

Spring Frost Update:

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April was one of the warmest months on records this year. Warmer temperatures were more than ideal for vines to break their buds earlier than normal. And that indicated a disaster was about to happen from the beginning of April through mid May. This period is the typical frost threat from southern to northern Ohio, respectively. During that period, vineyards in Ohio experienced one or multiple (up to 4) major frost events. The last one on May 10th, 2010, was the most devastating to our industry in northeast Ohio, because it was the coldest and corresponded to the most advanced stage of development in several grape varieties and it affected a large grape acreage. Last week, I visited with my colleague Greg Johns, AARS manager, several commercial vineyards across northeastern Ohio to interview growers about their assessment of this event and to provide recommendations on how to proceed (see below). Even though several varieties have recovered and shoots appeared green again from a distance, the damage was significant from up close. All growers who have been in the business for more than 30 years agreed that this was the worst spring frost damage they have experienced. Many reported temperatures in the mid to high 20s. Damage of young shoots and/or clusters ranged from none to 100% and the stages of development ranged from bud swell to shoots 10-12" long. The following is a summary of our observations:

- Since 4 freezing events took place, some of the vineyards were hit by the frost multiple times; or they dodged many and were hit by one with minimum damage.
- Some vineyard blocks owned by the same growers experienced no damage while other blocks were partially or completely damaged.
- It was obvious that vineyards planted in good sites with good cold air drainage suffered the least damage. This is another reminder that there is no equal to a good site for frost protection.
- Also, some vineyards with good *absolute elevation* (feet above sea level) did not fair well. This again shows the importance of *relative elevation* (elevation relative to surrounding area). This observation was also made in 2006.
- The spread of bud break in different varieties was narrow due to the warmer than normal April. Thus many varieties broke earlier and quickly reached a developmental stage that is sensitive to temperature just below freezing (critical temperature of 30F) when the frost hit.
- Growers who have wind machines and used them on that day, experienced minimum or no damage as long as temperatures near the vines were kept above the critical temperatures. It was amazing to see the level of full protection or no protection provided by the wind machines within the same row of the same variety (see pictures below and by Greg Johns in his article).
- The above two observations indicated that there was an inversion and wind machines were effective to pull the warmer air down to the vineyards. Growers who have wind machines were all thankful; those who did not have them wish they did.
- It was also noted that a few growers tried soybean oil with different level of success. In one vineyard the delay in bud break of Concord was good enough to salvage a partial crop. In other instances it was ineffective because all varieties already broke buds by the time the frost event on May 10th took place.

- Growers used various cultural practices to protect against the frost including high training system, double pruning, mowing the grass, and cultivation of row middles. The success was not as dramatic and obvious as with that observed in good sites or where wind machines were used.

Pictures taken at commercial vineyards in Northeast Ohio last week:



Concord vineyard. Note shoot damage in the middle of the vineyard (low area).



Shoot and cluster damage on main shoots of Concord. Note small shoots next to each main shoot emerging from secondary buds.



Vineyards located in excellent sites with good cold air drainage and relative elevation fared well with no damage at all.



Wind machines were effective against the frost in May. Note this variety had no damage due to its proximity to the protection area provided by the wind machine. Vines few feet away (not shown) were not as fortunate.



In addition to good vineyard location, cultural practices such high training system and clean cultivation between rows helped alleviate frost injury in this vineyard.

At the research vineyard in Wooster, we recorded three frost events on April 10th (30.6F), April 19th (29.9 F), and April 28th (30.2 F). On May 10th, temperature dropped only to 32.1 F. Even though the early varieties already broke buds ~ 2 weeks earlier than normal, there was no damage. Chardonnay broke 50% buds on April 7th, followed by Concord on April 9th, and then Cabernet franc on April 11th. Based on published data, the critical temperature of 30F was not reached on that date. However, on April 19th, temperature was 29.9 F, near the critical temperature of 30F and observed some damage on the varieties listed. On that date, stages of development were as follows: Chardonnay 2-3” long shoots, Concord 2-3” and Cabernet franc 1-2”. Damage was estimated at less than 20% and was limited to vines at the end of rows (lowest spots).

