Evaluating grape bud damage prior to winter pruning

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Dormant buds of grapevines can sustain injury under low temperature conditions. Such cold injury might be the result of very low temperatures in mid-winter when dormant buds generally have reached their maximum winter hardiness or from moderately cold temperatures in fall or spring, prior to gaining or after losing maximum hardiness, respectively. There are many factors that influence bud hardiness including, but not limited to, variety and clone, shoot vigour, weather conditions prior to the cold event, previous season's crop load, and overall health of the vine. In general terms, American species tend to be more winter hardy than the European grape (*Vitis vinifera*), with hybrid varieties being intermediate. Warm temperatures preceding a cold event tend to lead to higher damage levels than if the temperatures remained low, likely caused by a de-hardening effect of high temperatures. Due to the complexity of the process and the many influences on bud hardiness it is difficult to predict the level of damage. Hence, growers should determine the level of cold injury prior to winter pruning so that pruning techniques might be adjusted to account for the bud damage.

How do you evaluate damage to dormant buds? We have used two different techniques: cutting through buds or putting them into water to see if they will grow. For the latter technique we have used single-nod cuttings rather than entire shoots. Single-nod cuttings are placed in pre-cut holes on a Styrofoam board (½-¾" thickness) floating on water so that the basal part of the node is immersed in water while the bud is above the board (Photo 1). Depending on the time of sampling, the temperature of the water in the "water bath", and the variety it may take several weeks before the buds break. For example, it took about one additional week for the first buds to break for samples taken in mid-December 2003 versus samples taken in late-January 2004. Increasing the water temperature from room temperature (about 70 F) to 80 F accelerated bud break by 3 to 7 days. This technique provides an indication of bud viability and, when considering the angle at which buds emerge, can be used to determine which part of the bud is viable (primary, secondary, or tertiary).

Photo 1: Single-node cuttings in water bath

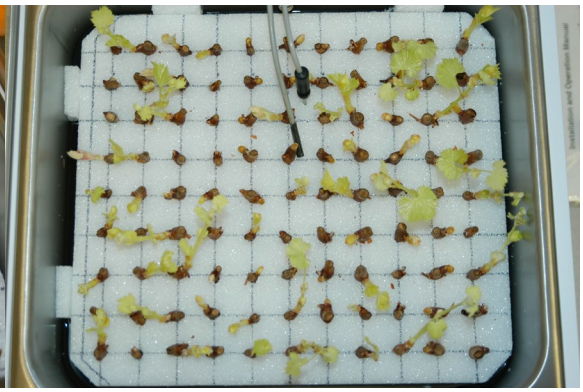

Photo 2: Single-node cuttings after 34 days

The second technique to evaluate bud damage involves cutting the bud. The following photos show a shoot segment with a dormant bud, the position of the blade, and a series of cuts. The first cut should be made about a third or half way down. Please always make the cuts away from your fingers!

Photo 3: Dormant grape bud

Photo 4: Position of the blade

Photo 5: Bud after first cut

Photo 6: Bud after a further cut

Photo 7: Bud after the third cut

Photo 8: Bud base (this cut was too deep)

Although a dormant grape bud looks like a single bud from the outside and we refer to it in singular as 'the latent bud', it is in fact a compound bud that contains several buds. These buds are referred to as 'Primary', 'Secondary', and 'Tertiary' bud. Under normal circumstances it is the Primary bud that will start growing in spring and produces a shoot, while the Secondary and Tertiary bud will not. Sometimes, however, the primary bud fails to grow and it is the Secondary bud that will produce a shoot. Likewise, the Tertiary bud might break in spring if both the Primary and Secondary bud are damaged. In summary, there are three buds enclosed within the structure that we refer to as the latent bud, each of them capable of producing a shoot. It should be noted, however, that the fruitfulness is highest for the Primary bud while the Tertiary bud is generally vegetative only.

What are we looking for when cutting buds? A bud with no damage will show green tissues for the Primary, Secondary, and Tertiary bud, indicating that these buds are alive (Photo 9). In contrast, a damaged bud will show a brownish/dark discoloration (Photo 10). With your first or second cut you may not see all three buds as the Secondary and Tertiary bud are embedded deeper in the latent bud structure. However, as the Primary bud is more susceptible to cold injury than the Secondary and Tertiary bud it is generally safe to assume that those are alive if the Primary bud is not damaged. So when we have determined that the Primary bud is alive we normally do not make further cuts to determine the status of the other buds. The following photos illustrate various levels of bud damage from cold temperature injury.

