WATER & VINE
Managing the challenge

MODULE 01

Post harvest care of grapevines: irrigation, nutrition and salinity

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POST-HARVEST CARE OF GRAPEVINES

Introduction

In most Australian grape growing regions, temperatures are sufficiently warm for vines to retain a functional canopy for up to four months after harvest. Providing the leaves remain in reasonable condition and the supply of water and nutrients is adequate, continued photosynthesis and root uptake during this period allows vines to store carbohydrate and nutrient reserves for use in the next season. The normal management approach for this period has therefore been to ensure that the water and nutrient supply to the vines remains adequate so that carbohydrate storage and nutrient uptake is maximised. With many regions now facing reduced irrigation allowances, lower rainfall, and declines in water quality, maintaining favourable conditions for the duration of post-harvest period is not always possible. What is the best way to manage irrigation and fertiliser applications after harvest with limited water supply, and what measures can be taken to reduce the impact of salinity on vine productivity?

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1 Carbohydrate reserves

Grapevines, like other perennial plants, require a supply of carbohydrates from stored reserves to support new root and shoot growth in spring. These are stored as starch and sugars, and an example of their seasonal concentration dynamics in root and wood tissue is shown in Figure 1. In warm climates a significant amount of carbohydrate can be stored after harvest due to continued photosynthesis. For high yielding vines where high crop loads prevent the recovery of reserves prior to harvest, this period is particularly critical for sustaining productivity. **Reserve replenishment can start before harvest if crop loads are lower, so the importance of the post-harvest recovery will vary according to yield, and conditions during the ripening period.**

2 Root growth

Grapevines appear to have only one main peak of root activity around flowering. A second flush of root growth may occur after harvest in some vineyards as shown in Figure 2, but not to the same extent as earlier in the season. Nutrient uptake during the post-harvest period may therefore be more reliant on existing roots. In warmer climates, new roots can appear before bud-break, suggesting that nutrient uptake may commence from the beginning of the season.

3 Nutrient reserves

Grapevines require a supply of nutrients from stored reserves to support growth in early spring. Nitrogen (N) is stored in the roots and wood, and follows a similar pattern to carbohydrate reserves over the season. Significant N uptake and reserve storage can occur after harvest. Uptake of other minerals may be equally important during the post-harvest period, but how they act as reserves is less understood. The ability to store and re-mobilise nutrients in spring depends on their mobility within the plant. This is high for all the macronutrients, except calcium, which has low mobility. With the exception on manganese, which is also low, all the other micro-nutrients have intermediate mobility. **In general, the post-harvest period is most important for N and phosphorus uptake.**

4 Irrigating with saline water

All irrigation water contains dissolved salts at some concentration and as water is transpired by the vine, these salts are left behind in the soil. The effect of these salts on the vine are twofold. The first is osmotic, where the concentration of salt in the soil solution makes it difficult for roots to take up water (effectively the same as if the soil was drying out). The second is ion toxicity from chloride and sodium, which among other effects, inhibits photosynthesis when they build up to high concentrations in the leaves. Grapevines are classed as moderately sensitive to salinity, but a number of rootstocks have considerably higher tolerance to salinity than Vitis vinifera.

For more in formation on salinity management see Module 03 Fact Sheet Sustainable Salinity Management in Vineyards.

5 Determining the importance of the post-harvest period for your vineyard

The main factors that determine the need for a post-harvest recovery are yield and photosynthesis during the ripening period (see Table 1). However, without actually testing nutrient and carbohydrate reserve concentrations it is difficult to predict how important the post-harvest period is likely to be for a particular vineyard. Given the range of situations that may be faced by growers after harvest, a set of generally applicable recommendations is provided below. These cover three different water availability scenarios, with particular reference to providing adequate carbohydrate reserve replenishment, and then generally applicable recommendations for nutrition and salinity management.

6 Recommendations for post-harvest management with variable water supply

Irrigation Scenario 1: Water supply sufficient to continue irrigation after harvest.

For high yielding vines (greater than 35 t/ha in Riverina) with a large permanent structure, six to eight weeks are required to fully replenish carbohydrate reserves after harvest. Irrigation therefore needs to be continued to maintain a healthy canopy for this length of time. If there is a post-harvest root flush it may take several weeks to reach a maximum, so fertiliser does not necessarily need to be applied immediately after harvest. However, for vines at intermediate cropping levels (~ 25 t/ha) there may be some option for saving water as reserves will be replenished in a shorter time and potentially prior harvest.