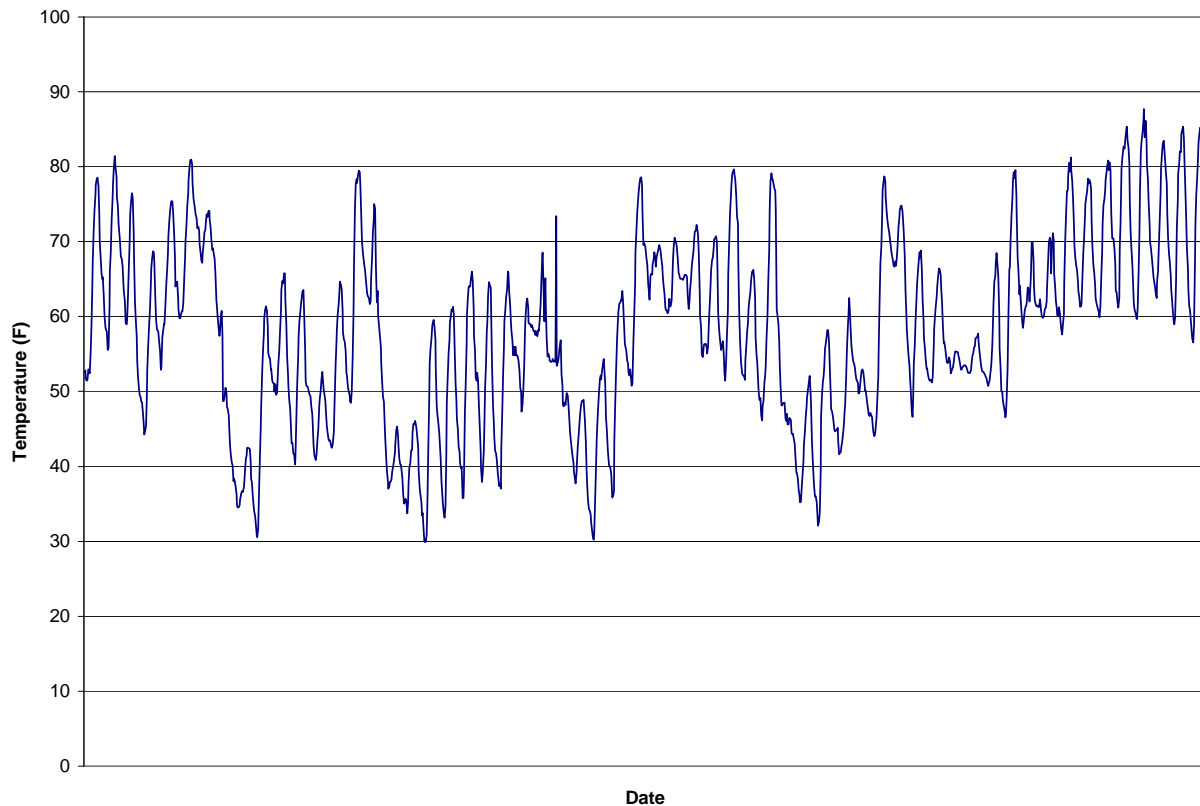


Figure 1. Hourly temperatures recorded in the research vineyard block on April 1 – May 30, 2010 at OARDC Wooster, Ohio.

Factors affecting frost injury:

During deacclimation, grapevines become increasingly sensitive to temperature below freezing (32F) and critical temperatures (CT) vary with the stage of bud development. That is, buds become more sensitive as they grow in early spring. The following is an example of critical temperatures that cause 50% damage of grape buds and young shoots:

- Swollen bud stage ---- 26F
- Bud burst (break) ---- 28F
- First unfolded leaf ---- 28F
- Second unfolded leaf ---- 29F
- Fourth unfolded leaf ---- 30F

You may visit web1.msue.msu.edu/fruit/grpfrost.htm to see critical temperatures of Concord with pictures of different growth stages.

CT also varies with weather conditions including air relative humidity and corresponding dew point. Dew point (DP) is the temperature at which water condenses out of the air as dew or the temperature that corresponds to 100% relative humidity. Condensation releases heat and slows the drop of air temperature. Thus, if DP is higher than CT, heat will be released before reaching damaging temperatures and may provide some protection. If the air is dry, DP is low and temperature will drop rapidly and may reach CT and thus cause more damage. During the frost event in May, the relative humidity was high which means that DP temperature is close to air temperature. High relative humidity may have worsened the extent of damage. The wet conditions may have led to ice nucleation and prevented supercooling and thus led to more injury.

What we learned from the 2006 spring frost:

At the research vineyard in Wooster, we recorded 27.2 F on April 26, 2006. Concord broke buds on April 24 2006 (normal) and their critical temperature was 27F. Ninety percent of new shoots were damaged. After berry set, many shoots originated from the basal buds and cluster count averaged 28 per vine (normal is 160 clusters/vine) or 83% reduction. Hybrids with fruitful secondary and base buds fared better even with severe frost damage. American varieties like Concord and many vinifera varieties don't have fruitful non-count buds. However, hybrids do and typically produce a normal crop from secondary and base buds. Generally, varieties bear fruit on shoots originated from primary buds. Some bear fruit from secondary and base buds. Secondary and base buds of Vinifera and Native grapes are not as fruitful and thus may sustain more crop loss than French Hybrids. Secondary buds may produce 30-50% of the crop potential. Tertiary buds typically are not fruitful.

What to do after a frost event:

- First, do not give up! Grapevines have an amazing way of recovering and compensating for yield. Also, the percent of damage does not equate the percent of crop loss. The best way to assess crop potential in 2010 is to wait after fruit set when the clusters are visible. Cluster number per vine should give you an idea about percent cluster number loss. However, this does not mean you would have a reduction in yield. The fewer clusters may have more and larger berries.
- Whether the damage is severe or not, you should not discontinue your disease and insect management program. You need to keep the leaf area healthy.
- Fertilization: if the damage is severe and only fruitless shoots recovered, this situation may lead to excessive shoot growth and vigor. You should avoid nitrogen fertilization. If the

damage is minimum and a normal crop is expected, continue a normal fertilizer program. If you practice split application of nitrogen (N), skip the first one and then, based on the fruit to shoot growth, decide whether to apply the post-fruit set N application.

- Canopy management: due to excessive foliage and resulting shading you may need to be more aggressive with your canopy management practices.
- Plan for the crop to ripen later than normal if it all originate from later developing shoots. The weather pattern is still on the warmer side though, and we observed vines near bloom already which is almost 2 weeks earlier than normal.
- Disaster Assistance: Contact your local USDA-FSA (Farm Service Agency) and report to them your crop loss. It is important that you record the extent of damage you have, in case some assistance program becomes available.

Finally, I would like to thank Greg Johns for his time and effort and joining me on this tour to visit affected vineyards. I would also like to thank all the growers who allowed us to see the damage in their vineyards. After such a disastrous frost, I am amazed with admiration just how composed growers have reacted to this event by not throwing in the towel and remaining enthusiastic about the future. They understand that's viticulture in Ohio, and you must be resilient to deal with it...