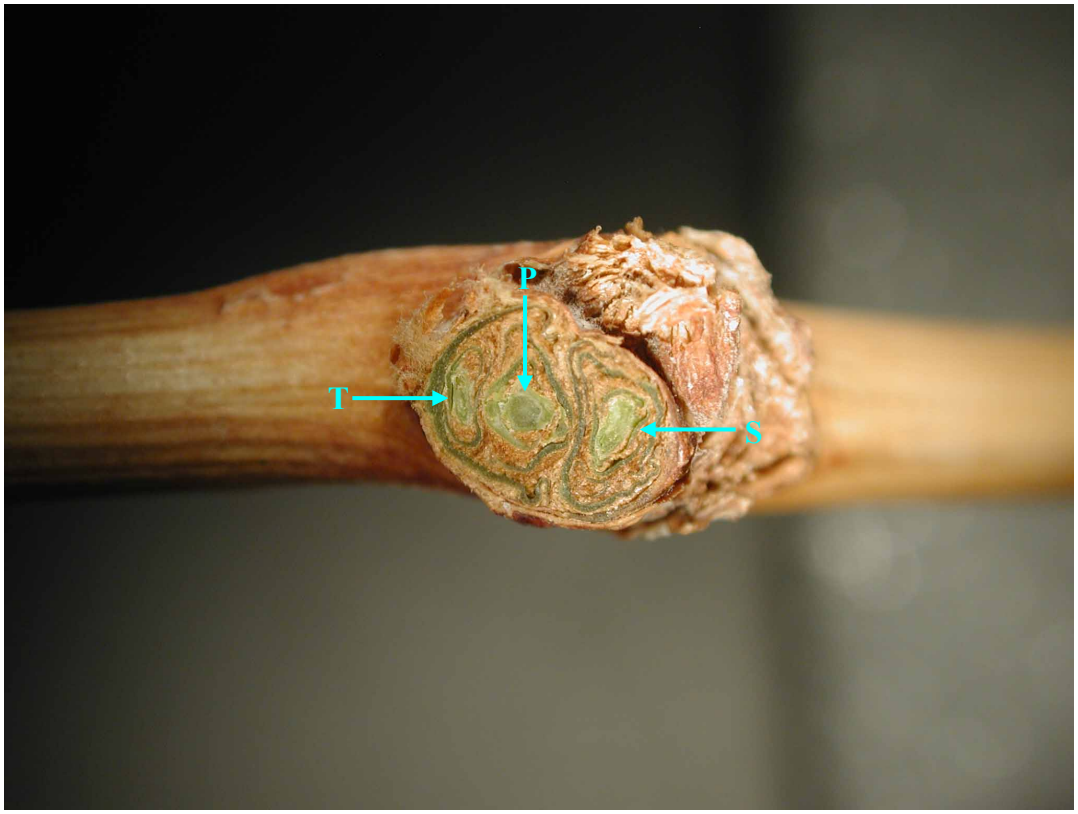

Photo 9: Sectioned grape bud showing the compound nature of the 'latent bud'. All buds are alive (P – Primary bud; S – Secondary bud; T – Tertiary bud).

