Department of Primary Industries
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NSW GOVERNMENT

Options for vineyards: reworking, top-grafting, replanting or removing

NSW PRIMARY INDUSTRIES MANAGEMENT GUIDE

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Rootlings grown in a field nursery from late spring until late autumn. Photo: Yalumba Nursery.

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Wine Australia

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Figure 1. Successful top-grafting of Riesling to Shiraz rootstock (refer to Case Study 1 on page 18).

Introduction

Economic pressures are triggering significant change in many Australian vineyards. Growers are facing increasing global competition, low grape prices, market oversupply and reduced consumption. Large areas of vineyards in NSW are now reaching an age where productivity naturally declines. Many were established during the rapid expansion of the 1990s and early 2000s. Although these vines are not old by traditional viticultural standards, years of drought, waterlogging, frost, and periods of low investment have weakened plant health. As a result, trunk disease, crown gall-like symptoms and grapevine virus infections have become more common, further reducing vineyard performance. In some cases, the quality of planting material used during the expansion boom may also have contributed to these long-term issues.

Ageing vineyard infrastructure, such as posts, wires, end assemblies and irrigation systems, is also creating challenges. Decades of machinery traffic and continuous cultivation have led to soil compaction, declining fertility and organic matter, and, on some sites, increased salinity and sodicity. These factors collectively diminish vine vigour and productivity.

Consequently, many growers are now reassessing their options for vineyards with declining yields, poor fruit quality, and rising maintenance costs. Some are also considering how best to deal with abandoned or severely under-performing blocks. The available choices, reworking, top-grafting, partial or full replanting, or complete vineyard removal, each have advantages and constraints. Determining the right option, and the right timing for investment, can be complex and site-specific.

Vineyard options

Different regions have different terms, but for this document, we will be using the following:

Reworking

Reworking refers to changing the vine structure to correct underperforming vine yield or fruit quality. It generally involves removing the top of the trunk and cordon, then training a new shoot (Figure 2), but it might also involve only removing and replacing the cordons.

Reworking has been used in vineyards for centuries, but it was not widely used in Australia until growers started training bush vines to permanent wire systems to improve management and mechanisation. In the last 20 years, the increasing prevalence of trunk disease and cordon decline has prompted significant advances in reworking techniques. As a result, reworking is now a standard part of many vineyard management programs to help sustain vine health and long-term vineyard productivity.

Remedial surgery is a term sometimes used in viticulture to describe the actions required after grapevines have had trunk disease (GTD) resulting from either Eutypa dieback (ED) and/or Botryosphaeria dieback (BD). Remedial surgery involves removing the top diseased section and reworking from the clean material below. Where there are crown gall-like symptoms, remedial surgery should be used to remove the diseased section of the vine.

Top-grafting

Top-grafting involves grafting a scion bud (taken from a *Vitis vinifera* cutting) into the trunk of an existing *Vitis vinifera* vine and re-establishing the structure of that vine from the resulting new scion shoot (Figure 3). Top-grafting is mostly used where a grower wants to change variety or clone, but it has also been used on reworked vines that have not thrown a water shoot. Top-grafting techniques were first developed to graft a scion onto American rootstock to enhance phylloxera resistance, alter vine vigour, and increase tolerance to drought and salinity.

Figure 2. An example of a vine that has been reworked from the trunk. Photo: Nick Dry.

Figure 3. Riesling top-grafted onto Shiraz rootstock.

The commercial application of top-grafting mature vines to change varieties became more prevalent in Australia in the late 1970s and early 1980s to help meet the increased demand for white grape varieties (Henschke and Dry 1982). Top-grafting is now widely practiced in almost all regions in Australia.

There are 3 options for top-grafting: a chip-bud (Figure 4, left), cleft graft (Figure 4, middle) or t-graft (Figure 4, right). The chip-bud is most common because of its higher success rate (Cowham 2008).

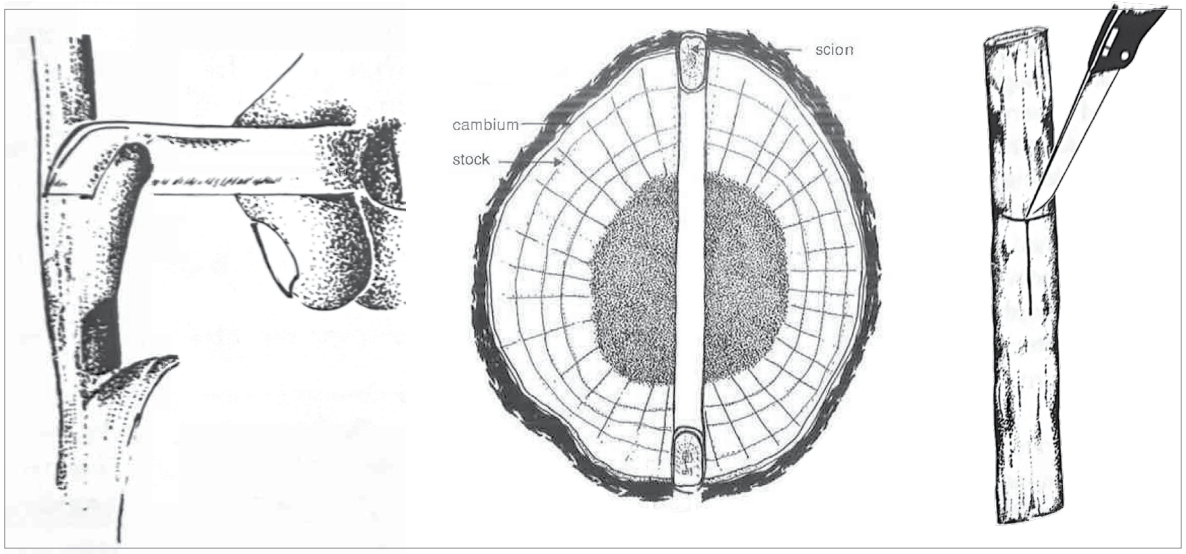

Figure 4. A chip-bud (left), a cleft graft (middle), and a t-graft (right). Source: Nicholas et al. (1992).

Replanting

Replanting involves removing the vines and replanting with selected varieties. Removing the whole vine also removes any disease or virus. Replanting is becoming more common where grafting is unsuccessful. It is also used where vines are coming to the end of their productive lives (most plantings being over 20 years old). Replanting is usually the more expensive option compared with top-grafting.

Replanting with grafted vines

With the risk of phylloxera and the benefits that a well-selected rootstock can bring to a vineyard, serious consideration should be given to using grafted vines when replanting. Grafted vines are produced by grafting a single scion bud (taken from a *Vitis vinifera* cutting) onto a rootstock cutting, which is almost exclusively a phylloxera-tolerant or resistant variety. The grafting process is generally performed in a controlled environment in a nursery via an omega or V-graft. Grafted vines grown in a field nursery will be supplied as a dormant rootling. Grafted vines grown in a greenhouse are referred to as potted vines, green-tops or spring-banded vines. Grafted vines were first used in the late 19th century to combat the threat of phylloxera following an outbreak.

Removing

Complete removal: market saturation, oversupply and declining consumption have led to a growing number of vineyards, including the infrastructure, being removed. This approach is suitable for those who want to diversify into alternative horticultural crops, other agricultural enterprises, or even agri-tourism ventures. Best practice for complete removal favours mulching, reusing and recycling materials wherever possible.

Partial removal: this involves removing only the vines, while retaining infrastructure such as irrigation systems, and gives the option to replant grapes when market conditions improve.

After several financially difficult vintages, some vineyards are being neglected or abandoned. These unmanaged sites present ongoing challenges for biosecurity by harbouring pests, diseases and weeds, and can detract from the appeal of wine regions that rely heavily on tourism. As each year passes, neglected or abandoned vineyards become more overgrown, more structurally compromised, and ultimately more expensive and difficult to remove.

When to start

Timing is critical when deciding whether to rework, replant, or remove a vineyard or block. Each site has its own 'trigger point' at which reinvestment becomes the most cost-effective option. Identifying this point requires consistent monitoring over several seasons. Tracking changes in yield, fruit quality and sales provides an early indication of declining performance.

Assessing the percentage of non-viable or missing cordon on a per-hectare basis (that is, how much of the fruiting zone is still productive) is another reliable indicator. This can be measured by on-ground vineyard assessments or supported by remote-sensing tools such as drone or satellite-based NDVI mapping, which can highlight areas of low vigour or poor canopy density (Bowman 2018).

Growers who participated in consultation sessions emphasised that acting too late can significantly reduce the success of redevelopment. One vineyard manager noted that attempting to rework vines immediately after a severe drought is a common example of missing the optimal trigger point. Although drought quickly exposes problem blocks, vines are often too stressed to produce the vigorous growth needed to rebuild new trunk or cordon architecture, reducing the likelihood of a successful rework.

Prevention is better than cure

Experienced viticulturists and vineyard managers commonly observe that declines in yield and fruit quality associated with ageing wood and deteriorating vine health start to become noticeable after about 20 years. This is why monitoring should begin well before symptoms appear.

