

Grapevine Management Options in Times of Drought and Water Restrictions



SOUTH AUSTRALIAN WINE
INDUSTRY ASSOCIATION

Scholefield Robinson
HORTICULTURAL SERVICES

KEEPING OUR MEMBERS INFORMED

INTRODUCTION

Wine growing regions in southern Australia generally have Winter and Spring dominant rainfall with drier conditions in Summer and Autumn.

A drought will normally result in vines requiring more water than is available from rainfall, and stress will occur.

A dry Winter may require irrigation early in Spring, using valuable water resources earlier in the growing season.

Irrigation must be rationed to minimise or avoid water stress at critical times, so that the best yield and quality is produced from the limited amount of water available for irrigation.

BEFORE THE BEGINNING OF THE SEASON

1. Know how much water you need
2. Know how much water you have
3. Adjust your quality and yield targets if required

DURING THE SEASON

4. Monitor your water applications
5. Adjust applications as necessary

AT THE END OF THE SEASON

6. Review your water usage
7. Review the quality and yield achieved
8. Plan best and worst case scenarios for next season

CONSEQUENCES OF A DROUGHT YEAR

Water issues

- Soil profile not full at end of Winter.
- Less water in dams, rivers, lakes and aquifers.
- Allocations of irrigation water may be reduced.
- Salinity is usually higher.
- Irrigation may commence earlier than 'normal' in the season.
- Often more wind with greater evaporation.
- Need more water when you have less.

Intensity of frost events may be higher due to dry soils, leading to consumption of water for frost mitigation.

Vine issues

- Shoot growth may be less with fewer functional leaves to ripen the crop.
- Flowering may occur earlier than in a 'normal' year.
- Stress may result in significant basal leaf loss, increasing the risk of sunburn of the fruit.
- If the functioning leaf area is not sufficient the vine may not be able to fully ripen the crop.

One benefit of drier conditions is lower disease pressure.

Questions for a 'normal' season

- How much water did you use?
- Yields, quality, vigour?
- Any leaf burn or early senescence?
- Do you really know what happens in your vineyard?

Questions for a drought year

- What is the reduced water allocation?
- How does this compare with what was used last year?
- Can I cope with this?

WATER BUDGETING

In a drought water application will need to be prioritised to the most valuable blocks (discuss with your winery if necessary). Other blocks will be given reduced volumes with consequent effects on production and quality.

A key question in applying reduced or fixed volumes of water, is how to apply that water across the season to ensure that the level of stress applied to the plantings is minimised and spread evenly across the season, with consideration given to the most sensitive growth stages. See page 2 for more details.

Preparing a water budget will avoid applying too much water too early, and running out before the end of the season.

HOW MUCH WATER AND WHEN? MONITORING IS ESSENTIAL!

It is important to know how deep the rootzone is and how much water is required to wet the rootzone.

Dig holes between the drippers and out into the mid row approximately 24 hours after an irrigation to determine the depth and width of the wetted front. A 'dig stick' is a useful tool for this job.

The CSIRO 'Full stop' device provides a visual indicator of when moisture has reached the rootzone.

For more information see <http://www.fullstop.com.au>

Adjust the length of the irrigation period until you are confident water isn't draining past the roots. This will give you an indication of the **length** of the irrigation required. The **volume** of water applied can be determined by reading your meter at the beginning and end of a shift, or by multiplying the emitter discharge (L/hr) by the number of emitters in the block. The **timing** of application will be determined by how quickly the rootzone dries out.

Make a point of regularly checking any drains and sumps. Flowing drains indicate that excess water has been applied.

Prepared by Mary Retallack and Peter Scholefield
for The South Australian Wine Industry Association.