Irrigation Scenario 2: Sufficient water for one or two post-harvest irrigations.

For vineyards where a post-harvest recovery is thought to be necessary, and some water is still available, try to manage remaining irrigations so as to maintain a functional canopy for three to four weeks after harvest. This should be sufficient to replenish adequate reserves for the following season. An earlier loss of canopy may result in renewed shoot growth if rainfall occurs later in the season, but next year's buds won't burst in this situation, and the extra growth does not appear to be detrimental for the following seasons growth. Post-harvest fertilser applications are still possible, but these need to be timed with irrigation. If not taken up prior to leaf-fall, mobile forms of nitrogen fertiliser may be lost with winter rainfall. If a lack of water is anticipated, it may be more effective to apply nutrients earlier in the season when

root growth is at a maximum. Foliar nitrogen sprays can assist with building reserves for the next season, but beware of water quality used for the application. A final consideration is the risk that leaving a dry soil profile over winter may lead to problems with restricted spring growth in the following season. Although the cause of this disorder is not well understood, young vines maybe more vulnerable in this situation.

Irrigation Scenario 3: No water remaining for irrigation after harvest.

Water stress during the post-harvest period for one season appears to have little impact on yield in the following year. Reserve accumulation may be reduced, but providing the vines have had reasonable irrigation or rainfall prior to harvest, the amount of reserves stored should still be adequate. However, with successive seasons of poor post-harvest conditions, it would be expected that yield and vine health would start to decline. If comparable water shortages are expected in the medium-term, this essentially means that yields need to be reduced so that the vineyard is not in a situation where water is running out before harvest every year. In the longer term, options such as alternative varieties or more water use efficient rootstocks need to be considered.

7 Post-harvest Nutrition

Stay with standard industry recommended practice of annual petiole testing combined with visual assessments, and build up a longer-term picture vineyard nutrient status. Determine application rates based on petiole results, removal of nutrients from the vineyard with fruit and past experience. For the major nutrients, avoid any significant changes unless clearly justified as the soil and reserves will provide some buffering capacity. Continue with post-harvest applications in higher yielding vineyards, but if water is limited, keep in mind when roots are most active and time fertiliser with irrigation events. **If there is no water for post-harvest irrigation then the nutritional status of the vines can be maintained with soil and foliar fertiliser applications earlier in the season.**

8 Post-harvest Salinity Management

The salt content of water in the Murray Darling system increases as it moves downstream, but with precautionary monitoring of soil salinity and some leaching, it does not generally present a major issue to viticulture. Within regions, greater problems may arise if vineyards become dependent on poor quality groundwater. In these situations it may be essential to leach salt from the soil to avoid excessive build-up. Approximate leaching fractions can be calculated using the conductivity of the irrigation water and the amount of irrigation applied during the season. **Typical leaching fractions may be in the range of 10 to 20%, and are best applied prior to bud-break if soil testing shows salinity levels were not reduced sufficiently by winter rainfall.**

9 Summary

The importance of the post-harvest period is largely determined by climate, yield and management prior to harvest. If there is one situation to avoid, it is running out of water in the middle of ripening a heavy crop, as this will stress the vine exactly when the demand for carbohydrates is at a maximum. Vines will tolerate a season or two of poor post-harvest conditions, but productivity will eventually be reduced. While beyond the scope of this paper, it highlights the importance of long term planning and understanding that yield, together with effective salinity management, is a key factor in determining the sustainability of vines with reduced water supply.