A practical approach is to start reviewing blocks as they approach 15 years of age and develop an initial plan to overcome any emerging issues, including reworking sections of the vineyard where necessary.

Market signals might also prompt earlier decision-making. Reduced sales opportunities for certain varieties or falling demand for specific tonnages can encourage growers to consider alternative pathways, such as changing varieties or diversifying into other horticultural crops. Acting early provides more options and typically reduces the cost and complexity of redevelopment.

By contrast, leaving a vineyard unattended can quickly compound the problem. Each year that a block is neglected or abandoned adds significant cost to its eventual removal, as weed growth, structural deterioration and disease pressure increase. Early planning and timely intervention therefore support both vineyard productivity and long-term financial viability.

Timelines

Whether you decide to rework, replant, top-graft, or remove, planning must begin early. The time it takes each option from initial planting to filling the wire varies (Table 1).

Table 1. The time it takes each option from initial planning to filling the wire.

Process	Time from initial planting to 'filling the wire'	Total time (months)	Number of lost harvests	Comment
Replanting dormant rootlings, no fallow period, top tie* year 1.	September year 1 to April year 4.	44	3	Pushing vines to fill the wire in the first year will reduce the timeline by 1 year.
Reworking from the trunk, fill the wire in year 1.	September year 1 to May year 2.	21	1–2	Might end up with better vine structure by not cropping in the second year after reworking.
Top-grafting, fill the wire in year 1.	September year 1 to May year 2.	21	1	Assuming all goes well with the top-grafting process.
Removing.	Add a 3-year rest/fallow period before replanting with another crop.	–	–	Start removal as soon as possible as costs increase with every year the vineyard is abandoned.

*Tying up the top of the trunk to the cordon wire.

Reasons for changing a vineyard

Deciding which option is best for a vineyard is not always easy; there are many vineyard-specific factors to consider, such as vineyard ownership and the operating environment. The complexities involved mean that it is possible and reasonable for 2 different management teams to develop 2 different plans for the same vineyard or block. Some of the factors to be considered when deciding are shown in Figure 5.

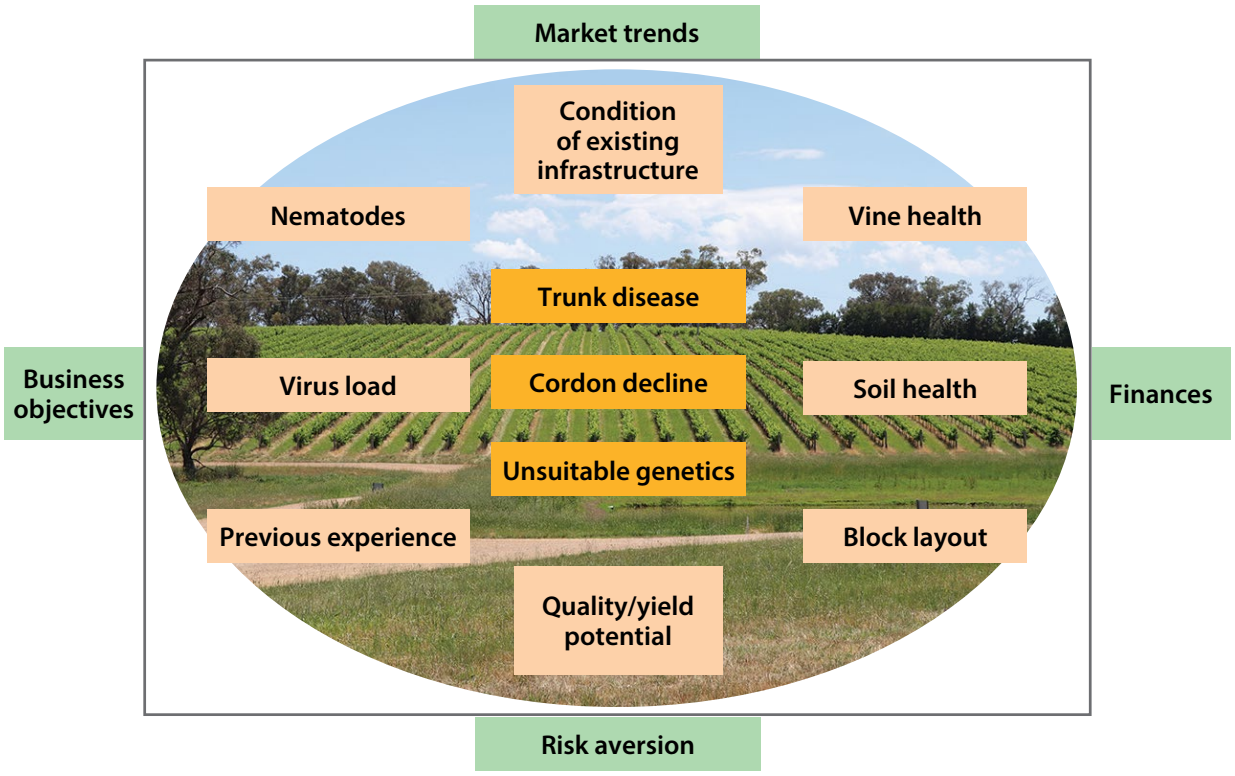

Figure 5. Factors to consider when deciding whether to rework, top-graft, replant or remove a vineyard. Source: Nick Dry.

A good starting point is to define the primary reason or underlying problem for change in the vineyard. If you do not know the underlying reason for making the change, then you are essentially guessing which option is best. Making the wrong decision could have significant financial implications for the business.

Other considerations are related to the vineyard status and are particularly important when deciding whether to top-graft, rework, replant or remove.

Using real estate investment terminology, analysing these secondary considerations is about making sure the vineyard has 'good bones' for reinvesting in top-grafting, reworking or replanting and that you are 'not throwing good money after bad'.

Key questions to consider include:

- Will the infrastructure last beyond the reinvestment payback period?
- Did the block have good quality and yield potential before problems started?
- Does the current block layout suit your plans?
- Is there any virus or disease?
- Is the soil in good condition?

Strategic and financial factors

Further influencing factors require more strategic thinking, for example:

- Is changing the vineyard financially viable?
- What is the cash flow?
- How much work can you afford to do?
- What are the market trends?
- Is it the right variety to meet your goals?
- What is the 10-year plan?
- Finally, how much risk are you willing to take? If you are looking to try a new process, such as top-grafting or to rework a disease-affected vineyard, understanding the risk is important.

Risk

Even with all the right preparations and a vineyard well-suited to the process, top-grafting can fail due to growing season conditions (too hot/too cold/too wet) or because of unexpected incompatibilities between the scion and rootstock. When top-grafting goes wrong, it can take years to remediate with re-grafting and training; in some cases, only complete removal and replanting can fix the situation. Growers must be aware of these risks before committing to the process.

Regional and climatic factors

Each region has factors that strongly influence whether it is best to rework, replant, top-graft, or remove. These are based on the end-product objectives, growing conditions and related vineyard management. The following information was developed from consultation workshops with vineyard managers and viticulturists in NSW.

Warm–hot regions with low rainfall (based on Griffith)

In these regions, the focus is on yield from younger vines (Table 2). The longer growing season, access to water, and the quick establishment of newly planted vines mean that replanting is generally the preferred option. An exception is in relatively young vineyards (with good infrastructure and vine health), where you would like to change the variety by top-grafting or those exhibiting problems associated with tight cordon wrapping, as these can be fixed by reworking.

Removal is becoming more common in this region due to oversupply. In 2025, the vintage oversupply was estimated to be about 375,000 tonnes (Wine Australia 2026).

Table 2. Key considerations influencing reinvestment decisions in warm–hot regions with low rainfall.

End product objectives	Growing conditions	Vineyard management
The yield from younger vines is profitable.	Lower rainfall and therefore lower incidence of trunk disease.	Higher reliance on vineyard mechanisation, therefore potentially less well-suited to reworking and top-grafting.
Dynamic variety changes to match market demands, that is, requires a consistent replanting program.	Longer growing season and access to water lead to quicker establishment of newly planted vines, compared with cooler climates.	Using high vigour rootstocks for drought tolerance allows for young vines to establish more quickly. Market demand for some varieties is at an all-time low, and these are being removed in some areas.

Warm–hot regions with high rainfall (based on Hunter Valley)

Maintaining older vines for quality and wine style, marketing or preserving genetics are major factors to consider when deciding to rework vines in regions such as the Hunter Valley (Table 3). However, it is also important to recognise that even after successful reworking, the block yield potential is lower than with replanting. This means the block must be financially viable at those lower yields. For producers who do not make their own wine, negotiating for a higher price/tonne could be considered before reworking. However, with the current market saturation, this might not be possible.

Another important consideration is the high risk of trunk disease in this region. When reworking, infected vines can be removed, but care must be taken not to infect new vines or leave wounds for infection entry.

Table 3. Key considerations influencing reinvestment decisions in warm–hot regions with high rainfall.

