Impact of eutypa dieback in the Limestone Coast

Stage 1: Vineyard survey

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1. SUMMARY

- A survey of vineyards in Coonawarra and Wrattonbully confirmed that eutypa dieback was prevalent, particularly due to the predominance of the susceptible varieties Cabernet Sauvignon and Shiraz and the age of vineyards.
- Incidence of dieback was higher than foliar symptoms, which may be due to the fact that foliar symptoms are a secondary effect of the disease and can vary from season to season and the presence of other dieback pathogens, such as botryosphaeria and phomopsis.
- Disease incidence was greatest in vines aged over 15 years, increasing up to 2% per year on average, with considerable variation due to varietal differences and vine management.
- Disease incidence was lower in detail pruned vineyards compared with other pruning management systems, probably due to the smaller number and surface area of wounds created and the removal of dead spurs.
- Vineyards reworked by 15 years of age were observed with lower incidence of eutypa dieback, possibly due the increased likelihood of removing all infected wood in the younger vines.
- Planting on rootstocks appeared to reduce incidence of disease, however further investigation is required to confirm this.
- Frost protection appeared to have no effect on disease incidence
- Eutypa dieback incidence was greater in Coonawarra than in Wrattonbully, due to the advanced age of vineyards in Coonawarra.
- Eutypa dieback management consists of removing infected wood and reworking vines and most importantly protecting wounds from infection.

2. INTRODUCTION

Grapevine trunk diseases such as eutypa and botryosphaeria dieback contribute to grapevine decline, reducing productivity and longevity, causing considerable economic loss to the $8.3 billion Australian wine industry. It was estimated that eutypa dieback cost South Australian growers up to $2800 per hectare through lost production (Wicks and Davies 1999).

Trunk pathogens infect vines through pruning wounds, colonise woody tissue at a rate of up to 50 mm/year (Sosnowski et al. 2007b) causing dieback of cordon and trunks, observed as dark wedge-shaped tissue in cross-section. The *Eutypa lata* fungus produces toxic metabolites which are translocated to the foliage, causing stunted shoots, necrotic and distorted leaves, reduced bunch size and uneven ripening.

The occurrence of eutypa dieback in the Limestone Coast wine region has been reported over the past 40 years (Wicks 1975, Highet & Wicks 1998, Sosnowski et al. 2010, 2011). Trunk disease is believed to have a significant effect on grape production, particularly in older vineyards, where it has had longer to establish. More recently, anecdotal evidence suggests that the prevalence of trunk disease is rising with increased reports of dieback and foliar symptoms in the region, along with the many other regions of Australia (Sosnowski and Wicks 2012). There is now a need to quantify the extent of trunk disease in the region and its economic impact to create awareness and facilitate development and implementation of strategies to combat the problem.

Research over the past decade, some of which has been conducted in Coonawarra, has developed effective methods of managing trunk disease by removing existing infection using remedial surgery and protecting pruning wounds from new infection (Sosnowski et al. 2009, 2010). It is envisaged that with a better understanding of the extent of the problem and its future impact, the industry will adopt appropriate methods to manage trunk disease, not only in the Limestone Coast but in regions across the country.

The aims of stage 1 of this project are to:

1. Survey Limestone Coast vineyards in collaboration with growers and vineyard managers for incidence of eutypa dieback across a range of varieties, vineyard ages and management systems
2. Compile the data and provide a report of the current status of eutypa dieback in the Limestone Coast which will contribute towards an economic study (Stage 2)
3. METHODS

From 3-7 December 2013, 207 vineyard blocks across Coonawarra and Wrattonbully were assessed with collaboration from 35 growers/companies. Vines ranged in age from 3 to 100+ years and included 10 varieties with Cabernet sauvignon and Shiraz the most common. In each block, 200 vines were visually assessed (Error! Reference source not found.a&b) for both dieback and foliar symptoms of eutypa dieback. Dieback symptoms consisted of at least two dead spurs on a vine. The number of vines with any symptoms was counted and incidence calculated.

![Figure 1](https://example.com/figure1.png)

Figure 1. Visual assessment of 207 blocks in 35 vineyards throughout the Coonawarra and Wrattonbully wine regions in December 2012.

In addition, information on each vine block was collected in collaboration with growers and vineyard managers. This included variety, age, pruning management system as well as information on whether vines were on own-roots or rootstock, have been reworked and if frost protection was used.

Pruning management systems of cordon-trained vines were as follows:

- Detail – precision hand pruning of vines back to a set bud number level, most spurs will be hand space apart and contain 2 buds.
- Semi-detail – vines machine pruned and then cleaned up by hand leaving varying spur and bud numbers per vine, generally all spurs are cut but may vary from 1-3 buds each.
- Hedge – vines are machine pruned and a very quick skirt around posts and downward facing shoots is done by hand, spurs can be any length depending on where they grew from in the canopy the previous year.