For any queries you have about this bulletin
or any other water related matter please contact:
SAWIA admin@winesa.asn.au
Tel: 08 8222 9277 Fax: 08 8222 9276

www.winesa.asn.au

Industry Offices National Wine Centre
Botanic Road, Adelaide, SA 5000

Grapevine Management Options in Times of Drought and Water Restrictions

Regulated Deficit Irrigation (RDI)

RDI is commonly applied to red varieties from fruit set until veraison to reduce berry size. This is not as relevant for whites but may be useful for reducing excess vegetative growth. A smaller vine requires less water, and savings during this period may be utilised later in the season.

The amount of water stress required to influence vine vigour and berry size will vary depending on several factors.

Do not implement an RDI strategy if you have shallow water tables, high soil salinity, a poor performing irrigation system, no soil water monitoring or poor vine health. RDI on vines already under reduced irrigation may reduce shoot growth to unacceptable levels and result in excessive fruit exposure and delayed ripening.

Hot weather can quickly move the vines from mild to high stress, particularly on sandy soils. As excessive water stress may cause severe crop loss, plans should be made to ensure that water can be applied to the RDI area relatively quickly if required.

See the reference list if you would like to know more about RDI.

WHEN IS STRESS MOST DAMAGING?

The amount of water required at different stages of vine growth will depend on the region and irrigation strategy employed. Throughout the season, monitoring of soil moisture levels is essential. It is easy to over-water, or apply too much stress.

Figure 1 provides a guide to the % water requirement of vines at key times during the growing season. Calculate the volume of water (from the percentage indicated or historical records) that you will require for these periods. This can be calculated for each month. Keep in mind that additional water may be required at the start of the season to fill the soil profile if Winter has been particularly dry.

Spring: Budburst to Fruit Set

Monitor soil moisture shortly before budburst. Do not assume that winter rainfall has been adequate, nor that irrigation is essential.

High water stress in this period, which includes the sensitive flowering process, can severely reduce **yield**. Up to 50% of fruit can be lost if berries drop ('shot berries') or do not develop properly ('hen and chicken').

Soil water should be maintained during flowering. Maintain level towards refill end of Readily Available Water (RAW). After fruit set the vine will be able to move quickly into deficit to limit vine vigour and/or berry size.

Spring: Fruit Set to Veraison

Moderate stress in this period can be beneficial, especially for red varieties. The application of Regulated Deficit Irrigation (RDI; see left) can result in water savings. This water can then be used later in the season.

Summer: Veraison to Harvest

- Fruit **quality** can be significantly affected during this time. If the vine does not have adequate healthy foliage the accumulation of berry sugar will be reduced.
- If stress has reduced vine vigour, this may affect the vines' ability to ripen fruit properly (affecting sugar accumulation, acid balance, flavour, aroma and colour).
- If basal leaves have dropped this may lead to over exposure of the fruit and sunburn (especially whites).
- If conditions have been particularly dry and a significant rain event is forecast after veraison, it is worth considering a small irrigation just prior to the rain (within 3 days) if you have water available. This may prevent the splitting of berries (and secondary fungal infection) by slowing the uptake of water by the vines.

Avoid severe moisture stress during ripening.

Autumn: Harvest to leaf fall: then dormancy to budburst

Post-harvest irrigation is important but should be limited. The aim is to avoid an unwanted flush of vegetative growth while ensuring that the vines' capacity to store carbohydrate is not affected.

Very dry conditions prior to budburst may result in restricted growth early in Spring and reduced bunch number and size.

Water stress should be avoided after harvest and prior to budburst. Normally Autumn and Winter rains will be sufficient, but soil moisture must be checked if rainfall is below average in this period.

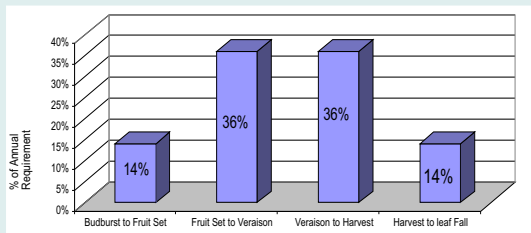


Figure 1: Approximate % of water required at key growth stages.

