Cold Injury in Grapevines

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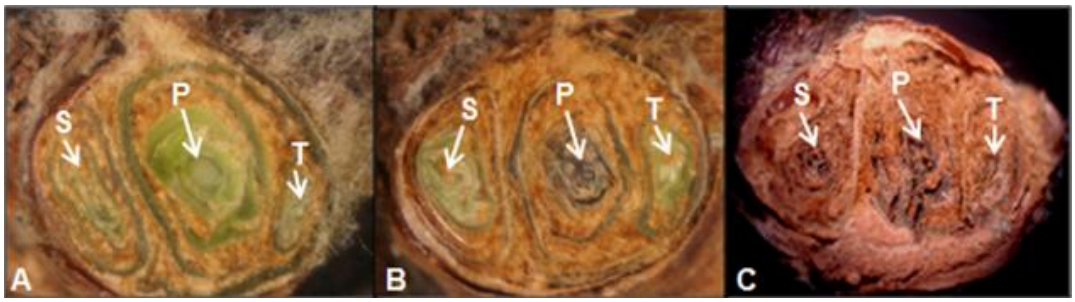
There are many limiting factors to grape production, but one of the most challenging is that of winter cold damage. Different grape cultivars, depending on parentage, have different levels of cold hardiness. *Vitis vinifera* tends to be very sensitive to low winter temperatures and rapid changes in temperature, and even within *V. vinifera,* different cultivars acclimate and deacclimate to winter temperatures in different ways. Beyond these traditional wine grape varieties, hybrids such as those originating out of the University of Minnesota Grape Breeding Program are extremely cold hardy. There are also various viticulture techniques, such as irrigation strategies and use of rootstocks and other root manipulation techniques, that can help vines optimize their cold hardiness.

Assessing Grapevine Cold Injury

Assessing cold damage can be done in many ways. Please check the Recommended Resources section for additional, region-specific information.

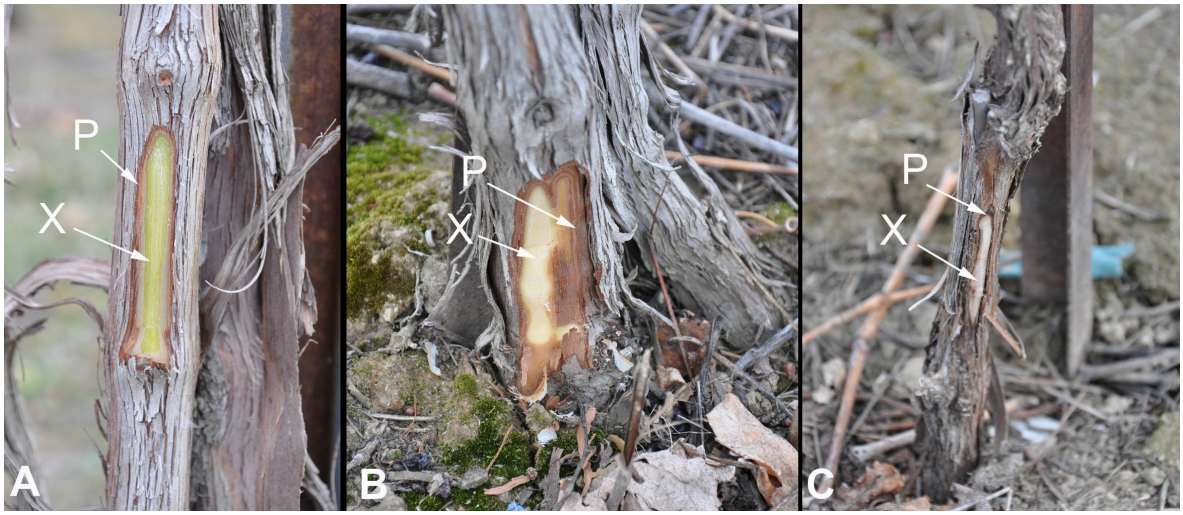
Bud injury: Hans Walter-Peterson, extension viticulturist at Cornell University, has a series of videos that show how to assess bud damage.