End product objectives	Growing conditions	Vineyard management
Maintaining vine age is important for quality and wine style.	Higher rainfall increases trunk disease (particularly Botryosphaeria dieback).	Consider how to manage the vines in premium blocks for yields that will allow for the expression of the anticipated style after reworking or top-grafting.
Preserving genetics from older vines is important for the region.	Higher rainfall increases the need for weed control.	Older vineyards have deteriorating infrastructure. Removing structurally unsound vines with trunk diseases and unsalable varieties is also occurring.

Cool–warm regions with moderate rainfall (based on Canberra, Tumbarumba and Orange)

In these regions, there is a general focus (Table 4) on the quality benefits that come with older vine age. This, coupled with the slower establishment of younger vines, means that reworking is perhaps more easily justified. However, this must be balanced with the opportunities provided by replanting and changing to 'quality' clones and appropriate rootstocks.

Table 4. Key considerations influencing reinvestment decisions in cool–warm regions with moderate rainfall.

End product objectives	Growing conditions	Vineyard management
Greater focus on quality, lesser focus on yield.	Higher rainfall increases trunk disease (particularly Eutypa dieback).	Cooler climates typically have a higher cost of production.
A higher-value end-product is often based on older vines.	Cooler conditions and shorter growing seasons will affect how quickly young vines can establish.	Rootstocks appropriate to cooler conditions generally have low vigour.

The final decision

There is no magic formula to determine the best option for a vineyard because every site is different, and so is every grower. Whatever option you choose needs to be well-planned, properly budgeted, documented and reviewed for planning. Do not rush into a decision; if in doubt, delay it for a year, try some techniques, collect more data, talk to your network about their experiences and continue planning.

Reworking: key considerations

There are many ways to approach reworking. This section aims to help you plan the process.

Vineyard suitability

Implementing a reworking program to remedy declining wood health is a major undertaking that requires a significant financial commitment. Before starting, you need to be confident the vineyard block you are investing in is suitable. To help determine a block's suitability to reworking, a reworking suitability checklist is included in Table 5. If you find that you are marking a cross next to some or most of the factors listed, then the best decision might be to remove and replant the vineyard and take it as an opportunity to plant a different variety or clone, revitalise the soil or upgrade infrastructure.

Table 5. A vineyard suitability checklist for reworking.

Vineyard/block attributes	✓ or ×
Trunk disease has not spread to ground level.	
Vine dieback is not significant; look to remove and replace instead.	
Historical performance (yield/quality) was good before problems developed.	
Vines are free of grapevine virus and disease.	
Variety is suited to reworking.	
Block layout/row orientation is suited to current and future requirements.	
The vineyard infrastructure is in good condition and worthy of reinvestment.	
There is a low proportion of missing vines.	
There are no major soil health issues.	
The current variety is in demand.	
The current variety/clone/rootstock is suited to the site.	
No immediate plans to set up for different mechanisation processes.	

Adapted from Hoare (2017).

Varietal suitability

Some varieties, for example Cabernet Sauvignon, are less suited to reworking as they do not produce water shoots as readily as others. Semillon might also present some challenges, particularly if the vineyard has suffered from prolonged drought before reworking or if the vines are generally in poor health (low capacity to produce new, strong shoots for re-training). There are still options when presented with these scenarios, such as:

- training the water shoots before reworking* (Figure 6)
- top-grafting the original variety into the trunks well below any trunk disease infection
- using a combination of approaches, beginning with reworking and, where vines have not thrown a shoot, using top-grafting to fill in the gaps.

*In this approach, water shoots are identified and trained up to the wire in the season before reworking. This will lead to a quicker return to yield. The key management consideration is protecting the shoots from damage (particularly from herbicides) during the growing season. This approach is more successful in regions with lower rainfall and less need for weed control. In higher rainfall regions, this approach has been used in combination with grow guards to protect vines from herbicide damage. There are additional costs associated with training shoots and using grow guards, and this needs to be considered when deciding which option to use.

Figure 6. A water shoot trained in the season before reworking. Photo: Nick Dry.

Whole row/block approach versus individual vine approach

Based on Wine Australia's *Best practice management guide for grapevine trunk disease*, deciding on whether to rework large areas (whole rows/complete blocks) or individual vines is determined by the grape value and percentage of vines affected. While this guide was written for trunk disease-affected vineyards, the same principles apply in vineyards with cordon strangulation, crown gall-like symptoms and where spurs have been lost through mechanical damage from harvesters and pre-pruners.

The **whole row/block approach** is best suited to vineyards where grape value is lower and/or where symptoms are widespread throughout the block. It provides a uniform, consistent outcome and is easier to implement because it removes the need for vine-by-vine decision-making. This technique is well-suited for less-experienced operators.

The **individual vine approach** is better suited to higher value grapes or where there is a lower percentage of symptoms in the vineyard. This approach is particularly successful when integrated into an annual management plan, but it does require a more experienced operator who can make decisions 'on the run'. This approach can also be applied in vineyards with crown gall-like symptoms.

Grapevine trunk disease

For reworking to be successful, it is critical to remain vigilant in identifying and managing grapevine trunk disease (GTD). For detailed information on identifying diseases, assessing vineyards, and a 'decision tree' for developing a remedial management plan for vines affected with trunk disease, it is highly recommended that you read Wine Australia's *Best practice management guide for grapevine trunk disease* (Figure 7).

Reworking in vineyards with trunk disease (remedial surgery)

Using reworking to fix trunk disease requires careful planning. Before making any decisions, it is highly recommended that you read Wine Australia's *Best practice management guide for grapevine trunk disease*.

A primary consideration when reworking in vineyards with trunk disease is deciding where to cut the vine. The answer will depend on how far the trunk disease has spread. If it is only in the cordons, then only the cordons need to be removed. If it has spread down the trunk, then the cut will need to be closer to ground level.

With experienced operators who can identify symptoms, work can be done on a vine-by-vine basis where cuts are made until symptoms are no longer observed, with the final cut made at least 200 mm below the infected woody parts (Sosnowski et al. 2017). While this will make the process slower, if done properly, this option will reduce the length of the shoot required to reach the cordon wire and hasten re-establishment.

Successful reworking relies on accurately assessing the extent of internal trunk infection to identify how far back each vine needs to be cut. If operators are not confident or experienced in accurately identifying symptoms, then a decision to cut all vines at a uniform height from the ground can be made. The closer to the ground the vine is cut, the lower the risk of retaining the disease, but the further you need to train the new shoot.

Reworking in vineyards without trunk disease

Reduced wood productivity in vineyards without trunk disease is generally associated with cordon strangulation (Figure 8) from tight wrapping at the establishment site (Caravia et al. 2015) or where spurs have been lost through mechanical damage from harvesters and pre-pruners.

The main decision will be whether to only rework the cordon, to rework from the trunk, or to combine both approaches. Replacing the cordon is the preferred option as it tends to produce a quicker turnaround on yield. However, suitability for this option will depend on whether any appropriately placed replacement spurs in the crown will produce shoots to be trained as a cordon. If there are no replacement spurs or the spurs are sitting too high above the cordon wire, then the vines should be cut at the trunk and a new water shoot trained.

While vineyard assessments before reworking might not have identified trunk disease, it is important to remain vigilant for symptoms, as shoots derived from an infected part of the vine will eventually show trunk disease symptoms.

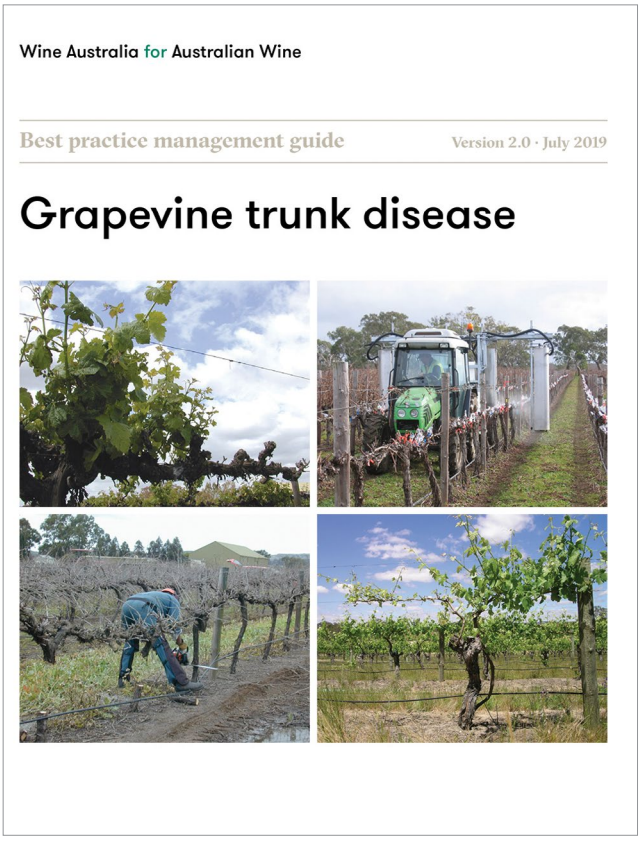

Figure 7. The cover of Wine Australia's best practice management guide for grapevine trunk disease.

Figure 8. Loss of spur positions from cordon strangulation. Photo: Nick Dry.

