



Autumn Freeze Damage in San Joaquin and Stanislaus counties Walnuts: November 2020

Mohamed T. Nouri, UCCE Orchard Systems Advisor, San Joaquin County, Stockton, CA

Kari Arnold, UCCE Orchard and Vineyard Systems Advisor, Stanislaus County, Modesto, CA

Background

Over the last three years, we have received several calls from walnut growers in Sacramento and northern San Joaquin Valleys reporting widespread dieback observed in both young and mature orchards during the spring. In most cases, we suspected autumn freeze to be the major cause of those dieback symptoms. We usually try to differentiate between injury during the growing season, which is referred to as frost injury and the freeze damage that occurs in late fall or winter. The term frost injury is restricted to damage due to freezing temperatures during the growing season while the tree is not dormant, which is due to a late spring frost. This was not the case for the past three years, based on our farm calls and minimum air temperature data (°F) collected from CIMIS stations located near affected walnut orchards. **Fig. 1** showed the minimum air temperatures data (°F) collected from the CIMIS station located in Manteca CA, for the Nov., Dec. of 2018 – Nov., Dec., Jan., and Feb. of 2019 and 2020 – and Jan., Feb., of 2021.

In mid-November 2018, sudden minimum temperatures were low (ranging from 26.4°F to 29.8°F) in some locations, causing damage in young vigorous orchards as well as in mature orchards. The damage observed was not as widespread compared to what we are seeing this year, which may be due in some ways to the rains that occurred after the 9-10 day freeze event (**Fig. 2**).

Fortunately, we went through the 2019 winter with little stress to young/mature walnut orchards, since temperatures were warm enough to protect these trees, and notice the rainfall we received during the end of November and December of 2019 compared to the 2020' November-December time (**Fig. 1 and 2**).

This year, from mid to late April, we received several calls reporting severe dieback/not leafing out symptoms in large areas of walnut orchards in San Joaquin and Stanislaus counties. Symptoms were observed in newly planted orchards, young vigorous orchards as well as mature orchards including Chandler, Howard, Tulare, Serr and Solano cultivars (**Fig. 3 and 4**).

Why was the freeze damage so severe in some locations/areas this year?

To face the November- early December freeze events walnut trees must harden by developing processes of resistance to cold and frost. We believe that the acclimation to temperatures below freezing results from exposure to the gradual decline in temperatures, which allow trees to gradually lower the freezing point of their cells, in order not to be damaged under the freezing effect. It is a very complex process: once the temperature slowly begins to drop, the trees synthesize enzymes that will break down the starch (large sugar molecules) – made by photosynthesis and stored in summer in the bark and the wood – in smaller soluble sugars with higher anti-freeze activity, which protect against ice formation in tree cells.

This was not the case with the significant temperature fluctuation we faced during November- early December of 2020. Starting with a first freeze event on November 9th and 10th of 2020 which followed a period of temperatures ranging from 37 to 44°F (first eight days of November – at least allowing the trees to harden off a little but not enough). Then, we noticed that the temperatures rose over the next ten days (ranging from 30 to 50°F), then relapsed again below freezing for a few hours early in the morning of the 21st and 22nd, and the last four days of the month. Temperatures continued to fluctuate during the first nine days of December 2020 (**Fig. 1**).

These temperature fluctuations pose a serious threat especially for young vigorous walnut trees during the winter. Sudden temperature drops, place high amounts of stress on trees, the effects of which are much worse when followed by mild and dry weather.

Symptoms Observed

The severity of symptoms is variable across and within orchard blocks. Significant damage can be observed in young vigorous orchards. Tip dieback occurs with many branches in affected trees still green or partially green (damage beneath the bark appears as brown discoloration) and not leafing out (**Fig. 5**).

Based on our preliminary observation, we noticed that orchards irrigated in late October to early November showed less damage compared to those irrigated early to mid-October. More information should be gathered for the irrigation practices and other practices – prior to the November- December 2020 freeze event – from these severely affected orchards.

