin-skinned cultivars have a propensity to crack with an influx of water due to late-season rains. Regardless of cultivar, rainy and cloudy conditions exacerbate sour rot symptoms. Sour rot levels can increase when harvest is delayed late into the fall in an attempt to increase Brix, when the only fruit compositional changes may be increased pH and decreased acidity.

Figure 3. Sour rot infection early in ripening (~15 Brix).

Symptoms and identification

Barata *et al*. (2012) has suggested that damage to berries allows sour rot to initiate. The causal agent of the damage is not relevant to sour rot, but any damage results in exploitation of the berry pulp by fruit flies, AAB, and yeast. Fruit flies are attracted to the damaged berries, and thus act as vectors that transport AAB and yeast to injury sites in unaffected fruit clusters (Barata *et al*., 2012). Sour rot is then initiated through uncontrolled fermentation of the berry juice into ethanol. Ethanol is oxidized by AAB into acetic acid, which then turns the fruit shades of brown and causes the pulp to liquefy and emit a sour vinegar aroma, giving the disease its name. In fact, the smell of vinegar permeates the air and is indicative of sour rot. Damaged and rotting fruit attract more fruit flies that continue the cycle by spreading the AAB and yeast to unaffected fruit. The fermented pulp can also ooze and drip onto the other berries within the cluster, spreading the infection to previously undamaged berries. Sour rot can be visually distinctive, with deflated tan to brown berries and no obvious fungal structures (Figure 4 and Figure 5), though the disease can often coincide with *Botrytis* bunch rot infections (Figure 1). Sour rot can resemble sunscald, but the scent of acetic acid is a diagnostic key to identifying this disease complex.

Figure 4. 'Vidal blanc' with damaged skins and sour rot symptoms.

Figure 5. Sour rot symptoms on 'Chardonnay'. Sour rot can manifest as browned berries with no fungal infections (left), but the vinegar smell is diagnostic of this rot complex.

Management

Sour rot has been historically difficult to manage. The disease complex, its environmental requirements, and the factors that cause sour rot are still in question by plant pathologists. This lack in knowledge has limited effective chemical management options until recently. Planting cultivars that have been observed to be less susceptible to sour rot, such as *vinifera* cultivars like 'Petit Verdot' and 'Cabernet Sauvignon', hybrid cultivars like 'Chambourcin' and 'Chardonel', and Pierce's disease-tolerant hybrid cultivars like 'Norton' and 'Lomanto', use the advantage of genetics to mitigate sour rot development in the vineyard. Further, judicious harvest decisions appear to be important to limit sour rot incidence. As grapes are left on the vine, grape berries tend to become softer, acidity declines, and pH increases; sour rot has been observed to increase over time in the post-veraison period. Some cultivars, like "aromatic" whites (e.g., 'Blanc du Bois', 'Sauvignon blanc', 'Muscat ottonel') often have varietal character at relatively low Brix levels. It is therefore important to weigh risks: do you want to risk crop loss and/or reduced wine quality due to sour rot? Or do you want to harvest a full crop and use winemaking tools to modify must composition to produce a well-balanced, finished wine? Only one choice can be made in certain cultivars in some vintages.

Sour rot can be partly managed through cultural practices that improve air movement and spray penetration to the fruit zone. Management strategies should focus on creating an environment that limits one or more of the disease-causing factors, such as controlling or mitigating fruit fly infestations, preventing berry damage, choosing a trellis style that reduces canopy density, and managing the canopy to optimize spray penetration and evaporation rates. Canopy management can decrease disease pressure; Hall *et al.* (2018b) documented higher disease severity in research plots with denser canopies and less managed vineyard floors. Similarly, Blaauw *et al.* (2019 and 2020) and Hickey *et al.* (2018) documented a decrease in sour rot incidence and severity with fruit zone leaf removal in 'Chardonnay'. Good weed management and carefully mowed row middles will also increase air flow and reduce canopy/fruit drying times.

In addition to cultural practices, a chemical program using antimicrobials and insecticides directed at controlling yeast, AAB, and fruit flies can further minimize risk of sour rot (Hall *et al.* 2018b). For example, weekly applications of insecticides and antimicrobial sprays (commencing at 15 Brix) resulted in a 64% reduction of sour rot severity when compared to untreated vines (Hall *et al.* 2018b). However, ongoing work suggests that less frequent sprays of insecticides and antimicrobials after 15 Brix will help regulate sour rot. As with the control of many vineyard diseases, an integrated approach that combines cultural and chemical programs will optimize sour rot management. However, recent work (Loeb and Walter-Peterson, 2019) suggests that it is important to use insecticides judiciously in order to reduce the incidence of resistance buildup in fruit flies and other insects. Resistance management should involve effective rotations of insecticides and fungicides with different modes of action.

Summary

Grape sour rot is a disease complex characterized by the smell of acetic acid and browning of grape berries. As berries ripen, the grapes begin to ooze rotting pulp. Fruit flies, which are attracted to damaged berries, are an important vector for the AAB and yeast that incite the disease. Management options are limited, but it is possible to minimize sour rot damage. Canopy management is important to prevent excessive shading, improve air flow, and increase chemical deposition to the fruiting zone. Limiting mechanical and insect fruit damage is also key in reducing the effect of the disease components. The addition of an insecticide and antimicrobial chemical program directed toward limiting sour rot casual agents (AAB, yeast, and fruit fly) will provide significantly better control than using only one form of disease management. Finally, scouting and harvesting before sour rot incidence and severity peaks will reduce the need to sort fruit and limit microbe introduction into winemaking facilities.

References

Barata, A., Santos, S. C., Malfeito-Ferreira, M., & Loureiro, V. (2012). New insights into the ecological interaction between grape berry microorganisms and *Drosophila* flies during the development of sour rot. *Microbial Ecology, 64*(2), 416–430. https://doi.org/10.1007/s00248-012-0041-y

Blaauw, B. R., Hickey, C., & Brannen, P. M. (2019). Review of IPM strategies to improve sour rot management in Georgia bunch grapes, 2018. *Plant Disease Management Reports, 13*, PF031.

Blaauw, B. R., Hickey, C., & Brannen, P. M. (2020). Review of IPM strategies to improve sour rot management in Georgia bunch grapes, 2019. *Plant Disease Management Reports, 14*, PF012.

Hall, M. E., Loeb, G. M., Cadle-Davidson, L., Evans, K. J., & Wilcox, W. F. (2018). Grape sour rot: A four-way interaction involving the host, yeast, acetic acid bacteria, and insects. *Phytopathology, 108*(12), 1429–1442. https://doi.org/10.1094/phyto-03-18-0098-r

Hall, M. E., Loeb, G. M., & Wilcox, W. F. (2018). Control of sour rot using chemical and canopy management techniques. *American Journal of Enology and Viticulture, 69*(4), 342–350. https://doi.org/10.5344/ajev.2018.17091

Hickey, C., White, R., Vogel, A., Brannen, P., MacAllister, C., Eason, N., Patrick, S., & Scaduto, J. (2019). Fruit zone leaf removal regulates sour rot and *Botrytis* bunch rot in Georgia-grown Chardonnay. *Plant Disease Management Reports, 13*, PF024.

Loeb, G. M., & Walter-Peterson, H. (2019, September). Managing fruit flies for sour rot in 2019. *Lake Erie Regional Grape Program Newsletter*, 6–8. https://nygpadmin.cce.cornell.edu/pdf/newsletter_notes/pdf116_pdf.pdf

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Circular 1212 **Reviewed July 2023**

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