Preventing trunk disease

Even if you are reworking for reasons apart from trunk disease, it is still important to implement trunk disease prevention strategies. Again, Wine Australia's *Best practice management guide for grapevine trunk disease* is your go-to resource on this subject. The guide focuses on the following as key prevention strategies:

Timing – trunk disease spores are released after rain, so avoid cutting trunks and cordons in wet weather.

Wound protection – several products that are effective against trunk disease spores can be applied to wounds (Table 6).

Disposing of the woody parts of the vine – woody parts potentially contain trunk disease spores and need to be either buried or burnt. Mulching is not sufficient to reduce the risk of retaining inoculum (spores) in a vineyard.

Developing the new vine structure

The reason for reworking is to develop a new vine structure with healthy, strong wood and well-spaced spurs. For sites with low vigour potential (marginal soil or where soil nutrition is low), increasing nutrient inputs in the period leading up to reworking will help build vine capacity and maximise the opportunities for the vine to produce a strong and healthy shoot that will ultimately become the foundation of the new vine structure.

For sites with high vigour potential, it might be necessary to leave 2 or more water shoots because if all the vine's energy is directed into one shoot, it will result in long internodes and excessively spaced spur positions.

It is essential to budget for multiple passes during the first 2 growing seasons to effectively manage vine training and ensure vine yield is re-established as rapidly as possible. Losing a harvest because you are not keeping up with vine training will very quickly undo the economic benefits of reworking.

Managing the vines after reworking

While the new vine architecture is maturing, it is important to manage the vines appropriately to retain the value of the financial investment.

Vine balance – the primary aim of reworking is to increase yield, but it is important not to over-crop the vine in the first couple of seasons, as this can have negative implications on the quality or desired wine style.

Structural support – developing a new trunk and cordon might need additional support, such as a catch-wire to prevent canopy roll and excessive fruit exposure.

Harvesting – hand-harvesting or a 'gentler' machine harvest set-up might be required to avoid snapping the newly established trunk and cordon.

Document and review – any reworking process should be documented and evaluated for success to help guide any decisions on reworking.

Table 6. Registered wound treatments to control Eutypa dieback (ED). Recent research has confirmed these treatments are also effective for Botrysphaeria dieback (BD). Always follow label instructions.

Active ingredient	Example trade name	Application method
Cyproconazole + iodocarb	Garrison Rapid Pruning Wound Dressing	Bottle top applicator
Fluazinam	Emblem	Sprayer
NA	Acrylic paint	Paint brush
Tebuconazole	Greenseal®	Bottle top applicator
Tebuconazole	Sprayseal®	Sprayer
Trichoderma harzianum	Vinevax™	Paint brush/hand trigger or backpack sprayer

Adapted from Wine Australia's *Best practice management guide for grapevine trunk disease* and the AWRI's *Agrichemicals registered for use in Australian viticulture*.

Reworking case studies

Case study 1 – reworking from the trunk

Region	Hunter Valley
Variety	Chardonnay
Reasons for reworking	• Vineyard planted in 1989 and was 29 years old when reworked. • Trunk disease was affecting yields.
Chosen process and justification for the decision	1. Cut off vines (just above the dripline was the best height (Figure 9) for the vines and operators). 2. Remove old cordon and wire (Figure 10). 3. Run, strain and staple new wire. 4. Tie vine trunks to new wire (Figure 11). 5. Install grow guards (tubes were specially made to fit over old trunks): - tubes used for weed control - increased cost of $550 per hectare + installation (2021 figures).
Do you consider the project successful? Why/why not?	'Very successful when training was done in good time, however, any delay with training caused problems with excessive growth inside the tubes. There has definitely been a yield increase from where we were before reworking.'
Take-home messages	• Investing in a well-planned, additional process (that is, the grow guards) can pay off. • Reworking benefits from a 'thinking outside the box' attitude.

Figure 9. Removing the vine structure (winter year 1). Photo: Brett Keeping, Two Rivers Wines.

Figure 10. Cordon and spur establishment after reworking (winter year 3). Photo: Brett Keeping, Two Rivers Wines.

Figure 11. Fully established vine structure after reworking (winter year 4). Photo: Brett Keeping, Two Rivers Wines.

Case study 2 – reworking from the cordon

Region	Hunter Valley
Variety	Semillon
Reasons for reworking	Only 3–4 functioning spurs per arm, some evidence of trunk disease, but vines generally in good health.
Chosen process and justification for the decision	• It is difficult to get Semillon to throw a water shoot and the shoots can be brittle; they are also not easily forced down onto a wire. Based on those factors and with existing spur antlers sitting well above the cordon wire, we decided to train new fruiting canes onto the existing foliage wire (Figure 12 and Figure 13). • Cane selection to avoid trunk disease where possible.
Do you consider the project successful? Why/why not?	Yes, we had very good results.
Take-home messages	• Work with the attributes of the variety. • When reworking, be opportunistic in using existing resources, and in this case, converting the existing foliage wire into the cordon wire.

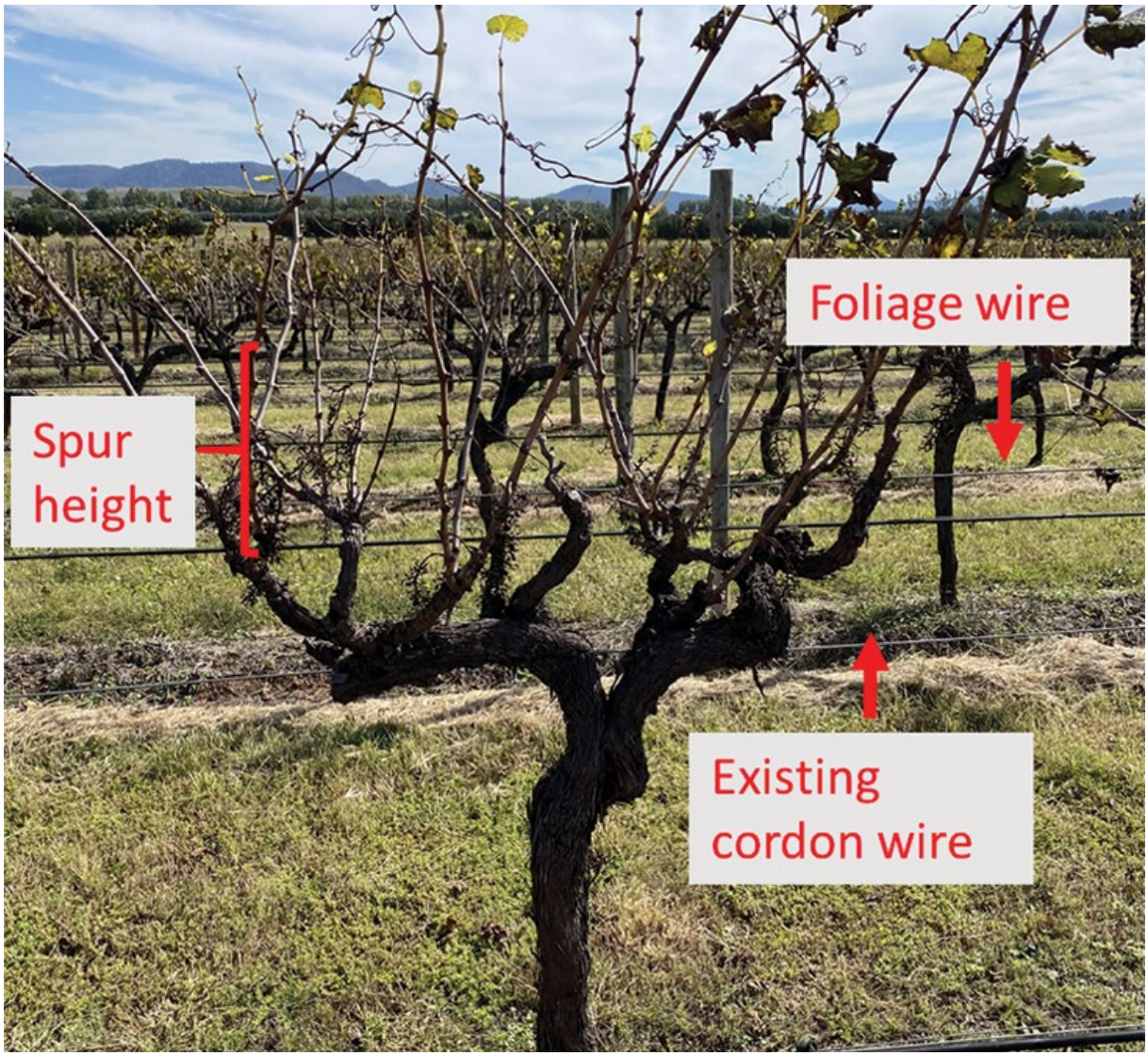

Figure 12. The vine structure before reworking. Spur height is sitting well above the existing cordon wire. Photo: Liz Riley, Vitibit.