We are in the process of developing a survey in collaboration with other Farm Advisors and PCAs, in counties showing severe freeze damage, to help identify the factors that have contributed to the freeze damage this year, and how we can mitigate their future impact.

Recommended cultural operations to manage freeze damaged trees/orchards:

For young vigorous trees as well as mature trees, the damage in some tree branches/limbs looks dramatic, but the survival of these tree parts depends more on whether they are still green/alive.

- Do NOT prune out damaged limbs now. Buds may be slow to break or may fail to completely break and adventitious buds may emerge from under the bark. Prune out the dead wood that did not revive at the time of pre- or post-harvest. Formed new shoots can be trained to replace the damaged wood.
- To help prevent further damage from sunburn, exposed larger limbs/branches (southwest facing area) can be painted with tree paint or white latex paint diluted 1:1 with water.

- Orchards/blocks severely affected by the freeze will have lower overall growth with an expected yield reduction, which will reduce nitrogen requirements. Much of the nitrogen demand comes from the crop, and hence must be reduced. Make fertilizer decisions based on current soil reports and leaf analysis.
- Less leaf surface area results in reduced water loss (less transpiration): Monitor your orchard carefully, and schedule irrigation using a pressure chamber and/or soil moisture measuring devices through the season. By using the pressure chamber, you directly measure the level of water stress your trees are experiencing, because it measures the plant and not the soil. Start your irrigation when pressure chamber readings are 2 to 3 bars below baseline.

Newly planted trees showing dieback symptoms due to freeze damage are more vulnerable than older trees: the lack of foliage will provide a prime target for Flathead Borer and more sunburn damage.

- With enough healthy shoots left on the tree, cutting below the damaged tissue would help the tree rejuvenate and should not be an issue at this point (**Fig. 6**).
- If there are not enough leaves, damaged tissue that was not painted with a white-wash (December/January) after the freeze events should be painted now to protect against further sunburn damage and/or borer.

How to prepare and protect trees from future freeze damage?

There are additional steps you can take to prepare for a freeze event.

- Trees should enter the fall months as healthy as possible, but growth should be reduced. Cutting back some on irrigation in September and no nitrogen applications after August could help slow down growth and may help the trees harden off before a sudden freeze event comes along.
- For young trees, stop irrigating in September to set the terminal bud (**Fig. 7**) on the trunk to harden the trees, then resume irrigation to avoid tree stress.
- A dry fall could make freeze damage worse. If there is not enough rain by the end of harvest, irrigate walnut orchards so the soil is moist in November.
- To keep orchards slightly warmer, it is advisable to run the irrigation system a few days before an expected freeze event to ensure the soil surface is moist and help the soil store a little more heat in advance during sunny days. This will also ensure trees are hydrated enough before the freeze occurs. Moist soil absorbs more solar radiation than dry soil and will re-emit heat overnight.

