

What to do when your vineyard has been damaged by frost?

Grapevines are sensitive to freezing temperatures during the growing season; spring frost frequently damages opening buds and young shoots, and in some regions early fall frost can defoliate vines before harvest. There is some variation among cultivars, but the LT50 (lethal temperature of 50% of subjects) of Pinot noir was 26°F for green swollen buds, 28°F at bud burst, 29°F at two-leaf stage, and 30°F at 4-leaf stage (Sugar et al., 2003). Freeze damage among buds at different stages often varies within a vineyard and even within a single vine. Death of a primary shoot usually results in subsequent development of a shoot from the secondary growing point. Most cultivars do not have good (or any) fruit production from secondary shoots, although some grape cultivars, especially French hybrids, may produce 50% of a normal crop or more from secondary buds and non-count basal buds. Growing conditions during flower cluster initiation in the previous year influences fruitfulness of both primary and secondary shoots. (Ed Hellman, Texas Agri-Life Extension. <https://grapes.extension.org/frost-injury-frost-avoidance-and-frost-protection-in-the-vineyard/>)

Low temperatures across the state on night of April 14 caused damage in many Tennessee vineyards. Unfortunately, another round of cold temperatures, perhaps lower than those on the 14th are forecast for the night of Apr. 15. Damage is reminiscent of the April 2007 Easter freeze, although that event was far more devastating than what we just experienced.

Based on what I have seen in grapes and other fruit crops following a frost event, do not be too hasty to judge the status of the crop. It will take a minimum of several hours to a couple days following the freeze event to get a decent idea on the extent of damage in most cases. I have seen peach growers give up on their crop following a frost only to find out later that there was still a fair crop in the orchard. Unfortunately, by the time they had discovered this, diseases and insects had destroyed whatever crop had gotten by the frost.

There are numerous references regarding frost prevention and protection in grapes and other fruit crops. However, there are not many good articles on what to do following a frost event. One such article, titled, "My Grapevines Have Been Frosted – What Now?" does a good job of outlining various scenarios based on damage suffered. I would like to use it, along with some personal observations and thoughts to address the situation.

Frost Damage in Spring:

- Damage may not be immediately noticeable. It may take several days of clear, sunny weather to get a better idea of the extent of damage.
- New growth will wilt once the frost thaws. With time, shoots may turn black and take on a water-soaked appearance.
- Frost damage to the flower head may not be immediately apparent. After several days, they may begin to dry out and start to fall off, especially when touched. Figuring out what to do following frost damage will depend on the severity of the damage, the type and variety of the grape:

Severe damage:

- All green shoots will have been killed back to the cordon or cane. No remedial action is needed. Vines should be allowed to grow out new shoots.
- Secondary buds will develop and, depending on the type and variety of grape, a partial crop may be produced. American bunch and *V. vinifera* grapes are considered to be relatively unfruitful on secondary buds. With them, expect about a 25% crop or less. French-American hybrids tend to be more fruitful on secondary buds than other types of grapes. Certain varieties, such as Seyval, appear to be highly fruitful on secondaries.
- Secondary shoot growth should be adequate to establish spurs and new canes for the subsequent year.
- If the frost damage occurred before shoots were at the 5-leaf stage (Modified Eichhorn Lorenz system (EL) 12, expect minimal impact on bud fruitfulness in the following year as shoot growth will have adequate time to produce fruitful buds during the current growing season. The Modified Eichhorn Lorenz system was developed for identifying major and intermediate growth stages on grapevines (<http://door.uwex.edu/files/2010/10/ModifiedEichhornLorenzsystem.pdf>).
- If frost occurred after the shoots are at the 8-leaf stage (EL 15), reduced bud fruitfulness has been observed in the following season.

Moderate to low frost damage:

- When frost damage occurred before the EL 12 stage (defined as 5 leaves separated, shoots about 4 inches in length and a clear inflorescence) and shoots were not killed completely back, rubbing out the buds to force secondary buds may be an option.
- Where damaged shoots are not removed, a proliferation of lateral shoots may develop. The resulting laterals will not be well-placed and they may not develop into good quality canes for cane pruning.
- Before stage EL 12, shoots can be easily broken off spurs or canes without damaging dormant secondary buds at the base of the shoot.
- When frost occurs after EL 15 (8 leaves separated, shoots elongating rapidly, single flowers in compact groups), no action is suggested as shoot removal at this time can result in damaged secondary buds and reduction in current season yields as opposed to doing nothing.

Options for responding to frost damage on vines:

Stored energy reserves in the vine were partially depleted to support the new growth and new growth had not progressed to the point that it was contributing to the vine. Therefore, subsequent regrowth on vines is apt to be weaker than with the first flush of growth. Efforts should be expended to keep these shoots healthy. Pay attention to insect and disease control programs.

The three options for responding to damage include:

1. No action.

- a. Once vines have reached stage EL 15 (8 leaves separated, rapid shoot elongation and single flowers appearing in a compact group), taking no action appears to be the best approach as these vines are apt to yield more than vines that were cut back or had shoots removed.
 - b. This is the best option where shoots were killed entirely.
 - c. The potential for disease in the canopy, especially botrytis, goes up due to the dead material remaining in the canopy.
 - d. Reduction of fruitfulness in buds retained from pruning may occur. Checking for bud fruitfulness in winter may warrant adjusting pruning levels.
2. Removing damaged material only:
 - a. Appears to have no advantage over doing nothing.
 - b. Cutting the tops off green shoots stimulates secondary bud break lower on the shoots. These shoots are not very fruitful and they can cause issues with pruning.
 - c. A late ripening, secondary crop can cause issues at harvest.
 - d. Differences in branch number, yield and growth are no different than where no action was taken.
 3. Removing all shoots back to the cordon:
 - a. Consider if shoots are less than 5 leaves (EL 12) and there is a desire to keep good quality pruning material for next year.
 - i. Shoots may either be rubbed off using gloves or mechanically by brushing or rubbing.
 - b. Current season's yields may be less than taking no action, but greater the following season.
 - c. The more advanced that shoot growth is, the more potential there is to damage secondary buds at the base of shoots being removed.
 - d. Late shoot removal results in reduced bud fruitfulness next year.
 - e. Removing all shoots removes dead material which decreases the risk of diseases.
 - f. Canes may be better quality and better placed than where no action was taken.

In marginal frost damage situations where not all the primary buds were killed, secondary buds may still develop and form clusters. This could cause complications at harvest as the optimal time to harvest the primary bud crop will come well before the secondary bud crop is ready to be harvested. Solutions may include cutting off either the primary bud crop or the secondary bud crop before harvest time or multiple harvests.

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April 15, 2020