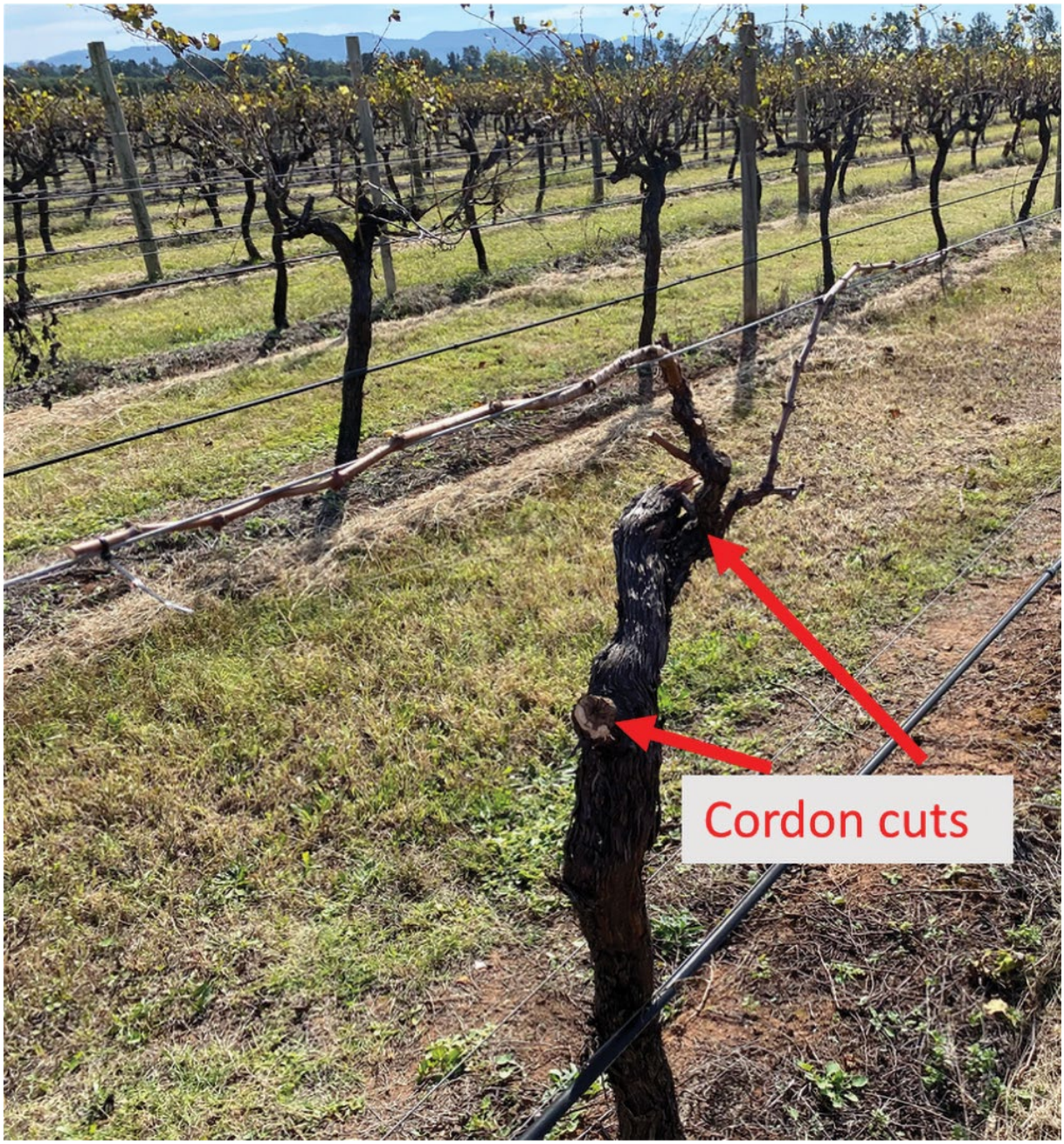

Figure 13. The vine structure after reworking. The new fruiting cordon has been trained to the existing foliage wire. Photo: Liz Riley, Vitibit.

Case study 3 – reworking from the cordon

Region	Orange
Variety	Shiraz
Reasons for reworking	Declining yield, increase in fungal disease, including Eutypa, botrytis, downy and powdery mildew, degrading wood quality, long-term spur pruning resulting in chronic wound sites and pathogen build up, and a desire to improve vine health, longevity and disease resistance.
Chosen process and justification for the decision	Shiraz has been one of the most consistent, reliable varieties. The block had been spur pruned for 25 plus years, which contributed to an increase in fungal pathogens. 1. Using wire cutters, mechanical pruners, and a reciprocating saw, the old cordon was discarded. 2. Selection of the new cane depended on the position on the crown, direction of growth, and cane size. 3. Once a new cane was selected, the fruit wire was cut, and the cordon was cut as close to the crown as possible. 4. Wires with cordon were dragged out of the blocks and placed well away from existing vines. 5. New fruit wire was run along each row and gently rolled down selected canes, secured with cable ties and a copper-based sealant was applied to the large cuts to protect the vines from infection.
Do you consider the project successful? Why/why not?	Yield increased by 41.6% and fruit quality improved with better bunch weights and more balanced growth (Figure 14).
Take-home messages	• Work with the attributes of the variety. • When reworking, be opportunistic in using existing resources and, in this case, converting the existing foliage wire into the cordon wire.
Costs (in 2025)	• Total cost for the Shiraz renovation was $12,500 for 1.1 hectares of vines. This included cutting and removing all old cordons, converting to cane pruning and re-wiring the vineyard. • Cost per vine worked out to be roughly $6.30. • We had 3 workers and it took around 3–4 weeks.

Figure 14. Reworked shiraz vines in Orange. Photo: Daniel Mortimer, Mortimer Wines.

Top-grafting: key considerations

Top-grafting is an excellent way to rapidly change a variety or clone without losing multiple harvests, but success is not guaranteed. Vineyard suitability, vine health, commitment to post-process management and a willingness to carry risk are necessary considerations in the top-grafting process.

Vineyard suitability

Top-grafting is a major undertaking that requires a significant financial commitment, so before starting, you need to be highly confident the vineyard block you are investing in is suitable.

A checklist to determine the suitability of a vineyard for top-grafting is in Table 8; it has been adapted from Hoare T (2017) Reworking vineyards – why, when and how? Part 2. *Wine and Viticulture Journal*, 3: 51–55.

Cuttings

Grapevine virus is a major consideration. The potential detrimental effects of combining a virus from the scion and rootstock or introducing a virus from a rootstock into a sensitive scion are high; both the scion and rootstock must be tested.

Before ordering or taking cuttings, calculate how many buds are required. The number of usable buds will depend on each cutting, which will be influenced by variety, growing season and the grafter's preferred bud size. The general rule is to budget on 2 buds per cutting plus some extras for any re-grafts. Cuttings supplied from nurseries and vine improvement groups will generally come in bundles of 100.

For example:

1,500 vines × 2 buds per vine = 3,000 buds @ 2 buds per cutting = 1,500 cuttings

+ 10% for re-grafts* = 1,650 cuttings; rounded up to 1,700 cuttings.

*Do not give the spare cuttings to the grafter in case they get cut up for the first pass.

Table 8. A vineyard suitability checklist for top-grafting.

Vineyard/block attributes	✓ or ×
Current variety is not viable and unlikely to change in the short term.	
New variety selected based on regional suitability and saleability in the short to mid-term.	
Vineyard infrastructure is in good condition and predicted to remain so for the mid-term.	
Vine trunk suitability – diameter, straightness, disease status acceptable, general health (no post-bushfire or frost damage).	
Vine uniformity is high; low numbers of missing vines.	
Costs of grafting and cash flow are organised.	
Vineyard labour for training is accessible and reliable.	
Knowledge of grafting preparation, post-grafting management, timing and pitfalls are well understood by the vineyard manager.	
Virus testing was performed on a representative sample from the vineyard rootstock to be grafted and diagnostic results confirm suitability for grafting.	

Adapted from Hoare (2017).

Top-grafters are characteristically particular about budwood, which is understandable as bud matching and quality are critical to grafting success. Always check with the grafter for their preferred cutting diameter specification before acquiring the cuttings. If the cuttings cannot be supplied to these specifications, order extra cuttings to provide more material to work with. Also, check with the grafter for their preferred treatment and storage conditions. Usually, cuttings should be tagged (with a permanent marker), hydrated, stored in clean plastic bags and refrigerated between 2 °C and 5 °C. Include 8–10 days' notice for getting the cuttings from the supplier to the grafter, especially if the cuttings are coming from interstate. Do not transport cuttings during hot weather.

If the cuttings are coming from a commercial vineyard, inspect the block pre-harvest to check and tag any off-types (that is, vines of the wrong variety) and also post-harvest (before leaf-fall) to identify and tag any virus-infected vines. Remember, the quality of the cuttings will 'make or break' the vineyard reinvestment; do not diminish the importance of this critical resource.

Managing the vines after top-grafting

Training the new shoots is critical to success, and the best top-grafting (Figure 15) outcomes result from having quick, but regular training passes (for example 7–10). A good tip is to develop a program before the growing season and then confirm the availability of your workforce for the peak labour periods. An excellent resource for planning your post-grafting management program is summarised in Table 9 (adapted from Hoare 2017).

Figure 15. An example of a well-managed vine, 5 months after top-grafting. Photo: Nick Dry.

