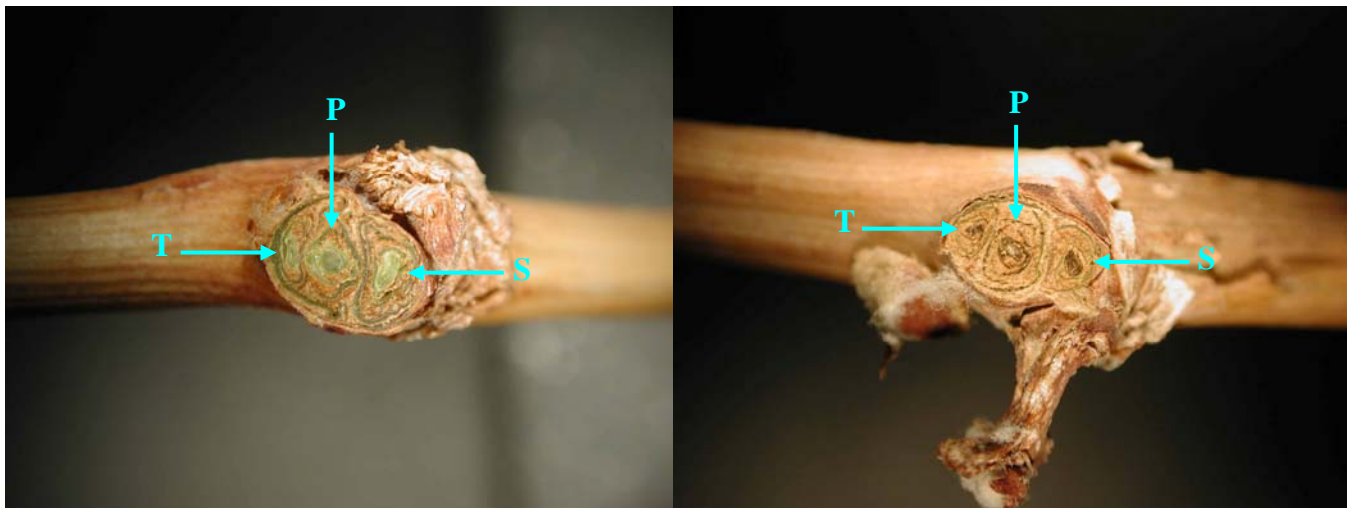


Cold hardiness of grapevine buds at the Western Colorado Research Center - Orchard Mesa near Grand Junction, Colorado, 2007/08.

Horst Caspari & Amy Montano, Colorado State University, Western Colorado Research Center, 3168 B ½ Road, Grand Junction, CO 81503

Dormant buds were collected from 15-year old, own-rooted vines growing at the Western Colorado Research Center - Orchard Mesa. Vines are planted at a vine x row spacing of 5' x 10', spur pruned on bilateral cordon, and trained to a VSP. 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 six buds were used from each shoot (i.e. bud position 5 to 10). Shoots were cut in the field into single-node cuttings. For each temperature treatment, twenty buds were selected at random, placed in plastic bags, and then placed into a programmable freezer. The starting temperature for the freezing program was altered depending on the outside temperature at the time of bud collection. For example, on 24 October 2007 the outside temperature at the time of bud collection was ~45 °F, so the freezing program was initiated at a freezer temperature of 45 °F. In contrast, outside temperature on 12 December was ~17 °F and the program was initiated at a freezer temperature of 17 °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 one bag containing twenty buds 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 (left photo below) whereas buds showing brown tissue were judged to be dead (right photo).



Photos: Sectioned grape buds showing the compound nature of the ‘latent bud’. All buds are alive in the left photo while they are dead in the right photo (P – Primary bud; S – Secondary bud; T – Tertiary bud).

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** buds¹

Variety	Date	Time at -10 °F (min)		
		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. Concord is more hardy than Riesling, which is more 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 lose 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 Table 1 are in part affected by the temperature conditions at our research vineyard (Fig. 1). Values from other sites might differ depending on local conditions. The data presented here is for information only, and growers should make their own assessment. Information on how to determine bud injury can be found at:

<http://www.colostate.edu/programs/wcrc/pubs/viticulture/EvaluatingBudDamage.pdf>

Cold hardiness information for a large number of varieties grown in Washington State, a region with a similar climate to that of Colorado, can be found at WSU's viticulture page: <http://winegrapes.wsu.edu/frigid.html>

Table 2: Percentage of dead **primary** buds as affected by temperature¹. Most recent updates highlighted in **red**.

Variety	Date	25°F	20°F	15°F	10°F	5°F	0°F	-5°F	-10°F	-15°F
Chardonnay	25 Oct 2007			0	0	65				
Chardonnay	31 Oct 2007				0	10	95			
Chardonnay	7 Nov 2007				15	5	95			
Chardonnay	14 Nov 2007				0	5	95			
Chardonnay	21 Nov 2007				0	20	15			
Chardonnay	28 Nov 2007						0	20	80	
Chardonnay	5 Dec 2007						30	25	100	
Chardonnay	12 Dec 2007						0	0	45	
Chardonnay	18 Dec 2007							5	20	75
Chardonnay	3 Jan 2008							5	15	55