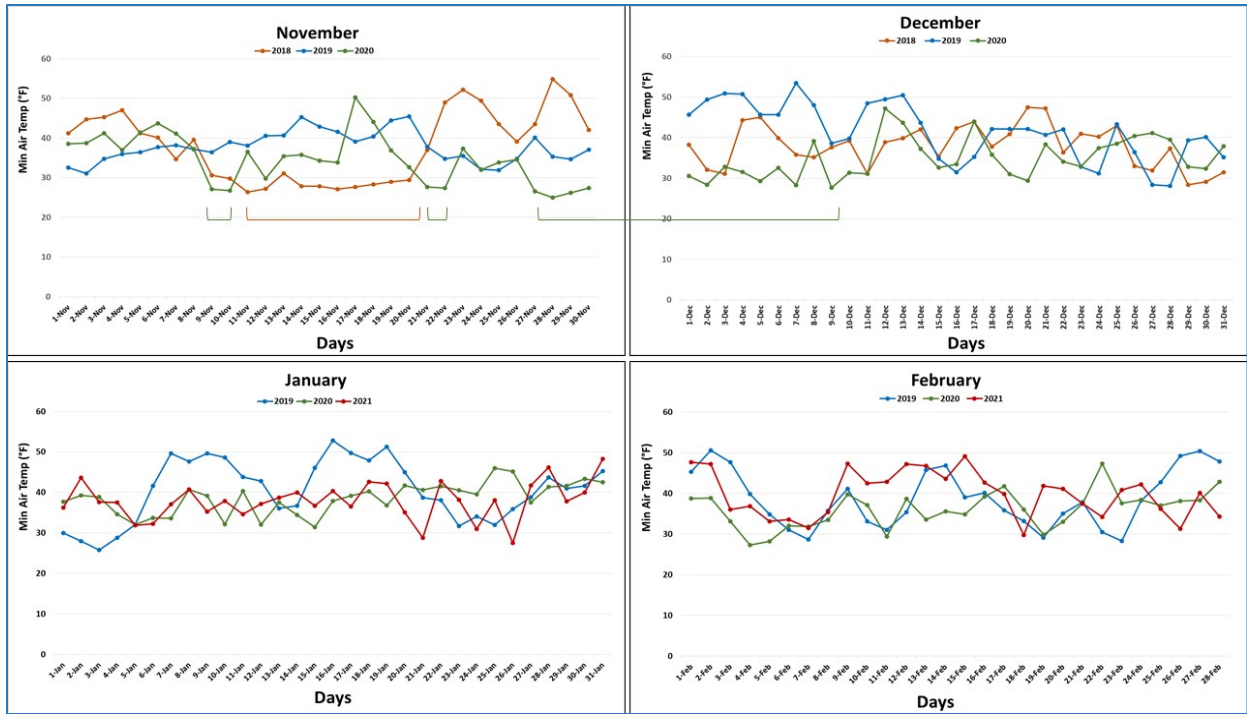


Fig. 1. Minimum air temperatures data (°F) collected from the CIMIS station located in Manteca CA, for the Nov., Dec. of 2018 – Nov., Dec., Jan., and Feb. of 2019 and 2020 – and Jan., Feb., of 2021.