Table 9. Post-grafting checklist for factors contributing to the success of field grafting.

Management	Monitoring symptoms	Action
Soil moisture	Too wet: excess sap flow, delayed bud burst, stunted shoots. Perform a 'squeeze test' around buds, look for dampness on the trunks.	Make cuts, withhold irrigation, and continue monitoring until bud burst; more than one pass of cuts might be needed.
Frost	Frost weather warnings.	Mow cover crop, mid-row growth, clean out under-vine weeds and debris, roll mid-row if soil is exposed; activate frost fans or irrigation sprays.
Pests and diseases	Monitor for mechanical damage to buds, leaves and shoots. Look for delayed bud burst, stunted, diseased or damaged vegetation.	Apply appropriate control measures within industry guidelines to maintain a pest and disease-free vineyard.
Secure grafted shoots	Avoid blown-out or broken shoots.	Install training strings immediately after the grafters finish and prepare vine trainers for the first few training passes.
Training/ de-suckering	Rolling and unsecured grafted canes. Water shoots/suckers on the trunk.	Train shoots onto a wire, remove all water shoots except one at the highest point until grafted buds have burst; this can then be removed. Expect up to 10 training passes.
Liaise with grafters	Unsure or inexperienced with post-grafting management.	Call grafters with any questions to discuss post-grafting management.
Prepare for re-grafts	The first round of grafted buds did not grow.	Consult with a grafting contractor. Maintain at least one water shoot at the highest point on each vine to preserve it for grafting the following season.

Adapted from Hoare (2017).

Top-grafting case study

Top-grafting a new variety

Region	Canberra
Variety	Riesling on Shiraz
Reasons for top-grafting	• Vineyard planted in 2018, top-grafted in November 2024. • Change of variety due to climate and wine variety demand.
Chosen process and justification for the decision	1. Cut off vines (just above the dripline was the best height (Figure 16) for the vines and operators). 2. Remove old cordon and wire. 3. Run, strain and staple new wire. 4. Tie vine trunks to new wire. 5. Install grow guards (tubes were specially made to fit over old trunks): - tubes used for weed control - increased cost of $550 per hectare + installation.
Do you consider the project successful? Why/why not?	'Very successful; of the 850 vines, only 17 did not bud. Another 50 were damaged by strong winds, so we needed the Shiraz to re-grow and to re-graft with Riesling (Figure 17) in November 2025.'
Take-home messages	• Ensure wind protection while the shoots develop to reduce replacement costs, that is, tie to the cordon sooner. • Top-grafting to change varieties is quicker to harvest than replanting as the vines are already established. • Reduced costs compared with removing and replacing. • Use if vines are free of trunk diseases.
Cost (contractor) (in 2024)	Purchase of clean, disease-free, certified 4 bud cuttings $2.75, and grafting to the Shiraz rootstock, total approximately $4.00 a vine.

Figure 16. Riesling top-grafted onto Shiraz rootstock.

Figure 17. Successful top-grafting of Riesling to Shiraz rootstock.

Replanting: key considerations

Replanting is the preferred option where vineyards:

- are suffering from high levels of trunk disease
- cannot support strong shoots developing for rebuilding the vine architecture
- have inappropriate infrastructure or block layout
- have an unsuitable existing variety, clone or rootstock.

Replacing vines or the whole vineyard

Removing and replacing only the vines (and possibly the cordon wire) is about half the cost of a complete vineyard redevelopment. However, completely redeveloping the vineyard is an opportunity to start again and learn from mistakes or build on successes. These could be related to row orientation, block layout or infrastructure materials and design. Completely redeveloping the vineyard also provides an opportunity to remediate the soil without infrastructure being in the way. Regardless of the option chosen, be aware of virus transmission from remnant roots, especially grapevine leaf-roll viruses.

Leaf-roll 3 virus transmission from remnant roots

Leaf-roll 3 (LR3) virus is the most economically significant virus in Australian viticulture, affecting both yield and quality. There have been reports of LR3 virus being transmitted from recently removed vines to new plantings, leading to high levels of infection in the newly planted vines (Daane et al. 2012).

A mealybug species that spends part of its life cycle on grapevine roots is the main cause. When vines are removed, remnant roots left in the ground remain as a viable food source for the mealybug. If the old vines are infected with LR3, it will also be in the roots. When feeding on these roots, the mealybugs spread the virus to the roots of the newly planted vines. Therefore, removing these remnant roots is critical and should be the primary focus of managing this potential problem. The current recommendation is to remove roots down to at least 300 mm (Bell 2020). Note: applying herbicide to vines before removal did not affect the viability of remnant roots and so is not recommended as a control measure (Bell et al. 2009).

Grafted or own-rooted vines

The difference between own-rooted vines and grafted vines is that the root portion of grafted vines has a hybrid American vine species, whereas own-rooted vines are ungrafted and are therefore growing on their 'own roots'.

Own-rooted vines are susceptible to phylloxera, whereas grafted vines can grow in the presence of this soil-borne pest. Depending on the rootstock, other potential benefits of using grafted vines include tolerance to salinity, drought and nematodes, influencing vine vigour, yield or rate of ripening.

The main consideration when selecting between grafted or own-rooted vines is cost; a grafted vine costs approximately 2.5 times more than an own-rooted vine. However, this could be a small price to pay for insurance against phylloxera.

Furthermore, there is scientific and commercial evidence suggesting that appropriately selected rootstocks will increase profitability compared with own-rooted vines by either leading to more consistent yields (without affecting quality) or by reducing inputs (water and nutrients). These increased profits will more than pay for the increased costs of the planting material over the life of the vineyard (Dry 2004).

Dormant rootlings or potted vines

Dormant rootlings should always be the first-choice product because they are propagated and callused in the nursery, then grown in a field nursery (Figure 18). This means they are already one year old and fully lignified with high carbohydrate levels when supplied. The only negative is the long lead time (15–18 months) from order to supply, whereas potted vines (green vines/spring banded vines), which are rapidly grown in a greenhouse (Figure 19), are supplied after about 10–12 weeks. This means potted vines will only be partially lignified and have limited carbohydrate stores when supplied. They are also supplied later in the season when it is potentially hotter and drier.

Figure 18. Rootlings are grown in a field nursery from late spring until late autumn. Photo: Yalumba Nursery.

Figure 19. Potted vines are grown in a greenhouse for approximately 10 weeks and are supplied in late spring/early Summer. Photo: Yalumba Nursery.

Rootstock selection

Depending on experience, choosing a rootstock for a vineyard can be complicated. However, many resources are available to help. Most notable is the Wine Australia-funded, web-based Rootstock Selector (www.grapevinerootstock.com).

This highly recommended tool was adapted from the Yalumba Nursery Rootstock selector and has been updated using the latest research findings from Australian and international resources; hence, it should be the starting point for any investigations on rootstock selection. The tool is easy to use and allows growers to input their general site information, and based on the data, a list of suitable rootstocks and detailed information about their attributes will be provided.

Importantly, this tool contains updated information on the relative susceptibility, tolerance and resistance of each of the rootstocks to the Australian phylloxera genotypes.

Creating a balanced vine by matching rootstock vigour to scion and site potential

Rootstocks influence vine vigour, so when selecting a rootstock, the inherent vigour of the scion and the site vigour potential must be considered. For example, a high vigour scion (for example Shiraz) grafted onto a high vigour rootstock (for example Ramsey) planted on a high vigour site will produce excessive vigour. Conversely, a lower vigour scion (for example Semillon) on a low vigour rootstock (for example 101-14) on a low vigour potential site will produce inadequate vigour to support the crop load. In both cases, maximum quality/yield potential will be hard to meet without significant inputs.

Rootstock characteristics: practical considerations

When selecting a rootstock, it is important to recognise that there is no perfect one for a site. Successful rootstock use is as much about understanding and managing the characteristics of that rootstock as the selection itself. In addition to the information provided in the grapevine rootstock selector, here is a list of the main rootstocks used in Australia and the practical considerations of using these.

Ramsey (*Vitis champinii*)

Ramsey rootstock imparts high vigour and generally encourages higher yields. It also has excellent salinity and nematode tolerance. As it produces a deep and extensive root system, it is the most drought-tolerant of all the rootstocks available in Australia, making it an ideal rootstock for hot regions. To maximise water use efficiency and quality, Ramsey should be irrigated less frequently than other rootstocks and vines on their own roots. Growers who manage Ramsey with the same irrigation schedule as other rootstocks or their own roots will find that the vines produce excessive vigour.

140 Ruggeri (*Vitis berlandieri* × *Vitis rupestris*)

140 Ruggeri is a moderate to high vigour rootstock with excellent drought and salinity tolerance, making it suited to warm and hot climates. This rootstock produces a large, dense root system, requiring less irrigation than vines on their own roots or any with *V. riparia* in their parentage.

140 Ruggeri is susceptible to producing excessive swelling at the graft union that can strangle and kill young vines within 3–18 months of planting. Typically, the percentage of affected vines is very low, but it can be higher when grafted to some scion varieties, including Grenache and Tempranillo. This rootstock can also be difficult to grow in a field nursery, which can lead to shortfalls with orders. However, once established, this rootstock can produce quality outcomes.