Chardonnay	9 Jan 2008							0	20	85
Chardonnay	16 Jan 2008							25	60	90
Chardonnay	24 Jan 2008							10	60	90
Chardonnay	30 Jan 2008							25	25	85
Chardonnay	7 Feb 2008							25	50	55
Chardonnay	13 Feb 2008							35	70	100
Chardonnay	27 Feb 2008					0	40	25		
Chardonnay	5 Mar 2008					0	5	35		
Chardonnay	12 Mar 2008					0	10	30		
Chardonnay	20 Mar 2008					10	40	100		
Chardonnay	27 Mar 2008				9	45	95			
Chardonnay	2 Apr 2008				5	48	95			
Chardonnay	16 Apr 2008	5	10	10						
Syrah	25 Oct 2007			0	25	95				
Syrah	31 Oct 2007				0	45	100			
Syrah	7 Nov 2007				0	15	100			
Syrah	14 Nov 2007				10	10	85			
Syrah	21 Nov 2007				0	0	5			
Syrah	28 Nov 2007						0	5	100	
Syrah	5 Dec 2007						0	5	75	
Syrah	12 Dec 2007						0	10	40	
Syrah	18 Dec 2007							0	0	70
Syrah	3 Jan 2008							0	10	15
Syrah	9 Jan 2008							0	0	80
Syrah	16 Jan 2008							5	5	45
Syrah	24 Jan 2008							15	15	90
Syrah	30 Jan 2008							5	5	50
Syrah	7 Feb 2008							10	15	30
Syrah	13 Feb 2008							0	5	74
Syrah	27 Feb 2008					0	0	0		
Syrah	5 Mar 2008					0	10	15		
Syrah	12 Mar 2008					0	20	15		
Syrah	20 Mar 2008					10	15	55		
Syrah	27 Mar 2008				9	32	45			
Syrah	2 Apr 2008				50	55	90			
Syrah	16 Apr 2008	35	40	85						

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.

Last update: 17 Apr 2008

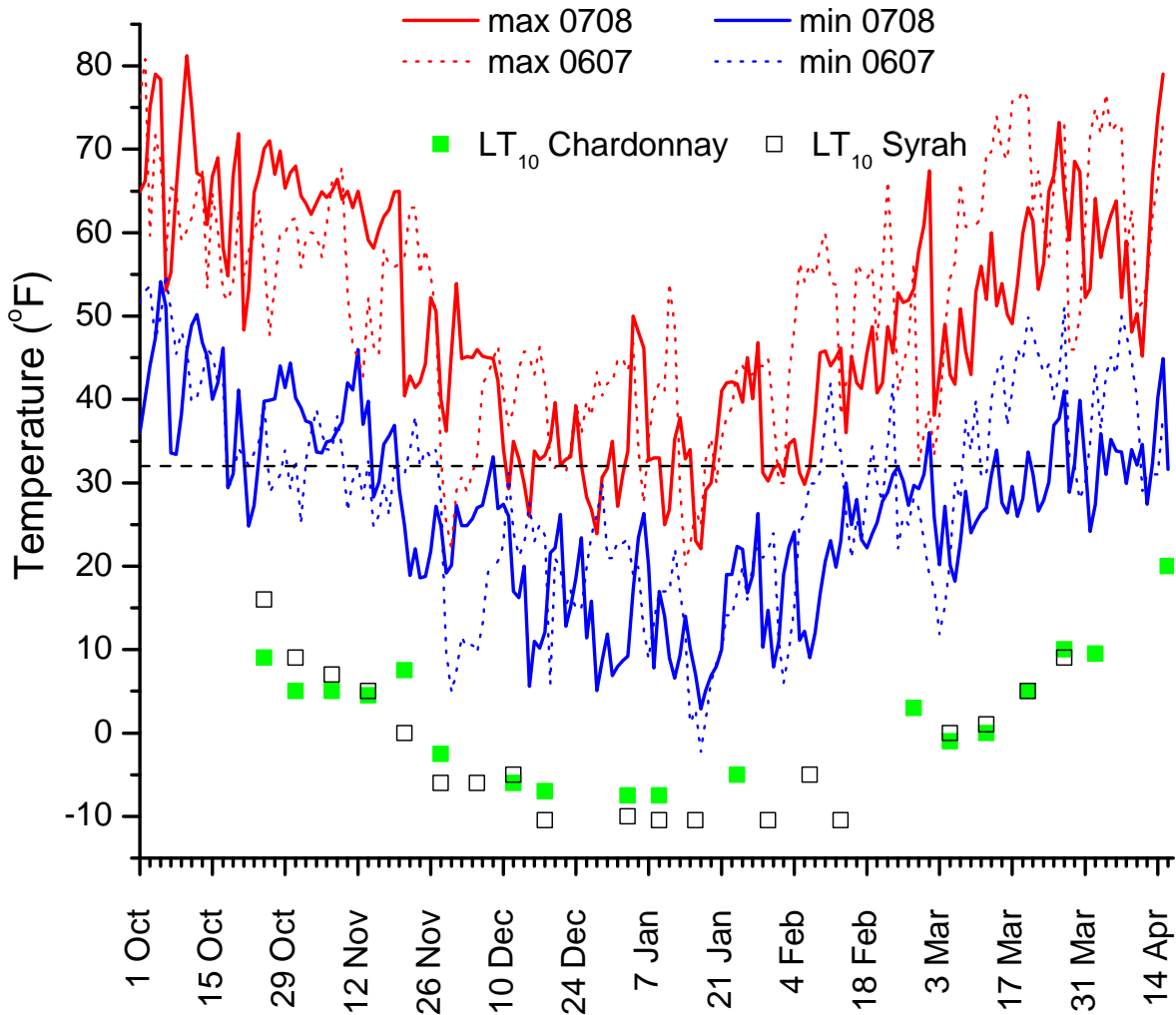


Fig. 1: Daily maximum and minimum temperatures recorded at the Western Colorado Research Center - Orchard Mesa near Grand Junction, Colorado, 2006/07 & 2007/08, and critical temperatures for a 10 % bud kill (LT_{10}) estimated from Table 2. Temperature data for various locations within the Grand Valley can be found at www.rmavv.org/weather.php. Meteorological data from other locations throughout Colorado may also be available from the COlorado AGricultural Meteorological nETwork - COAGMET.