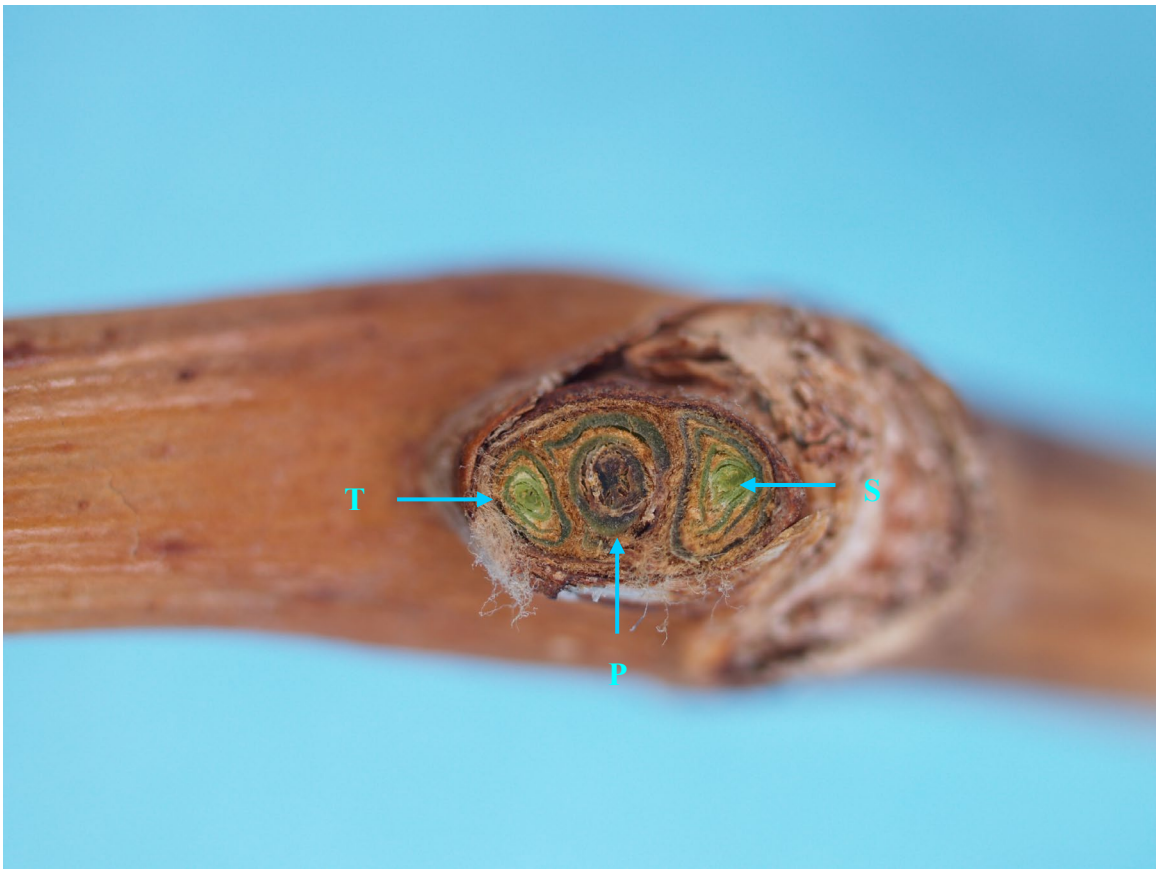

Photo 10: Sectioned grape bud showing a damaged Primary (P) and undamaged Secondary (S) and Tertiary (T) bud. Note the dark discoloration of the Primary bud indicating bud damage. The Secondary bud is likely to break in spring, and the developing shoot may be fruitful (although generally less fruitful than a shoot arising from the Primary bud).

Photo 11: Sectioned grape bud showing damaged Primary (P) and Secondary (S) bud. The Tertiary bud (T) does not show damage symptoms and is assumed to be alive. Although this type of latent bud is likely to break in spring and produce a shoot, it will not produce fruit.