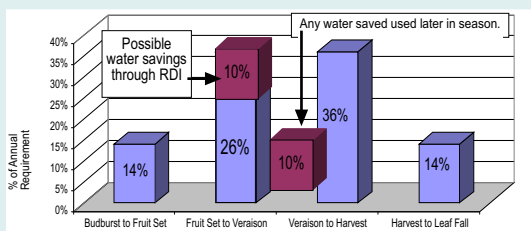


Figure 2: An example of how water saved through RDI could be used later.

MODIFIED FROM RURAL SOLUTIONS

Grapevine Management Options in Times of Drought and Water Restrictions

BEST WAYS TO USE LIMITED RESOURCES

Visual indicators of water stress in vines

The physiological reaction of a vine to water stress will affect the growth and development of the shoots, leaves and fruit, depending on the timing and level of stress during the season.

| Degree of Stress | Vine Vigour | Vine Appearance |
|-------------------|--|---|
| None | Vine healthy and shoot tips growing vigorously (early in season) | Shoot tip leaves light, bright green. Other leaves dull green. Tendrils not wilting at midday. |
| Slight | Slowing of vine vigour and shortening of inter node length. | Shoot tip leaves light, bright green. Other leaves dull green. Tendrils wilting at midday. |
| Moderate to High | | Shoot growth stopped. All leaves (including shoot tip leaves) dull light green. Tendrils and shoot tips drooping. |
| High | Vine canopy growth ceased | Leaves folding, with backs to sun on hot days. Exposed basal leaves yellow. Shoot tips dead. |
| High to Very High | | Leaves folded, light green with burnt margins, shoots drooping. Exposed basal leaves missing. Tendrils dead and some missing. |

Table 2: Grape vine physiological responses to different degrees of water stress

MODIFIED FROM RURAL SOLUTIONS (2004)

Salinity

Soil salinity may rise in times of drought. This may be in part caused by the application of saline water (concentrated through evaporation), or less fresh water being available to 'shandy' saline water. If salinity becomes too high, defoliation of the vine may occur or salt may accumulate in the fruit, reducing quality.

Salinity will build up in the soil if not leached periodically. Take salinity readings throughout the season to determine if a volume of water is required to leach salt from the rootzone.

If salinity is a problem, and you have access to more than one water source (eg one of lower salinity than the other), use the saline water early in the season while it has the least salt. The better quality water should be used at the end of the season or each irrigation as a 'leaching fraction'.

Soil salinity can be measured by taking a representative soil sample (0-15 cm) from the rootzone, sub-sampling to produce 20 g of soil and mixing with 100 mL of distilled water. Shake the sample for 5 minutes and leave to settle out for 1 hour. Use a salinity meter to obtain a salinity reading in dS/m. Salinity (EC_{1:5}) should be maintained in the following ranges: sandy soils < 0.15; loam < 0.17; and clay < 0.4 dS/cm.

- If an exposed vine leaf feels cool to touch when pressed quickly against the palm of the hand, the vine is transpiring water through the stomata. When vines are stressed, stomata partially or completely close, so transpiration of water ceases and the leaf feels warm.
- On a particularly hot day, the leaves may 'fold' to avoid the sun, and tendrils will appear to wilt.

- Berries may become less firm and start to shrivel.

Know your soil

The most important things to understand are the interaction of your soil with the applied water, the operation of your irrigation system to maintain soil moisture, and the responses of the vine to different watering schedules. Soil varies greatly within a region, and often also within a vineyard. Your vines are not in a uniform growing medium.

The important messages are:

- Find out as much about your soil as you can.
- Know the depth of the rootzone and how much water it can hold. Check RAW values from the soil survey.
- Where possible, keep similar soils in the same irrigation unit.
- Apply only enough water so that the part of a block that needs the least amount of water in the rootzone receives that amount. This will reduce waste and avoid drainage problems.
- Always check the soil water moisture information you are receiving with an in-field assessment.

Your strategy for heat waves?

Allocate a certain percentage of your irrigation budget for extreme weather events. If you do not have sufficient water to safeguard vines against extreme hot periods, stress to the vines can be extreme.

