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# Grapevine Frost/Freeze Damage I: Background and Prevention

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Damage from low temperatures in early spring when grapevines are initiating their growth is a risk to sustainable/profitable wine grape production in the Eastern US. The majority of Maryland vineyards do not experienced a significant amount of freeze damage annually, in a major part due to proper site selection. However with the extremes of weather experienced over recent years, Maryland vineyards are at increased risk. This “TimelyVit” will give an overview of how timing and conditions of frosts/freezes during early growth can influence the level of damage. For information on how to manage your vineyard after a frost event, please see the subsequent TimelyVit, **Grapevine Frost Damage II: Management, Compensation and Potential Options** and other TimelyVits at <https://extension.umd.edu/smallfruit/grapes/timely-viticulture>.

### The Deacclimation Process

- Grapevine buds attain their maximum cold hardiness in midwinter (late December-early January) but in late-winter through early spring, buds deacclimate in response to milder temperatures.
  - Spring deacclimation is typically more rapid than the acclimation process.
- As vine tissues gradually gain water and "sap flow" occurs, swelling bud tissue becomes vulnerable to freeze injury at only a few degrees below freezing.

### Practices that influence damage

The best practices in vineyards on frost vulnerable sites include the following:

1. Do not cultivate the soil! Cultivating reduces soil heat accumulation during the day and enhance radiation heat loss at night. It is best to mow between-row grass or cover crop, as it provides a surface insulation to the soil.
2. Utilize cane pruning instead of cordon/spur pruning.
3. If you spur prune, pre-prune to long spurs. Bud break will first occur on tops of long canes (which will ultimately be cut off) and delay bud burst of buds at basal nodes which you want to retain for the crop. Prune to final spur/bud-count when all danger of frost has passed.
4. Retain ‘spare parts’ as extra canes with extra buds as insurance. If no frost occurs, eliminate extra buds.
5. Utilize a training system that raises the fruiting zone well above the soil level. A high cordon/curtain system may be best (compared to VSP) at a site with frost concerns.
6. Monitor temperatures to determine frost probability and whether available protections are justified.

### Varietal and tissue differences

- Grape cultivars vary in date of bud burst up to 2 weeks. Coordinate cultivar selection and location with frost risk and preferred location (aspect, slope, and/or elevation) within the vineyard.

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Dormant

- Cold-hardy cultivars de-acclimate faster than less cold-hardy cultivars which occasionally can result in freeze injury in the springtime even in hardier cultivars.
- There are differences among cultivars in susceptibility/resistance that are not explained by development stage differences. At the same stage of phenology and same temperature there may be differences in damage. This means that both phenology and critical temperature differences can be considered with regard to cultivar choice.
- The conditions of the cold and the plant development stage will determine if and how much frost damage may occur. With some variance due to wind speed, cloud cover, and the relative dryness of the air, the temperatures (degrees F) that will damage grape buds are: dormant bud <20°F; dormant swollen = 26°F; burst bud = 28°F; one leaf unfolded = 28-29°F; two leaves unfolded = 29-32°F.

### Types of freeze events

There are 3-types that can cause damage in vineyards in Maryland and protection capability will depend on the type of freeze. These include:

1. A **radiation** freeze is characterized by still air and clear skies where air stratifies near the ground and radiant heat loss occurs from the ground and vine tissues.
2. An **advection** freeze is characterized by a mobile front moving through and cloud cover. There is no air stratification and no radiant heat loss.
3. A **radiation-advection** freeze combines the characteristics of the 2-freezes and is most damaging.

### Preventing Damage

Technologies exist to protect vines from freeze damage, however economic, practical and environmental considerations limit their application. Prevention through proper site selection is the best weapon to keep frost concerns to a minimum.

- “Sprayable” (fertilizers, sugars, pesticides) frost avoidance products have had inconsistent effects.
- During a **radiation** freeze the air is stratified (cold air close to ground; warm air aloft) so there is a greater probability that freeze mitigation techniques may be effective.
- Aerial wind machines and even helicopters can be used during temperature inversions to mix warmer above-ground air with cold air, thus raising temperatures above bud-injuring levels at the trellis. Amount of warming and acreage covered depends on the type of machine.
- Heaters are generally considered to be too expensive due to high fuel costs and there is a danger of environmental contamination through the spillage of fuel and air pollution.
- Overhead sprinklers or evaporative cooling works on the basis of the heat of fusion: water changing from the liquid phase to solid (ice) phase releases a small amount of heat which can raise the temperature of grapevine tissues. Although the method seems straightforward, a thorough understanding of the influence of dew point, water temperature, and wind speed on temperatures is necessary to be effective. Large volumes of water are required for this method and improperly operated sprinklers can cause more damage than no treatment.

The following resources were utilized in this “TimelyVit.” For more information on freeze injury:

- *Frost Injury, Frost Avoidance, and Frost Protection in the Vineyard*. Ed Hellman, Texas AgriLife Extension
- *How Grapevine Buds Gain and Lose Cold-Hardiness*. Tim Martinson, Cornell University
- *Factors Related to Spring Frost Damage: What Are the Options*. G. Stanley Howell, Michigan State University

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