Data was analysed using Microsoft Excel and results and correlations presented graphically.
4. RESULTS
Foliar symptoms characteristic of eutypa dieback (Error! Reference source not found.a-d) were observed in 155 of the 205 blocks surveyed, with incidences ranging from 0.5 to 66%. Dieback symptoms, which ranged from at least two dead spurs to whole dead arms and vines (Error! Reference source not found.e-g), were observed in 190 of the 205 blocks surveyed, with incidences ranging from 0.5 to 100%.

Figure 2. Grapevine trunk disease symptoms observed in Limestone Coast vineyards in December 2012; (a-d) foliar symptoms of eutypa dieback, (e) dead spurs, (f) dead arms and (g) trunk canker on dead vine.
4.1 Variety

Ten varieties were included in the survey of Coonawarra and Wrattonbully vineyards (Table 1). The proportion of blocks surveyed for each variety was consistent with the proportional area planted to each variety in the Coonawarra Geographical Indication Region (Phylloxera and Grape Industry Board of South Australia, 2012).

The six varieties that were represented by four or more vineyards in the survey are presented in Figure 3. Cabernet Sauvignon and Shiraz were observed with the greatest mean incidence of dieback, 47 and 44%, respectively. Sauvignon Blanc was the next most affected variety (35%), but with lower incidence, possibly due to the lower average age of vineyards and the limited number of vineyards surveyed. Chardonnay and Riesling had 30% incidence of dieback symptoms whereas Merlot was recorded with 10%.

The mean incidence of foliar symptoms was 8 and 12% for Cabernet Sauvignon and Shiraz, respectively, with 4% for Chardonnay, 0.6% for Merlot and 0.1% on the four Sauvignon Blanc and five Riesling vineyards surveyed.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Area (ha)</th>
<th>% area</th>
<th>No. blocks surveyed</th>
<th>% blocks surveyed</th>
<th>Ave. vine age (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cabernet Sauvignon</td>
<td>3438</td>
<td>60.8</td>
<td>122</td>
<td>58.9</td>
<td>22</td>
</tr>
<tr>
<td>Shiraz</td>
<td>1159</td>
<td>20.5</td>
<td>46</td>
<td>22.2</td>
<td>30</td>
</tr>
<tr>
<td>Merlot</td>
<td>405</td>
<td>7.2</td>
<td>16</td>
<td>7.7</td>
<td>18</td>
</tr>
<tr>
<td>Chardonnay</td>
<td>358</td>
<td>6.3</td>
<td>8</td>
<td>3.9</td>
<td>21</td>
</tr>
<tr>
<td>Sauvignon Blanc</td>
<td>107</td>
<td>1.9</td>
<td>4</td>
<td>1.9</td>
<td>17</td>
</tr>
<tr>
<td>Riesling</td>
<td>92</td>
<td>1.6</td>
<td>5</td>
<td>2.4</td>
<td>24</td>
</tr>
<tr>
<td>Pinot Noir</td>
<td>44</td>
<td>0.8</td>
<td>1</td>
<td>0.5</td>
<td>15</td>
</tr>
<tr>
<td>Cabernet Franc</td>
<td>38</td>
<td>0.7</td>
<td>2</td>
<td>1.0</td>
<td>26</td>
</tr>
<tr>
<td>Petit Verdot</td>
<td>18</td>
<td>0.3</td>
<td>1</td>
<td>0.5</td>
<td>22</td>
</tr>
<tr>
<td>Pinot Gris</td>
<td>na</td>
<td>na</td>
<td>2</td>
<td>1.0</td>
<td>11</td>
</tr>
</tbody>
</table>

Table 1. Varieties included in the survey, area and proportion planted in the Coonawarra Geographical Indication Region (PGIBSA 2012), number and proportion of blocks surveyed and average vine age.

![Figure 3. Grape varieties surveyed and incidence of eutypa dieback.](image)
4.2 Vine age

The influence of vine age on incidence of eutypa dieback is shown in Figure 4 and 5. Vines (Cabernet Sauvignon) as young as 5 years old were recorded with dieback (20%) and foliar symptoms (0.5%). The prevalence of eutypa dieback symptoms increased with age, more rapidly for dieback (1-2% per year on average) than foliar symptoms (<1%), with a great deal of variation observed for Cabernet Sauvignon and Shiraz between 15 and 50 years of age.