1103 Paulsen (*Vitis berlandieri* × *Vitis rupestris*)

A moderate to high vigour rootstock with excellent drought and salt tolerance and good affinity with almost all varieties. It has produced quality outcomes in warm and hot climates in a range of soil types. It has also performed well on low-moderate vigour potential sites in cooler regions where water availability has been limited.

There have been isolated incidences of poor performance of 1103 Paulsen in soil with high or aggressive populations of root-knot nematode (Walker and Cox 2011).

110 Richter (*Vitis berlandieri* × *Vitis rupestris*)

110 Richter has moderate vigour with good salt and drought tolerance. It is particularly well-suited to moderate to high potential sites in warm climates or low–moderate potential sites in cooler climates. The popularity of this rootstock is increasing as growers and vineyard managers become more familiar with its characteristics. It performs similarly to vines on their own roots with the benefits of having better drought tolerance. It can be a difficult rootstock to grow in the nursery, which can lead to shortfalls with orders. As with 140 Ruggeri, this rootstock is also susceptible to producing excessively swollen graft unions.

5C Teleki (*Vitis berlandieri* × *Vitis riparia*)

This rootstock imparts moderate vigour and is best suited to cooler sites on well-drained clay/loam soil. *V. berlandieri* × *V. riparia* rootstocks (5C Teleki and 5BB Kober) tend to produce more lateral spreading root systems rather than the plunging root systems of the *V. berlandieri* × *V. rupestris* rootstocks. It is important to consider this when designing irrigation systems, that is, closer spacing of emitters with lower emitter output will better match the lateral spreading root systems. Avoid using this rootstock on sandy soil in warm climates and at sites with saline irrigation.

5BB Kober (*Vitis berlandieri* × *Vitis riparia*)

5BB Kober imparts moderate to high vigour and productivity and has similar characteristics to 5C Teleki. It is best suited to cooler sites on well-drained clay/loam soil.

101–14 (*Vitis rupestris* × *Vitis riparia*)

This rootstock has low vigour and a short vegetative cycle, which makes it well-suited to cool climate regions. It produces a shallow, lateral spreading fibrous root system and has higher water requirements than other rootstocks.

Planting this rootstock should be conditional on consistent access to irrigation water or in regions with high summer rainfall. Even in cool climate regions, if planted on exposed, shallow or rocky sites, it might struggle to maintain canopy freshness in the summer heat.

3309C (*Vitis rupestris* × *Vitis riparia*)

This rootstock has not been widely planted in Australia but is one of the most widely planted in premium wine-growing regions in North America, Europe and New Zealand. The rootstock is low vigour and, while it is reported to have better performance in dry conditions than 101–14, it will still need consistent access to good quality irrigation water in most regions.

Schwarzmann (*Vitis rupestris* × *Vitis riparia*)

This rootstock imparts moderate to low vigour and good productivity. Similar to the other *V. rupestris* × *V. riparia* rootstocks, they are not drought-tolerant and are best suited to deeper soil where there is access to good quality irrigation. Schwarzmann has been reported to take up higher levels of potassium, which can reduce wine quality. It was once a very popular rootstock, but its use has decreased in favour of 101–14 and 3309C.

CSIRO Rootstocks

In the mid-2000s, CSIRO released 3 rootstocks bred specifically for Australian conditions. These rootstocks have not been widely planted yet, but so far observations from commercial plantings and trials suggest that M5489 and M5512 have good potential to produce quality outcomes, but further evaluation would be required to determine suitability to specific sites.

Merbein 5489 (*Vitis berlandieri* × *Vitis cinerea*)

Merbein 5489 has been the most widely distributed of the 3 Merbein rootstocks. M5489 is more vigorous and produces higher yields than M5512 and M6262.

Compared with more common rootstocks such as 140 Ruggeri and 1103 Paulsen, vigour is generally lower with similar or slightly lower yields (Dry and McLoughlin 2020). There have been reports of variable grafting success in the nursery, which can limit supply.

Merbein 5512 (*Vitis berlandieri* × *Vitis cinerea*)

This rootstock accounts for approximately 20% of the supply of the 3 Merbein rootstocks. In terms of vigour and yield, it sits between M5489 and M6262 (Dry and McLoughlin 2020). When compared with its own roots, M5512 is more vigorous and produces higher yields. There have been reports of variable grafting success in the nursery, which has a limited supply.

Maximising quality assurance of planting material

Bringing any planting material onto your vineyard is a significant threat to your vineyard biosecurity. If the plant material comes with a pest, disease or virus, then it is probably there for the life of the block and could spread into the rest of the vineyard. The quality assurance of planting material can be maximised by ensuring your supplying nursery is accredited and has followed virus and trunk disease management protocols.

Nursery accreditation

Accreditation might be from either the Vine Industry Nursery Association (VINA), Nursery Industry Accreditation Scheme (NIASA) or ISO:9001 Quality Management System. Accreditation does not guarantee freedom from pest, disease or virus, but does indicate that the nursery is run with professionalism, has quality systems in place, has product traceability, and understands the principles of propagation.

Grapevine virus protocols

To minimise the risk of viruses in your planting material, ensure the nursery:

1. inspects source blocks in autumn to identify potential vines with a leaf-roll virus
2. tests scion source blocks (using at least 1 in 200 vines in the last 3 years) to ensure no leaf-roll 1, leaf-roll 3 or grapevine virus A (GVA)
3. has done recent (in the last 3 years) 'complete' virus testing (at least 1 in 200 vines) of rootstock source blocks showing an absence of:
   - leaf-roll virus 1, 2, 3, 4 and 4 (strain 9)
   - grapevine virus A and B
   - grapevine fleck
   - grapevine red blotch
   - grapevine Pinot Gris virus
4. has evidence of at least one 'complete' virus test (refer to list above) on the scion source block.

More information on grapevine viruses and virus testing is available from Wine Australia (https://www.wineaustralia.com/growing-making/pest-and-disease-management/viruses-of-grapevines).

Grapevine trunk disease protocols

Infected planting material can lead to poor vine performance, inability to deal with environmental stress, vine decline and sometimes vine death. To reduce the opportunities for trunk disease to enter and infect plant material, follow these minimum standards.

- **Hot water treatment** (HWT) is critical for controlling trunk disease but should only be done by an experienced operator who understands the process. The HWT is a condition of entry for grapevine propagation material into NSW. Scions and rootstocks should be treated for 30 minutes at 50 °C and rootlings should be treated for 5 minutes at 54 °C.
- **Good nursery hygiene**: does the nursery look clean? Is there any dust or debris? Are benches wiped down regularly, and are grafting machines being cleaned regularly?
- **Pathogens** can build up in nursery soil so field nursery rotation should occur after 3 years, or the soil should be fumigated.
- Always **inspect plant material** before planting; the nursery should do this and, to add another layer of quality assurance, you should also check.

Planting

If you are not planting the vines yourself, it is essential to provide clear specifications on the process you want followed. The specifications can be as simple as:

1. create a wedge in the soil using a shovel with approximately a 100 mm opening
2. place the vine in the wedge opening
3. ensure the roots are oriented downwards (to avoid j-rooting)
4. plant the vines so that at least 50 mm of soil is above the root ball
5. firmly push the soil down around the vine to remove air and to ensure maximum contact between the soil and the roots (that is, no air holes)
6. gently tug the vine upwards to ensure the roots are oriented downwards
7. push back any soil disturbed during tugging.

> Planting young vines is the foundation of a 20+ year investment…take your time and get it right.

J-rooting

J-rooting is a common problem in vineyards that happens when vines are pushed into the ground and the roots get folded upwards causing J-rooting (Figure 20). This has been associated with root and trunk disease (Úrbez-Torres et al. 2014) and can lead to root death. Vines with J-rooting must expend energy redirecting the roots downwards. This can severely delay the time to establish and possibly cause long-term problems for the vine (Figure 21).

Figure 20. An example of severe J-rooting. This rootling was removed (dead) 6 months after planting. J-rooting was not the sole reason for vine death but was a strong contributing factor. Photo: Nick Dry.

Figure 21. J-rooting is evident in this vine that was removed 22 years after planting. The block had always performed below expectations. Photo: Nick Dry.

Cordon wrapping

Wrapping the cordons at the establishment sites too tightly can eventually reduce the effective cordon length by constricting nutrient flow (Bowman 2018). This can result in the cordon wire becoming embedded in the cordon (Figure 22). To prevent this from happening:

1. **Wrap and unwrap**: tightly wrapping shoots helps provide stability to the vine, but it is important to plan and budget for unwrapping once the trunk has developed sufficiently to support the vine. At this point, cordons can either be wrapped loosely around the wire or fastened with a clip or tie*.
2. **Securing cordons at the establishment site**: fastening clips or ties* can be attached to secure cordons at the establishment site. Research suggests that 3 ties along each cordon are required, along with some additional support from foliage wires to prevent canopy roll (Caravia et al. 2015).
3. **Cane-pruning**: wrapping and renewing canes each year for the first 4–5 years until the trunk has established sufficiently to support itself is another option that has been used successfully. As with the option of securing cordons at the establishment site, foliage wires might be required to prevent canopy roll.