10 Acknowledgments

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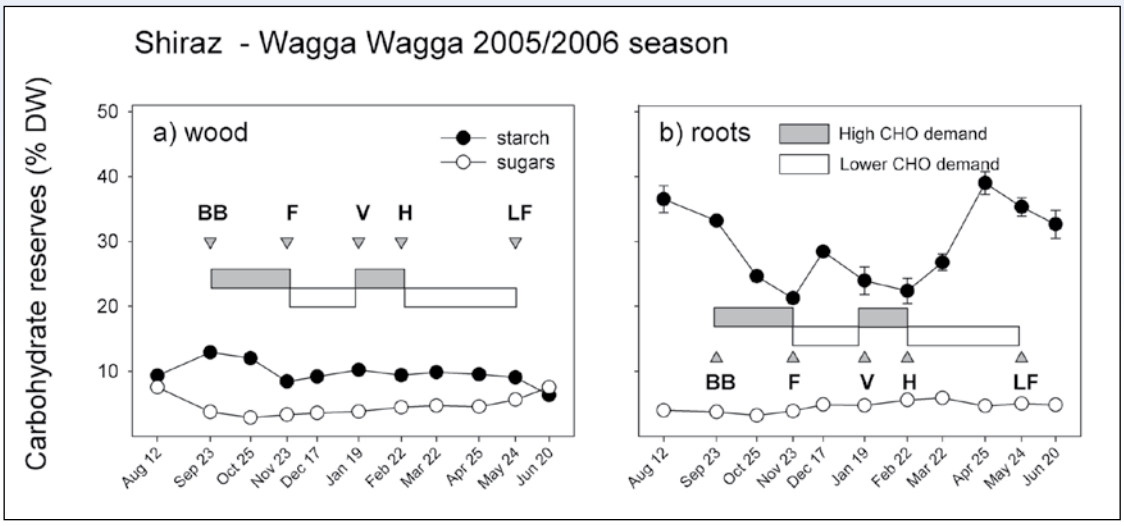

Figure 1. Example of the seasonal pattern of carbohydrate reserve concentrations in the wood and roots of mature own-roots Shiraz grapevines grown in Wagga Wagga (yield 13 t/ha in 2005). Shaded boxes indicate approximate periods when there is a high demand for carbohydrates from either shoot growth, root growth or berry sugar accumulation. Open boxes indicate periods of lower demand when carbohydrate reserves in the perennial parts of the vine can be replenished.

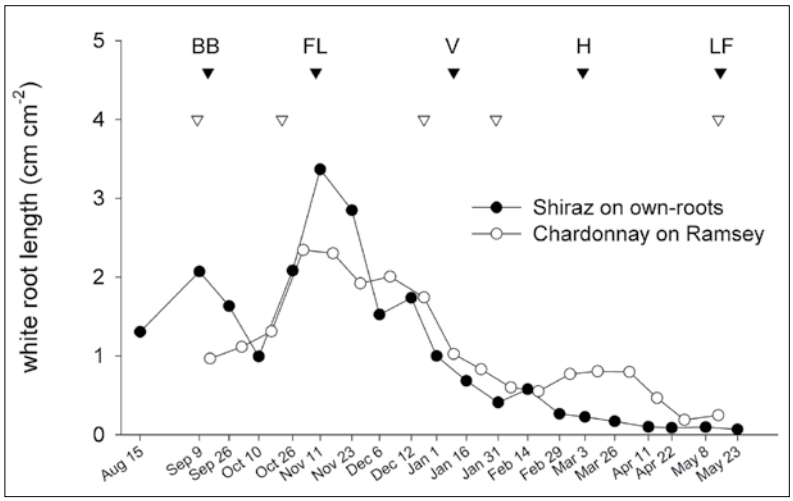

Figure 2. Seasonal pattern of root growth for grafted Chardonnay vines at Griffith in the Riverina, and own-rooted Shiraz at the Charles Sturt University vineyard at Wagga Wagga during the 2007/2008 season. For the Shiraz and Chardonnay respectively, yields were 14.6 and 28.9 t/ha respectively and irrigation volumes 3.5 and 4.8 ML/ha. Values refer to the length of white roots visible through clear plastic tubes installed immediately under the vine row to a depth of 60cm.

Yield	Post-harvest period
Less than 5 t/ha:	Little importance, or other issues (eg. frost, long term drought)
5-10 t/ha:	Minor importance, reserves largely replenished by harvest
10-15 t/ha:	Important, but some replenishment pre-harvest with good conditions
15-20 t/ha:	Important, but minimal post-harvest irrigation will suffice.
20-30 t/ha:	Important, and requires reasonable post-harvest conditions.
30-40 t/ha:	Very important, and requires good post-harvest conditions.
More than 40 t/ha:	Critical, and requires good pre- and post-harvest conditions.

Table 1. General guide to the importance of the post-harvest period at different cropping levels for vines grown in the Riverina region of NSW.

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