One Cabernet Sauvignon vineyard had reached 100% incidence of dieback by 14 years of age, with Chardonnay and Shiraz vineyards taking somewhat longer to reach 100%, at 33 and 40 years of age, respectively. Merlot was recorded with a maximum of 15% incidence of dieback in a 27-year-old vineyard. A greater rate of increase (4% per year) in dieback incidence was observed in Chardonnay than the other varieties (1-2% per year).

Foliar symptoms reached a maximum incidence of 66% in 50 year old Shiraz vines and up to 36% in 44 and 51-year-old Cabernet Sauvignon vines. Foliar symptoms were recorded on up to 14 and 1.5% of Chardonnay (23yo) and Merlot (22yo), respectively. Shiraz had the greatest rate of increase (1% per year) in foliar symptom incidence.

![Dieback](image1)

**Figure 4.** The effect of age on incidence of dieback on the four most common cultivars surveyed. Vineyards over 60 years old and those reworked are not included in the analysis.

![Foliar symptoms](image2)

**Figure 5.** The effect of age on incidence of foliar symptoms on the four most common cultivars surveyed. Vineyards over 60 years old and those reworked are not included in the analysis.
4.3 Pruning management

Cane-pruned vines were recorded with the highest incidence of dieback symptoms (86%), although only five cane-pruned vineyards were represented in the survey (Figure 7). There was no difference between the hedge (Figure 7a) and semi-detailed (Figure 7b) cordon-pruned vines (46%), however the detailed vineyards were recorded with a mean incidence of 27%. Detailed vineyards were also observed to have lower incidence of foliar symptoms (5%) compared with 16-21% for the other pruning management styles. Figure 7c & d illustrate the result of using saws to hedge-pruned vines which has left large wounds exposed to infection.

Figure 6. Pruning management systems and incidence of eutypa dieback.

Figure 7. a) Hedge-pruned vines with dieback, b) semi-detailed vines with two dead spurs (arrows), c & d) large wounds caused by saw pruners (arrows).
4.4 Reworking

There was a slight decrease in mean incidence of dieback in all vineyards that had been reworked (35%) compared with those not reworked (41%). However, when vines were reworked at ages up to 15 years old, a reduction in incidence was observed. Incidence of foliar symptoms ranged from 8 to 2% across the categories, also reflecting a reduction due to reworking, particularly when conducted up to 15 years of age.

Figure 9 illustrates the use of reworking vines in the Limestone Coast for the control of eutypa dieback, showing successful (a,b & d) and unsuccessful (c) examples.

Figure 8. The influence of reworking on incidence of eutypa dieback. Vineyards were further classified by those reworked at ages up to 20 years old and 15 years old. The number of vineyards in each criteria are indicated in brackets.

Figure 9. The use of remedial surgery to control trunk disease was observed in the Limestone Coast in December 2012; (a) reworking water shoot from trunk, (b) vines successfully reworked with layering seen in background to replace vines that did not produce watershoots, (c) dead vine with shoot taken from top of trunk that did not remove all infected wood and (d) very old, diseased vines (100+ years) sustained by cordon renewal.
4.5 Planting material
Based on this survey, vines planted on own-roots were recorded with a greater incidence of dieback and foliar symptoms (44 and 9%, respectively) than those planted on rootstocks (26 and 2%), with average ages of 24 and 18 years, respectively.

![Graph showing the effect of using rootstocks on incidence of eutypa dieback.](image)

Figure 10. Effect of using rootstocks on incidence of eutypa dieback. The number of vineyards in each criteria are indicated in brackets.

4.6 Frost protection
No effect on eutypa dieback symptoms were observed with vineyards using frost protection.

![Graph showing the effect of using frost protection on incidence of eutypa foliar symptoms and dieback.](image)

Figure 11. Effect of using frost protection on incidence of eutypa foliar symptoms and dieback. The number of vineyards in each criteria are indicated in brackets.

4.7 Region
The incidence of dieback and foliar symptoms were greater in Coonawarra (51 and 10%, respectively) than in Wrattonbully (10 and 1.3%), having average vineyard ages of 27 and 14 years, respectively.

![Graph showing the incidence of eutypa dieback symptoms in Coonawarra and Wrattonbully.](image)

Figure 12. Incidence of eutypa dieback symptoms in Coonawarra and Wrattonbully. The number of vineyards in each criteria are indicated in brackets.
5. CONCLUSIONS

5.1 Variety

Results from the survey indicate that Cabernet Sauvignon and Shiraz, which represent the majority of plantings in the Limestone Coast Wine Region, are very susceptible to eutypa dieback and Merlot is the most tolerant of the main varieties grown in the region. These findings support previous research on susceptibility of varieties (Sosnowski et al. 2007b) along with surveys in other wine regions (Wicks 1975, Highet and Wicks 1998, Loschiavo et al. 2007, Sosnowski et al 2010).