*When using clips or ties, make sure they do not end up constricting the developing cordon.

Figure 22. Cordon wine is embedded in the removed cordon.

Replanting case study

Region	Orange
Variety	Shiraz and Chardonnay to Prosecco
Reasons for top-grafting	Market oversupply for Shiraz and Chardonnay, increased disease pressure, especially with powdery mildew in Chardonnay. Many vines were over 20 years old, and productivity was declining. It was easier to remove and replace rather than top-graft or rework. Strategic reinvestment, replant with a more saleable variety such as Prosecco.
Chosen process and justification for the decision	• Two full-time employees were dedicated to the task in the post-harvest period. • Raising the irrigation line was essential before removing the vines to retain the irrigation for the replanting (Figure 23). • An excavator, tractor and trailer were used to pull vines out and manage debris. A squeeze lift and removal head was used to remove the vines, and then a grab attachment was used to collect the vines and place them in the trailer (Figure 24 to Figure 27). • Two employees successfully removed 1,100 vines a day.
Do you consider the project successful? Why/why not?	Reduced 40 hectares to 33 saleable hectares of vines with varieties that meet market demands.
Take-home messages	• Removing old vines has reduced disease pressure and improved vine health, and by cane pruning the remaining vines, reduced powdery mildew pressure. • Converting the old vine material into biochar to be reused in the vineyard.
Costs to remove (in 2025)	• Labour: $640 per day (2 workers at $40 per hour) • Machinery: $800 per day • Total daily cost: approximately $1,400 • Cost per vine: $1.27 to $1.50
Costs to replant (in 2025)	• Cost per vine: $5.25 • Contractors to plant 10,200 vines: $5,674 • Green tubes: $1.60 • Additional casual labour to put tubes on: crew of 14 people took 1.5 days

Figure 23. The irrigation line is raised while the vines are being removed from the block.

Figure 24. The tractor used to remove the vines.

Figure 25. The Kubota head used to squeeze and lift the vine straight up out of the soil.

Figure 26. Removed vines.

Figure 27. Tractor, trailer, excavator and two employees removing the vines from the block, infrastructure left in place for rootlings.

Figure 28. A new planting in the Canberra region.

Removing: key considerations

Removal should be considered when:

- vineyards are no longer economically viable
- disease or pest pressure (for example phylloxera) has resulted in severe vine decline or death.

It is best to remove a vineyard as soon as the last harvest is complete. Abandoned or damaged vineyards are costly to remove, and this cost increases with every year a vineyard is abandoned.

AWRI guide for vineyard removal and waste management

The Australia Wine Research Institute (AWRI) released a *Vineyard removal and waste guide* (https://www.awri.com.au/wp-content/uploads/2025/04/Guide-for-Vineyard-removal-and-waste-management.pdf) and an accompanying Excel tool to assist with managing and removing a vineyard. These are an excellent resource to help with decision-making.

Removing all or part of the vineyard

- When removing the vines and the infrastructure, this should be done as close to the last harvest as possible.
- The longer a vineyard is neglected, the more it costs to remove.
- When only removing the vines, make sure the remaining infrastructure is not damaged.
- The main section that will need replacing when replanting is the cordon wire.

Copper chrome arsenic-treated posts

Between 1.3 and 3.3 million copper chrome arsenic (CCA) treated posts are being replaced annually in Australia. Currently, there are no recycling solutions. It is advised to reuse the posts in fencing and gardens where possible.

Growers are advised to store the unusable posts in a dry area on waterproof flooring until they can be disposed of at a licensed landfill.

Wine Australia is working with various partners to create alternative, low-emission uses for end-of-life CCA posts.

Removing case studies

Case study 1 – removing to reuse the area

Region	Central Ranges
Variety	Shiraz and Cabernet Sauvignon
Reasons for removing	• Vineyard was planted in 1998–99 and was 25–26 years old when removed (no period of abandonment). • Oversupply meant they are unable to sell fruit.
Chosen process and justification for the decision	A 5-step process completed by the contractor: 1. Unhook the irrigation tubing from the wire. 2. Wind or roll up the tubing (Figure 29). 3. Wind or roll up the wire. 4. Remove the posts and pile them up ready for sale or reuse (Figure 30 to Figure 32). 5. Pre-ripping the ground (Figure 33) makes it easier to remove the vines (Figure 34). We wanted to reduce the vineyard by half and the process was selected as the most environmentally friendly approach. Retained 32 hectares and is now a mixed enterprise with stock.
Do you consider the project successful? Why/why not?	'Very successful if completed early. If the vineyard is abandoned for a period, the costs for removing it increase. We can now graze stock in the area formerly used for vines.'
Take-home messages	• Avoid using wire with dripper tube as it might affect recycling opportunities. • Removing a vineyard straight after harvest is advised as abandoned vineyards with stock damage are difficult to recycle and cost more to remove as the years progress.
Costs (in 2025)	• 3 m × 2 m vine spacing removal costs $2,750 per hectare. • Some costs can be recouped by reselling steel, wood posts and irrigation lines in good condition.

Figure 29. Bundled irrigation tubing after rolling.

Figure 30. Steel posts bound for resale.

Figure 31. Wooden posts bound for resale.

Figure 32. Vines, broken wooden posts, wire and vine guards were pushed together for burning in winter as the timber was not CCA treated.

Figure 33. Rip lines in the soil to assist with removing vines and posts.

Figure 34. The vines after being removed.

Case study 2 – removing

Region	Hunter Valley
Variety	Any
Reasons for removing	• Grape oversupply means they are unable to sell the fruit. • Trunk disease and vine death.
Chosen process and justification for the decision	• Only posts and vines were removed by the contractor using a skid steer and vine grab. • Oversupply. • Trunk diseases.
Do you consider the project successful? Why/why not?	'Successful if removal is occurring on alluvial or sandy soil, tight dry soil and clay soil tend to slow the process down, making it more expensive.'
Take-home messages	• This method left fewer holes and less disturbance.
Costs (in 2024)	• Wires, dripline and tops of vines had already been removed before entry. • Vine removal $140 per hour. • 120 to 140 vines per hour if conditions are good.

Abandoned and neglected vineyards

Neglected vineyards (Figure 35 top and bottom) can become breeding grounds for pests and diseases, posing serious biosecurity risks to neighbouring vineyards.

Figure 35. Abandoned vineyards.

Neglected vineyards

- Become breeding grounds for pests and diseases.
- Pose risks to neighbouring growers and the broader viticultural industries.
- Remain biosecurity threats as long as vines are alive and can host pests and diseases.

Responsibility lies with both current and new landowners to manage pests, diseases and weeds on neglected sites.

Understanding your general biosecurity duty

Under the *NSW Biosecurity Act*, everyone has a general biosecurity duty (GBD). If you are dealing with a biosecurity matter, you are legally obligated to prevent, minimise or eliminate biosecurity risks as far as reasonably practical.

Neglected vineyards can pose serious biosecurity threats. If pests or diseases are suspected or detected due to vineyard neglect, appropriate response actions must be taken.

For more information, refer to:

Neglected horticultural enterprises (https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0003/1632081/Primefact-Neglected-horticultural-enterprises.pdf)

Managing neglected vineyards and orchards (https://www.dpi.nsw.gov.au/dpi/biosecurity/plant-biosecurity/managing-neglected-vineyards-and-orchards)

General Biosecurity Duty (https://www.dpi.nsw.gov.au/dpi/biosecurity/managing-biosecurity/general-biosecurity-duty)

Management options if keeping the vines

Even if production has ceased, the vines must be managed by:

- maintaining seasonal pest and disease control programs
- mulching or removing unharvested fruit to reduce the risk of propagating pests
- managing weeds by pasture suppression, that is, grazing, slashing or spraying with herbicide

Management options if ceasing production

- The most effective way to eliminate biosecurity risks is to remove and or kill the vines.
- To reduce the spread of pests and diseases:
  - cut vines approximately 300 mm above ground level, ideally in late spring
  - remove and burn the upper vine material or leave it on the trellis to dry out
  - apply a systemic herbicide to the stump immediately after cutting to prevent regrowth
  - control weeds with grazing, slashing or spraying with herbicide to remove potential habitat for pests and diseases and reduce fire hazard.

Note: treated trellis posts (CCA or creosote) **must not** be burned or buried. Dispose of them at a licensed landfill or store them as dry as possible on waterproof floor until they can be disposed of appropriately.

Reporting biosecurity risks

If you suspect a biosecurity issue

- Call biosecurity compliance on 02 9741 4790
- Report online at quarantine@dpird.nsw.gov.au
- Learn more at www.dpird.nsw.gov.au/biosecurityact
- Email biosecuritylegislation@dpird.nsw.gov.au for legislation information.

- **Report anything unusual, do not ignore potential biosecurity risks.**
- **Community effort is essential to protect our industry.**

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NSW GOVERNMENT

Options for vineyards: reworking, top-grafting, replanting or removing

Wine Australia Regional Program NSW–ACT 2025