- Vines planted on sandy soils will dry out quickly.
- Risk of crop loss is high. Vines may 'shut down', resulting in delayed or uneven ripening.
- Defoliation of the bunch zone and along the shoots can occur; this will result in over-exposed fruit and possible stewed or phenolic characters.
- To minimise water used during heatwaves, make sure vines have water before the hottest part of the day. Water at night or early in the morning.
- Be willing to sacrifice a small part of the block to get the majority through without creating excess vigour.
- Be prepared to act quickly. You may need to forego a post-harvest irrigation to save this season's crop. Note that this may affect the following growing season if Autumn rains do not eventuate.

Grapevine Management Options in Times of Drought and Water Restrictions

IF WATER IS SO SHORT THAT VINES ARE IN 'SURVIVAL' MODE...

As this has not been a common issue in the past, there is considerable uncertainty regarding the best strategies to keep vines alive and protect future production capacity with very limited water supplies. However, the following broad points apply if you have decided to abandon the crop in this season and keep the vines as healthy as possible for next year:

- The first priority is to retain bud fruitfulness, to maximise the potential for a crop in the next season.
- The second is to retain as much of the vine's carbohydrate store as possible, to assist the vine to recover when conditions improve.
- These two aims are achieved by maintaining a very small canopy of functioning leaves, and by removing all fruit.
- Winter pruning should aim to reduce the number of buds retained.
- Remove all bunches shortly after berry set. This can be done at 'pea size' with a machine harvester (with beaters at high speed), or by hand at flowering.
- Only apply early season irrigation if vines are showing extreme stress. Preferably, wait until shoot growth has ceased; probably around the time of flowering.
- Where possible, limit shoots to approx. 30–40 cm in length. Withholding irrigation will achieve this at many sites. Early summer hedging may also assist.
- Irrigation can then be cut to an absolute minimum. Aim to retain 6-8 healthy leaves per shoot.
- Massive leaf loss should be avoided, as it will lead to reduced carbohydrate availability and poor fruitfulness of basal buds.
- Careful observation of the condition of each block will replace detailed soil moisture monitoring – spend time in the vineyard and manage according to how different blocks are responding to soil conditions.
- Be aware that this strategy offers little buffer against extreme weather events. If possible, irrigate prior to any forecast very hot and dry days.

THINGS TO CONSIDER BEFORE NEXT SEASON

Look back on your past irrigation management and think about ways you can make small (or large) changes. Tough decisions may be necessary.

- Know the profitability of each of your blocks (yields, quality, variety etc). Then decide on which sections are more likely to do best with less water. Evaluate marginal cost of water against marginal economic loss.
- Have a plan for 'worst case' scenario. Which 50% of your vineyard will you water?
- Remove all weeds, cover crops etc unless absolutely essential, eg for drift control.
- Utilise mulch to maintain soil moisture for longer and reduce evaporation (caution: frost risk).
- Turn off water on windbreaks/blocks which are unviable.
- Are any blocks due for redevelopment? This is a good time to start removing the vines. Water savings can be used on other blocks.
- Prune to normal bud numbers in Winter and remove crop after set if the season stays dry. Reducing bud number too much will induce a vigour response.
- Reduce nitrogen application if vines are showing signs of high vigour. This will reduce vegetative growth and the amount of water required to sustain the canopy.
- If you have vines on rootstocks, use your more saline water on them. Own rooted vines have a lower resistance to salinity than do rootstocks such as Ramsey and Ruggeri.
- Watch water market. If sales are available, look at economics of top-up purchase as a form of insurance.

Keep accurate records for reference and fine tuning of irrigation. If water use is not measured it cannot be managed.

REFERENCES

General

www.fullstop.com.au

Rural Solutions (2004)

www.pir.sa.gov.au

Regulated Deficit Irrigation (RDI)

www.gwrdc.com.au

www.pir.sa.gov.au

www.crcv.com.au/viticare/vitinotes/