5.2 Vine age

This is earliest vines have been recorded with foliar symptoms in Australia, with 7 years of age being the previously youngest vines observed with foliar symptoms (1%) in the Adelaide Hills (Loschiavo et al. 2007). This reflects the time it takes for foliar symptoms to arise after infection has occurred, which can take 3 to 8 years (Sosnowski et al. 2007a). In terms of dieback, although some vineyards are severely affected within 15-20 years of age, it can often take many more years for the symptoms to become severe.

Therefore, it is important to protect pruning wounds from infection from the first pruning season. As vines age, symptoms become more severe due to; longer incubation time, greater number of wound sites for infection and exposure to more pruning events.

5.3 Pruning management

There were differences observed in the incidence of eutypa dieback symptoms between pruning management systems. Cane pruning generally leaves large wounds very close to the top of the trunk increasing chances of infection and more rapid progression into the trunk and may explain the greater incidence of dieback in this survey. In a long-term (20 year) field trial in France, Dumot et al. (2012) reported greater mortality in cane-pruned compared with cordon-pruned vines.

Hedge pruning can lead to large wounds on the cordons and trunks when saws are used which increases the likelihood of infection compared with detailed pruning. Furthermore, infected wood is not removed and hedge pruned vines can disguise dieback as new shoots fill any gaps, possibly leading to underestimation of disease incidence by growers. At harvest, due to the dense canopy structure, significant damage to wood can occur in these vines, exposing wood to further infection just prior to opening rains which release large loads of inoculum.

Semi-detailed pruning leads to a greater number of wounds and shorter spurs compared with detailed pruning which will lead to a greater likelihood of the establishment of disease.

Detailed pruning generally results in smaller and fewer wounds, leading to an overall lower wound surface area than the other systems, reducing the likelihood of infection. This pruning system also leads to removal of dead, infected wood, slowing disease progression.

5.4 Reworking

From this survey, reworking appeared to contribute to a reduced incidence of eutypa dieback. However, it is important to note the low sample numbers in these categories, so results should be taken cautiously. Previous research has shown that reworking or remedial surgery is the most effective means of controlling the disease once vines are infected (Sosnowski et al. 2011). Success depends on ensuring removal of all infected wood from the vine and reworking the vine from a healthy trunk.

There was considerable variation in incidence of dieback and foliar symptoms for both Cabernet Sauvignon and Shiraz at any particular age. Although reworked vines were removed from this analysis other factors such as pruning management strategies along with use of pruning wound protection may contribute to this variation. Furthermore, as is evident by this survey, factors such as use of rootstock may also be involved, although further research is required to confirm this.

5.5 Planting material

Of the vineyards in this survey, incidence of disease was significantly greater in own-rooted vines compared with those on rootstocks. This is the first report of the effect of rootstock on eutypa dieback incidence in Australia, but further research is required to confirm this finding and examine the reasons for differences. Current GWRDC funded research at SARDI to conduct preliminary evaluation of both rootstock and scion material for potential tolerance or resistance to eutypa and botryosphaeria dieback. In the future it will also be important to evaluate clonal scion material and interactions
between rootstocks in order to determine whether planting material selection can be used to manage eutypa dieback.

5.6 Frost protection
There were no apparent differences between vineyards with and without frost protection. This may dispel the theory that frost affected vineyards are more vulnerable to eutypa dieback disease.

5.7 Region
The incidence of eutypa dieback was much higher in Coonawarra compared with Wrattonbully. Varieties are generally planted in similar proportions in each region. The primary reason for the vast difference is likely to be the greater age of vineyards in Coonawarra, which has provided more time for symptoms to develop.

6. RECOMMENDATIONS
- Control of eutypa dieback can be achieved by remedial surgery which involves removing all infected wood and reworking vines from healthy trunks.
- Prevention of eutypa dieback relies on pruning wound protection. Apply paints and pastes by hand to large wounds associated with reworking vines and following annual pruning, apply fungicides at high volume rates with sprayers that target the pruning wound zone.
- Avoiding rain periods when pruning and delaying pruning until late winter can also assist in reducing susceptibility of vines to infection.
- Data from this survey will contribute to an economic analysis of the impact of eutypa dieback on the Limestone Coast wine industry and provide decision support for managing disease for the long-term sustainability of the industry.
7. ACKNOWLEDGEMENTS
Thanks to PIRSA, SARDI and GWRDC for their financial support of this project. Special thanks to grapegrowers in the Limestone Coast region for their enthusiasm towards the project and allowing access to vineyards for the survey.

8. REFERENCES