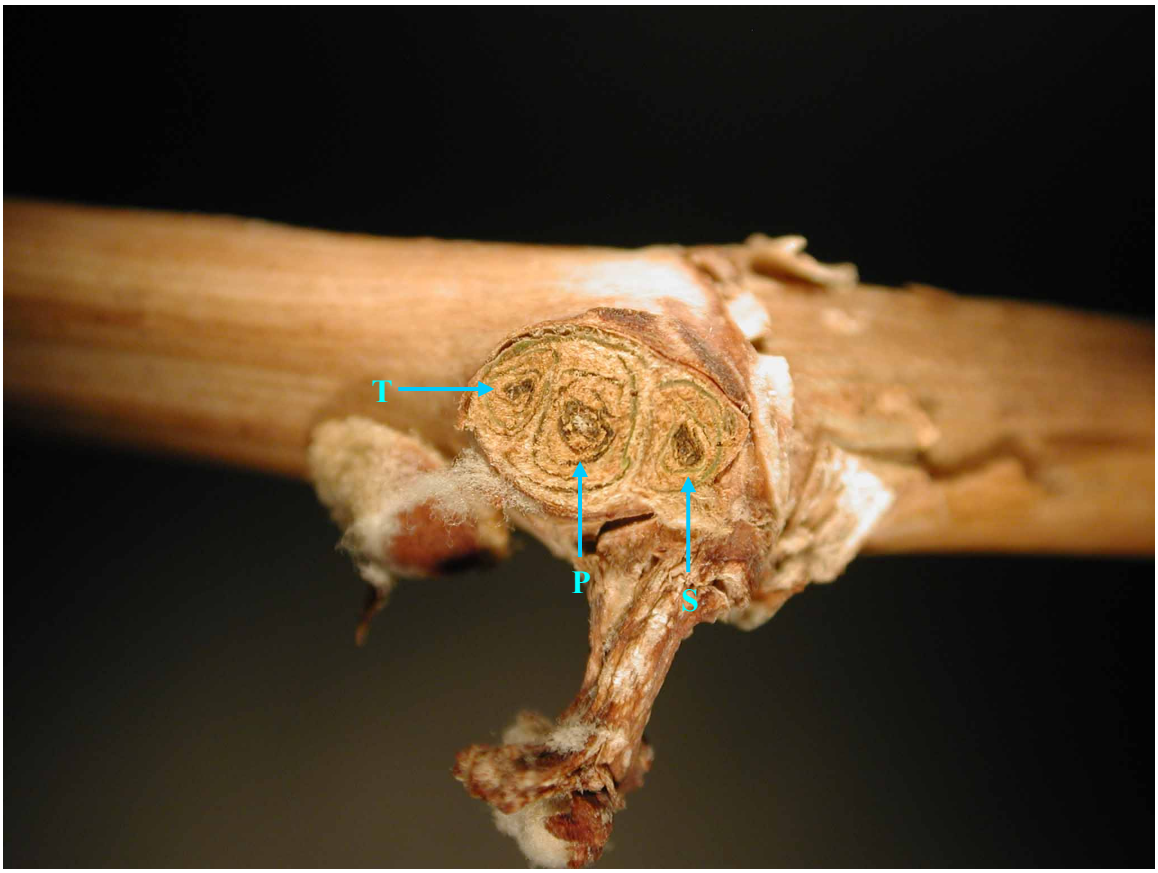

Photo 12: Sectioned grape bud showing damaged Primary (P), Secondary (S), and Tertiary bud (T). This latent bud is dead!

Which buds, and how many, should you evaluate? Obviously, you want to know the viability of the buds left after you have finished winter pruning. So if you are spur pruning to 2-3 bud spurs you will need to sample and evaluate those spur buds (the basal 2-3 buds on last season's shoots). However, if you are cane pruning you want to know the level of bud damage along the entire length of the cane. As winter hardiness of buds differs between varieties you should do a separate evaluation for each variety. How many buds you need to cut will depend in part on what you find. If your first 30 samples are all dead there is probably little value in evaluating more buds. On the other hand, when the results are highly variable (no damage on some samples yet 100 % damage on others) you should consider evaluating say 100 samples. If you are aware of differences in conditions in your vineyard (e.g. high and low vigour areas, cold spots) we recommend that you take separate samples from those areas and determine the level of bud damage for each area.

Adjusting winter pruning

What do you do with the information once the level of damage has been determined? Again, this will depend on the level of damage that you've found. With 10-15 % damage to Primary buds only there is probably no need to adjust your winter pruning. Remember, many of the *Vitis vinifera* varieties we grow have fruitful Secondary buds so that the impact on yield will be rather small. At higher levels of damage you will find a mixture

of buds that have damage to only Primary buds, Primary and Secondary buds, and Primary, Secondary, and Tertiary buds. Under those circumstances one may leave a higher number of buds at winter pruning; e.g. prune to 4-5 bud spurs rather than the standard 2-3 bud spurs and/or leave more spurs/canes per vine. If bud break in spring is better than expected we recommend that you do an early shoot thinning to reduce the number of shoots to the standard level for your vineyard. This is best done after the danger of spring freezes has past. At very high levels of damage, say 80 % or more, your focus during the coming season should be on reestablishing the bearing structure of the vine rather than on yield. With mature vines there may be enough shoot growth arising from dormant buds located in the old wood (cordon or trunk) to reestablish your vines within one season, whereas young vines may have to be retrained from the ground. Irrespective if you have mature or 2 or 3 year old vines you should NOT single out all but a few shoots for this reestablishment phase. Reducing the shoot number often results in the remaining shoots to have high to very high vigour – and this type of shoots tend to be less winter hardy and will have more bud damage the following winter. All you will achieve is to perpetuate the problem. With vigorous vines we will leave every shoot that develops (sometimes 15 or more). At winter pruning time we then have a range of shoots to choose from, and we try to select healthy shoots with medium vigour.