

Blackleaf in Grapes

Washington State grape production is increasing yearly, due to more efficient production practices. Despite improvement in production methods, physiological disorders can reduce yields. Blackleaf is one such physiological disorder, and can be a recurring problem in Concord (*Vitis labruscana*) and to a lesser extent in winegrapes (*Vitis vinifera*).

Blackleaf was originally believed to be caused by potassium deficiency, but attempts at recreating symptoms have proven unsuccessful. Blackleaf is a leaf discoloration or "blackening" often observed on the upper leaf surface, while potassium deficiency is exhibited by blackening in leaf margins. Applications of soil and/or foliar potassium to blackleaf-affected grapevines do not completely alleviate symptoms. Recent research has indicated that blackleaf is due to a combination of water stress and high UV-B radiation that is often sustained in many growing areas of eastern Washington State.

Symptoms

Blackleaf is characterized by a general darkening of grapevine leaves in the outermost layer of the canopy. Leaves in the outer canopy layer often display a darkened appearance or "blackening" of the leaf surface. This disorder appears to affect exposed leaf surfaces, specifically in the epidermis. The color ranges from brown to purple or black, resulting in the "black" canopy character. Symptoms can range from none to severe (Figures 1–4), and can



Figure 1. Green healthy leaf in a Concord (*Vitis labruscana*) vineyard showing no symptoms of blackleaf.



Figure 2. Mild symptoms of blackleaf in Concord (*Vitis labruscana* L.). Necrotic areas are developing between secondary veins in the leaf.



Figure 3. Moderate symptoms of blackleaf in Concord grapes. Necrotic areas are darkening in their intensity as symptoms worsen.



Figure 4. Severe symptoms of blackleaf. The leaf margins become dry and brittle before leaves abscise from the vine (inset).

Table 1. Classification of Blackleaf Symptoms in Vineyards.

Classification	Symptoms	Distribution
None	None – Mild	None to Dispersed
Mild	Mild	Occasional
	Medium – High	Dispersed (<10%)
Medium	Medium	Intermittent
	High	Dispersed (10-50%)
Severe	High	Widespread (>50%)

vary spatially and temporally in the vineyard (Table 1). It is important to note that once symptoms are visible, damage has already occurred earlier in the season.

Blackleaf symptoms often become visible around veraison (late July–August), although evidence from research suggests that the actual disorder affects grape leaves soon after fruit set. In affected leaves, chlorophyll is damaged and photosynthesis is reduced. In extreme cases, this leaf damage may adversely affect sugar accumulation toward harvest. Severe cases of blackleaf can result in vine defoliation. Vines that suffer severe blackleaf for a number of successive years are likely to decline, losing vigor and productivity. In extreme cases, vines will die.

Causes

Early water deficit, often referred to as Regulated Deficit Irrigation (RDI), has been used in some vineyards to control shoot growth. However, this early season water deficit has been linked to higher incidences of blackleaf development. Water deficits may lead to vine stress, degradation of chlorophyll, and, ultimately, blackleaf.

Excess solar radiation in the form of UV-B rays can damage photosynthetic systems

in the leaf, leading to necrotic areas. The low relative humidity and generally cloudless conditions common in Eastern Washington during the growing season result in a high UV-B environment. In affected grapevines, chlorophyll concentration is reduced, both in green and black tissues on the vine.

Effect on the Vine

Chlorophyll content in vines affected with blackleaf is reduced, and can result in lower



Figure 5. Epidermal cells are discolored in blackleaf-affected Concord leaves. This is a result of chlorophyll degradation and necrosis within the layer below the epidermis (mesophyll). *Photo: Markus Keller*



Figure 6. Necrotic areas also appear on the underside of blackleaf-affected leaves. *Photo: Markus Keller*

Table 2. Do's and Don'ts of Blackleaf Prevention.

Issue or Cause	Do	Don't
Nutrition	Fertilize according to soil or tissue test results.	Do not add excess potassium.
Water Management	Maintain adequate moisture above the permanent wilting point, but below field capacity.	Do not water stress vines, especially early in the growing season for Concord vines. Wine grape vines may be water stressed as part of an overall canopy management program.
Light	In perennial problem areas, consider using a sunblock spray (i.e. kaolin clay based product), beginning around bloom. Do encourage adequate light distribution throughout the canopy.	Do not encourage poor canopy development by excessive or inadequate pruning.



Figure 7. Severe blackleaf symptoms may sometimes lead to early defoliation.



Figure 8. Leaves affected by blackleaf may affect fruit ripening, especially if these are in close proximity to developing fruit.

photosynthesis rates. Leaves that are severely affected can develop necrotic (dead) areas, and may eventually abscise from the grapevine. The damage caused by destruction of leaf chlorophyll can reduce photosynthesis rates during an important time period in berry development. Leaves must be green and healthy to maximize photosynthetic rates and sugars that are produced. Reduction of photosynthetic capacity can reduce sugars that are available for berry sugar accumulation. In addition, if photosynthetic damage is severe, arrested sugar accumulation may develop, resulting in low sugar content of the berry. Over time, vine decline may occur. In extreme cases, this vine decline may cause the death of individual vines.

Blackleaf Prevention

Adjustments in vineyard management will depend upon whether the cause of blackleaf is a nutrition, water management, or light issue (Table 2). Often, two or all three of these issues may be a factor in blackleaf incidence, so be sure to address all of the issues when attempting to prevent blackleaf.

Summary

Blackleaf is a physiological disorder in which the top layer of leaves exhibit a blackened appearance. Blackleaf most often affects Concord grape vineyards, but may also affect *vinifera* vineyards to a lesser extent. Although potassium deficiency has been suggested as a cause of blackleaf in the past, attempts to recreate blackleaf symptoms have been unsuccessful. Recent research has shown that blackleaf can be attributed to both water stress and overexposure of the canopy to high UV-B radiation, resulting in damage to the photosynthetic apparatus in the leaf. This can cause a reduction in

photosynthetic rates, leading to less sugar accumulation and possibly delayed ripening. Blackleaf can be prevented by addressing three critical issues in vineyard management. Nutrition and water management play an essential part in canopy management, which determines light interception. In vineyards with perennial problems, canopy management in addition to the use of a sunblock product can reduce the incidence of blackleaf.

Photo credits: Lynn Mills, Mercy Olmstead, Markus Keller



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