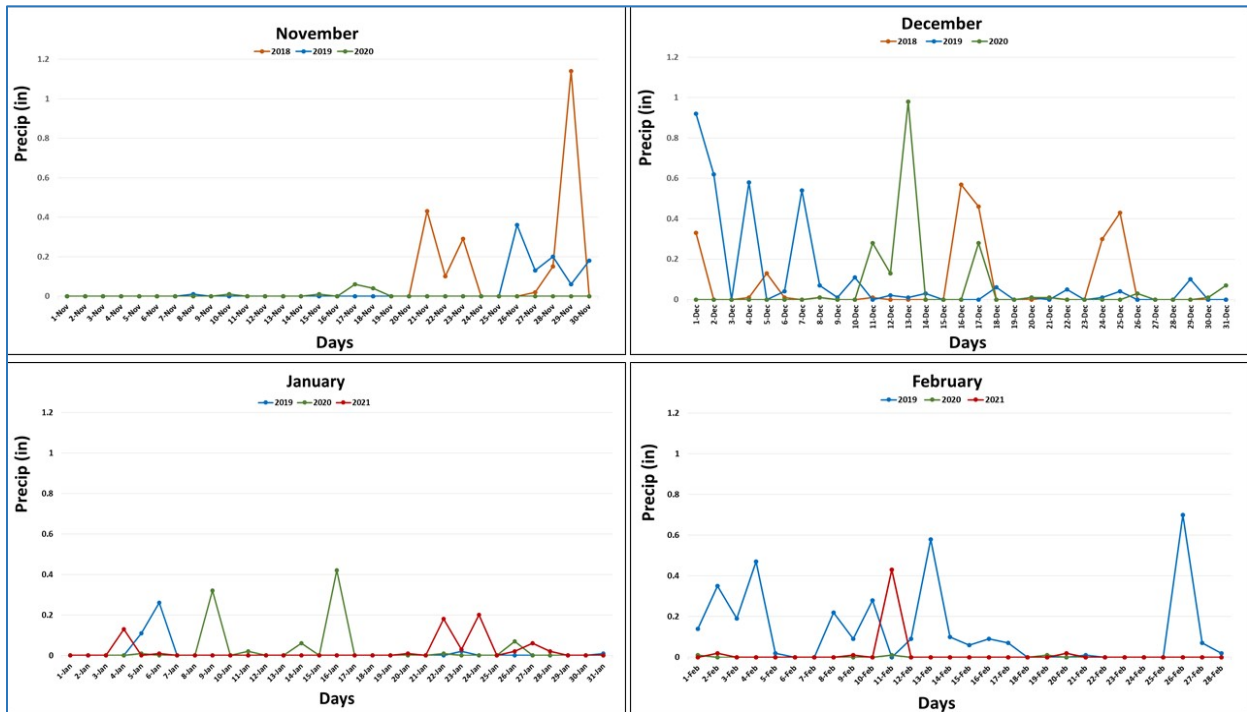


Fig. 2. Precipitation data (in) collected from the CIMIS station located in Manteca CA, for the Nov., Dec. of 2018 – Nov., Dec., Jan., and Feb. of 2019 and 2020 – and Jan., Feb., of 2021.



Fig. 3. Freeze damage in young walnut trees produces bark discoloration in the wood. Affected branches or trees dehydrate mainly from the top and show tip dieback.