Cross sections of grapevine compound buds showing the location of primary (P), secondary (S), and tertiary (T) buds. A) All three buds are alive; B) P bud is dead, S, T buds are alive; C) All three buds are dead. Photo from Assessing and Managing Cold Damage in Vineyards, Washington State University.

Typically, a collection of several canes is made before pruning, and 30-100 buds from cane positions that will be retained (e.g., first 2-4 buds for spur-pruned; first 6-10 node positions for cane-pruned vines) are cut (see photo), the number of live and dead primary (and sometimes secondary) buds is counted, and the percentage of dead buds is calculated. This information can then be used to determine how many extra buds need to be retained to compensate for winter injury.

Trunk and cane injury: Trunk injury is harder to determine. Severe damage can cause splitting in large woody parts, and may result in the expression of crown gall symptoms in infected plants, and dessication of the live phloem and vascular cambium cells. Injury to vascular tissue can also occur without apparent trunk splitting, resulting in poor growth or subsequent vine collapse later in the growing season.



Trunk cold injury can be challenging to assess. A) Dead phloem but healthy, green xylem is visible; B) Dead phloem and damaged xylem (milky-white) is visible; C) Both the phloem and xylem are dead. Photo from Assessing and Managing Cold Damage in Vineyards, Washington State University.

Managing Cold Injury

Cold injury is often difficult to prevent. In some regions, wind machines have proven effective in warming air surrounding buds to above injury-inducing levels, particularly where temperature inversions and radiative freezes are most common. Hilling up soil over graft unions protects scion buds from fluctuating air temperatures, and provides growers with the means to renew trunks after injury occurs. For transient spring freezes, sprinkler systems can be used to protect buds until temperatures rise above freezing during the daytime. Reactive strategies for managing cold injury include leaving extra buds to compensate for winter-injured buds, retaining multiple, differently-aged trunks and renewing them frequently. Observing weak trunks and planning for their replacement is a key element in recovering from significant trunk injury.

Managing cold injury is very region specific. Please see Recommended Resources or your local extension specialist for more information.

Cold Hardiness Monitoring Programs

There have been recent research efforts in monitoring cold hardiness for various grape cultivars. These efforts test the thresholds for bud, phloem, and xylem damage levels throughout the state. Most notable are the Washington State University Cold Hardiness Monitoring Program and the Cornell University Cold Hardiness Monitoring Program. Monitoring programs can help determine pruning strategies or assess whether mitigation actions need to be taken. In addition, Washington State University also has a Cold Hardiness Model available for the state. It provides the estimated critical low temperature thresholds for bud damage of over 20 wine and juice grape cultivars based on the locally observed temperature for each weather station. These thresholds represent temperatures that would kill 10%, 50%, and 90% of the primary buds for each particular cultivar. The model also predicts how the cold hardiness of the selected cultivar is changing in response to local temperatures as the dormant season progresses. If a temperature threshold has been reached, a warning statement indicating the level of damage is provided.

Recommended Resources

Winter Injury to Grapevines and Methods of Protection, *Tom Zabadal, Michigan State University*

Anatomy of Grapevine Winter Injury and Recovery, *Cornell University*

Assessing and Managing Cold Damage in Vineyards, *Washington State University*

Assessing Winter Injury, *Cornell University*

Protecting Grapevines from Winter Injury, *Pacific Northwest Extension Publication (OR, WA, ID)*

Assessing Bud Injury video, Part 1 and Part 2, *Cornell University*

Frost Injury, Frost Avoidance, and Frost Protection in the Vineyard

Cold Climate Grape Production

Northern Grapes Project

Using Wind Machines for Frost Protection, University of California

Cold Hardiness Model video, *Washington State University*

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