Cold Hardiness

Cold Hardiness of grapevine buds in Western Colorado, 2016/17.

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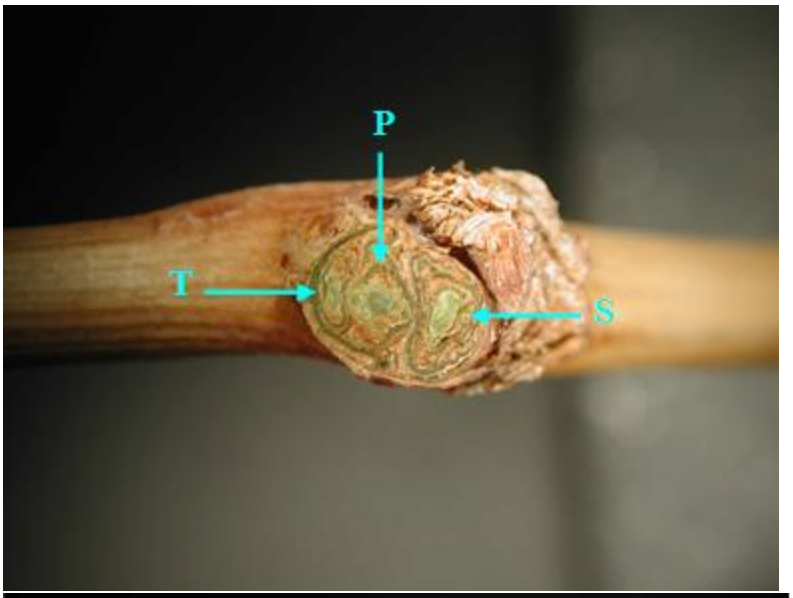
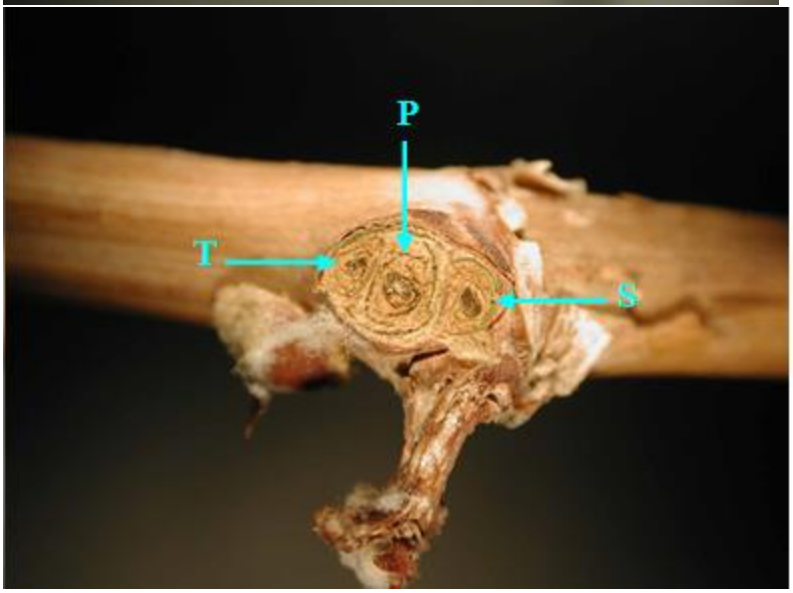
Dormant buds were collected from 9 to 25-year old, own-rooted vines growing at the Western Colorado Research Center (Orchard Mesa site near Grand Junction, and Rogers Mesa site near Hotchkiss). Vines are planted at a vine x row spacing of 5′ x 10′, 5′ x 9′ or 5′ x 8″ (Orchard Mesa), or 4-6′ x 8′ (Rogers Mesa), spur pruned on bilateral cordon, and trained to either a VSP or a high cordon. Buds were taken from shoots of moderate vigor that had no obvious sign of damage. Shoots were cut so as to leave a 4-bud spur, and eight buds were used from each shoot (i.e. bud position 5 to 12). Shoots were cut in the field into two-node sections. For each temperature treatment, twenty nodes were selected at random and then placed into a programmable freezer. The starting temperature for the freezing program was set to equal the outside temperature at the time of sampling. For example, on 16 September 2016 the outside temperature at the time of bud collection was ~49 °F, so the freezing program was initiated at a freezer temperature of 49 °F. Irrespective of the starting temperature, the freezer was programmed to reduce the temperature by 5 °F over a 30-minute interval, and then hold at that temperature for 30 minutes. This cycle was repeated until the threshold temperature for a sample was reached. At the end of the holding period for that threshold temperature a twenty-bud sample was removed, temperature decreased by 5 °F over 30 minutes and held for 30 minutes, etc. After removal from the freezer, buds were left at room temperature for a minimum of 24 hours and then cut open to evaluate the tissue. Buds showing vibrant green tissue were judged to be viable whereas buds showing brown tissue were judged to be dead (see photos below).

Sectioned grape buds





Orchard Mesa Data

Cold hardiness is influenced by many different factors, including variety, crop load, harvest time, post-harvest conditions, vineyard weather conditions, and the duration of a cold event. With our freezing protocol buds are exposed to a certain minimum temperature for a period of 30 minutes. Shorter or longer periods at this minimum temperature may result in lower or higher bud damage. For example, Table 1 shows that the percentage of dead primary buds for the varieties Chardonnay and Syrah increases as exposure time to -10 °F is extended from 30 to 90 and 180 minutes.

Table 1: Effect of the duration of a cold event (at -10 °F) on percentage of dead **primary** buds[1]

		Time at -10 °F (min)		
Variety	**Date**	**30**	**90**	**180**
Chardonnay	5 Dec 2006	10	30	35
Syrah	5 Dec 2006	5	77	100

[1] Note that the percentage damage is for the primary bud only. The damage is somewhat less when secondary and tertiary buds are included as they are more cold-hardy than the primary bud.

There is a genetically determined limit to cold hardiness (e.g. in mid-winter Concord is more cold-hardy than Riesling, which is more cold-hardy than Chardonnay). However, while this is true for mid-winter hardiness, the ranking might be different at the start or end of the dormant season. Some varieties will acclimate earlier in fall and will be able to withstand colder temperatures earlier in the dormant season than varieties that have otherwise more mid-winter hardiness. Likewise, early bud-breaking varieties tend to loose their hardiness earlier in spring and might be damaged at warmer temperatures than late-breaking varieties, irrespective of their mid-winter hardiness. Also, cultural practices can have a profound influence if the genetic potential of a particular variety is achieved.

In very general terms, warm temperatures tend to reduce bud hardiness while cold temperatures tend to induce more hardiness (within limits). Hence, the weather conditions at a site will influence the ability of buds to withstand cold temperature, and the values presented in Tables 2 and 3 are in part affected by the temperature conditions at our research vineyards. Values from other sites are likely to differ depending on the local conditions.

The data presented here is for information only, and growers should make their own assessment. Information on how to determine bud injury as well as historical data from the Orchard Mesa and Rogers Mesa sites can be found here:

http://aes-wcrc.agsci.colostate.edu/cold-hardiness-and-bud-evaluation/

Cold hardiness information for a large number of varieties grown in Washington State, a region with a semi-arid climate with some similarity to the climate of Colorado, can be found at WSU's viticulture page:

http://wine.wsu.edu/research-extension/weather/cold-hardiness/