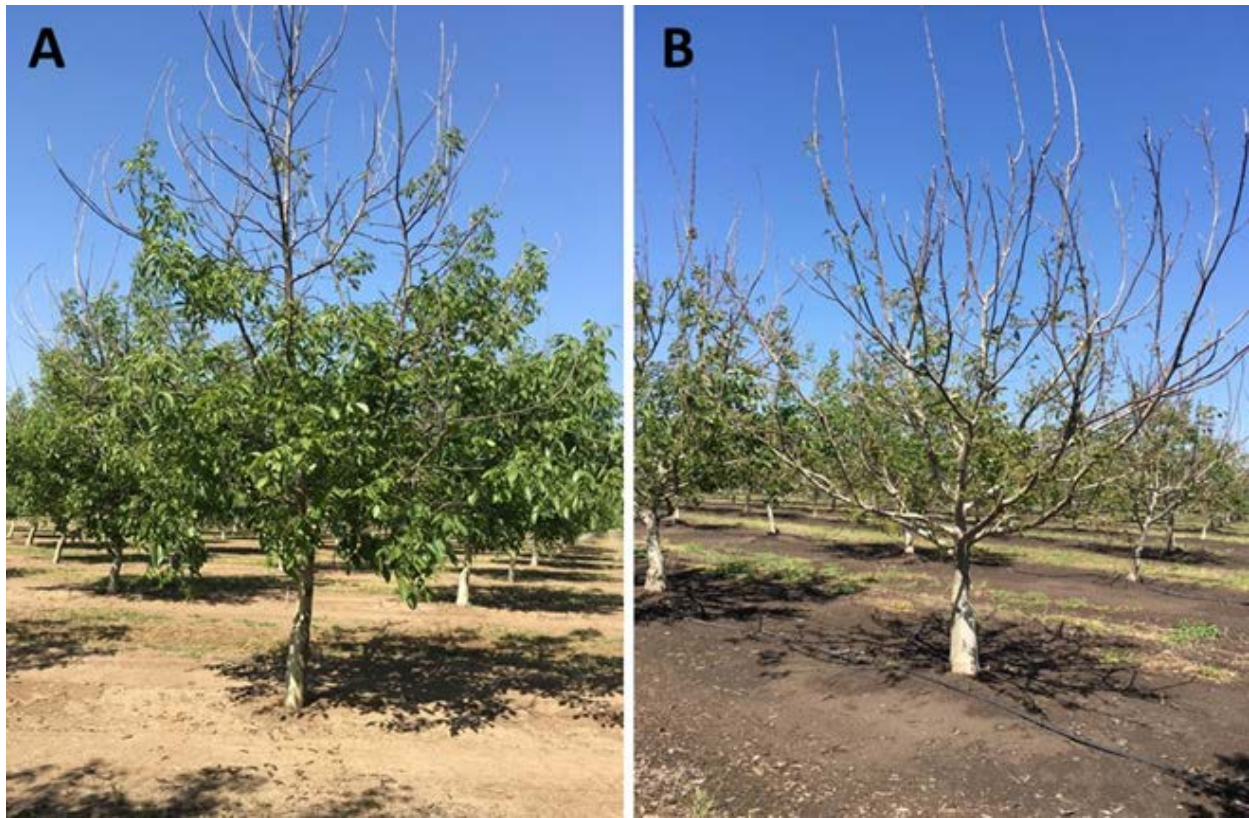


Fig. 4. Freeze damaged in, **A.** 9th leaf Solano and **B.** 9th leaf chandler.



Fig. 5. Freeze damaged in 9th leaf Solano. Severity of symptoms is variable across and within orchard blocks (damage beneath the bark appears as brown discoloration).

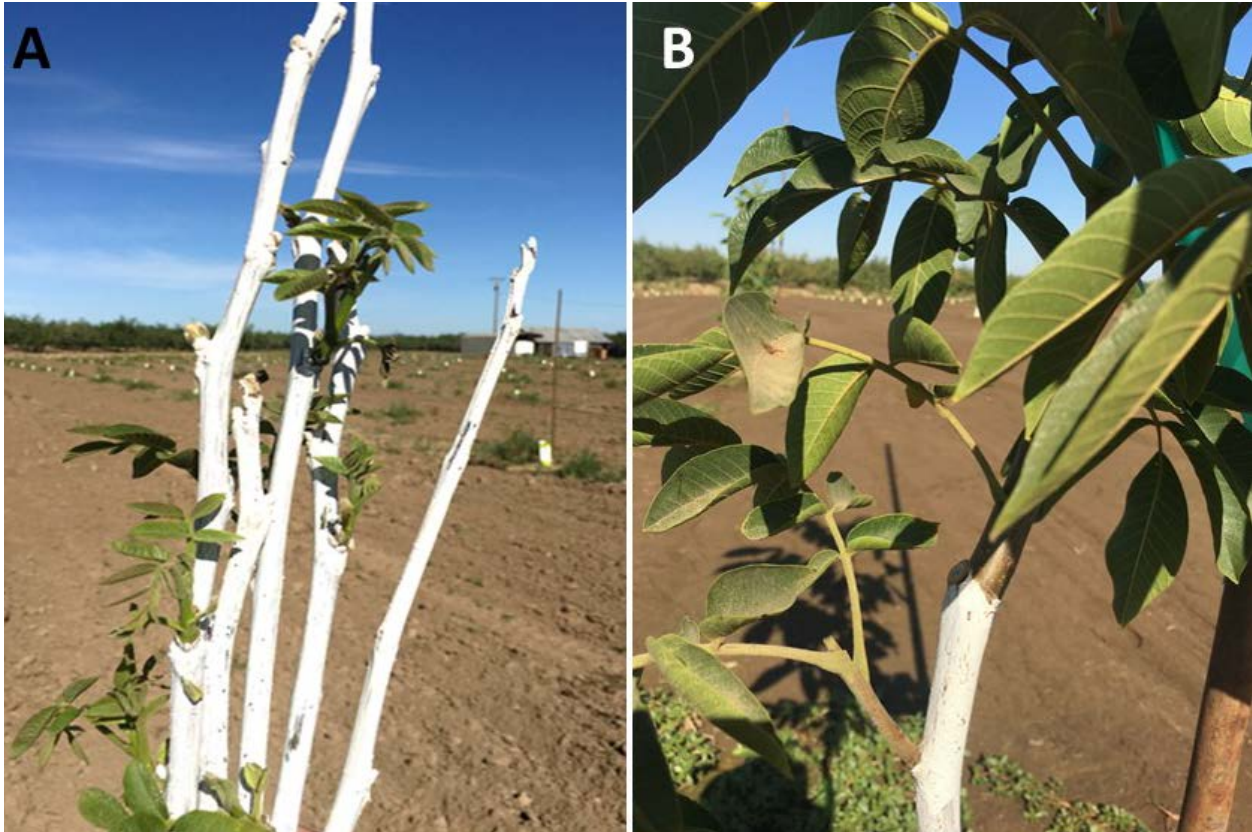


Fig. 6. Freeze damaged in 2nd leaf Chandler, **A.** pruned below the damaged tissue on April 30, 2020. **B.** Picture taken on July 30, 2020 showing tree recovery.

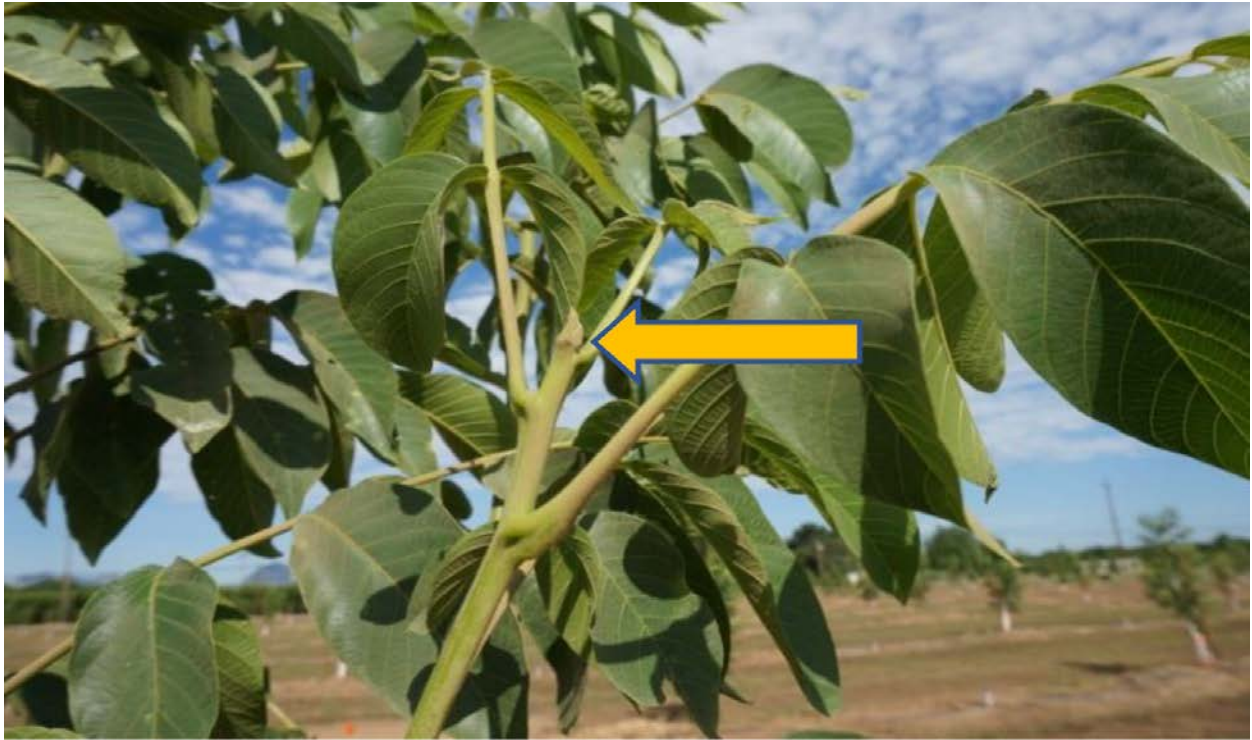


Fig. 7. Example of a set terminal bud. Photo provided by Janine Hasey.