

Grapevine Trunk Diseases

symptoms and distribution

Background

Grapevine trunk diseases are caused by fungal pathogens that grow primarily in mature wood. These can infect either:

1. propagation material and affect growth of newly planted vines; or
2. established vines through wounds (primarily pruning wounds) causing a loss of productivity, often as grapevines reach elite stage of maturity.

Grapevine trunk diseases affect vineyard productivity through:

- increased production cost;
- yield loss and reduced quality; and
- decreased vineyard longevity.

The most prevalent grapevine trunk diseases in Australia are:

1. **botryosphaeria dieback** (formerly known as bot canker); and
2. **eutypa dieback**.

Botryosphaeria dieback is caused by a number of species within the Botryosphaeriaceae family. These fungi infect a wide range of hosts but are most commonly associated with diseases of woody plants such as acacia and eucalyptus. Several Botryosphaeriaceae species are found in most grape growing regions of Australia.

Eutypa dieback is caused by the fungus *Eutypa lata*. *E. lata* was first described on apricot, and has since become an important pathogen of grapevines in Australia.



Figure 1 Botryosphaeria dieback causes dead arm or dieback of the cordons and trunk.

Photograph: Wayne Pitt

Symptoms

The two diseases are often mistaken for each other because some of the symptoms are identical (*Table 1*). Fungi enter the vine via pruning wounds or other exposed areas causing dieback of the grapevine often described as *dead arm* (*Figure 1*). Damage to the vascular system results in the loss of spur positions along the cordon and may progress to the trunk (*Figure 2*).

Wedge-shaped cankers in the trunks and cordons of declining grapevines visible upon cross sectioning are characteristic of both diseases (*Figure 3*).

Other symptoms may include:

- stunted shoots;
- delayed bud burst;
- bleached canes;
- bud necrosis; and
- bunch rots.

Eutypa dieback is distinguished from botryosphaeria dieback by the presence of foliar symptoms, but these are not always present. The foliar symptoms are caused by toxins produced by the fungus, resulting in:

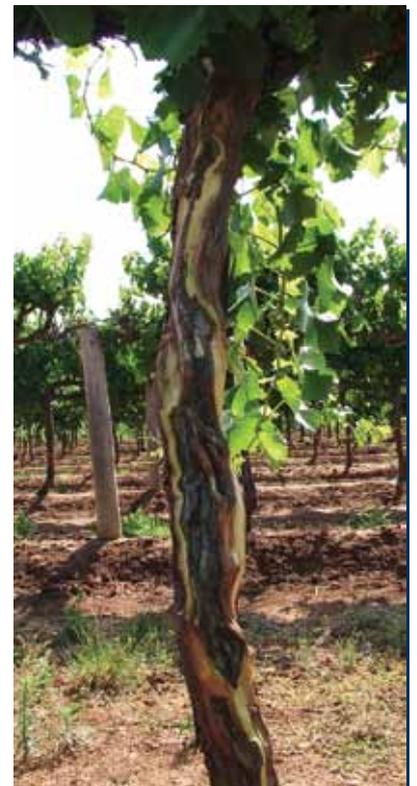


Figure 2 Botryosphaeria dieback in the grapevine trunk.

Photograph: Wayne Pitt

- stunted, yellowing shoots;
- shortened internodes; and
- small cupped leaves with necrotic margins, most obvious in spring (Figures 4 and 5).

Additionally, grape bunches may not initiate, and may drop off after flowering or shrivel. Smaller bunch size and uneven berry ripening may also occur (Figure 6). Fungal fruiting bodies on dead wood infected with eutypa dieback have a charcoal appearance (Figure 7).



Figure 3 Wedge-shaped canker seen in the cross section of the grapevine trunk typical of botryosphaeria dieback and eutypa dieback.

Photograph: Sandra Savocchia



Figure 4 Distorted shoots caused by the eutypa dieback fungus, *Eutypa lata*.

Photograph: Sandra Savocchia

Table 1 Symptoms of the grapevine trunk diseases botryosphaeria dieback and eutypa dieback. Not all symptoms occur together.

Symptom	Botryosphaeria dieback	Eutypa dieback
Wedge-shaped canker when cut in cross section	✓	✓
External cankers	✓	✓
Damage to vascular system	✓	✓
Dead arm	✓	✓
Loss of spur positions on cordon	✓	✓
Stunted shoots	✓	✓
Delayed bud-burst	✓	
Bleached canes	✓	
Bud necrosis	✓	
Dwarfing of shoots and internodes		✓
Yellowing shoots and leaves		✓
Leaf cupping with necrotic margins		✓
Flowers may not initiate or drop off post flowering		✓
Grape berries shrivel		✓
Grape bunch size reduced		✓
Bunch rot	✓	
Uneven ripening		✓

Symptoms not sufficient to accurately identify which grapevine trunk disease is present

Grapevine decline symptoms characteristic of trunk diseases were first reported in the Hunter Valley and Mudgee wine regions in NSW, where they were initially attributed to *Eutypa lata* infection. No foliage symptoms were ever observed, and further investigation revealed the causal organisms to be members of the Botryosphaeriaceae.

Spread in the vineyard

Botryosphaeria dieback

Fungi over-winter as small dark 'pimple-like' structures (pycnidia) on diseased wood. These structures release spores throughout the growing season and following hydration are spread by wind and rain splash. Infection occurs when spores land on fresh pruning wounds, or invade reworking or other wounds. Cankers form around initial infection points and damage vascular tissue, causing wood necrosis and dieback.

Eutypa dieback

The fungus survives on dead wood in fruiting bodies (perithecia) which have a darkened, charcoal appearance (Figure 7). These structures release spores throughout the pruning season and following hydration are spread by wind and rain splash. Infection occurs when spores

land on fresh pruning wounds, or invade reworking or other wounds.

Toxins are thought to be produced by the fungus in the wood and these are translocated to the foliage, producing the unique foliar symptoms of *Eutypa* dieback. Cankers form around initial infection points and damage vascular tissue, causing wood necrosis and dieback.



Figure 6 Grape bunches that form on grapevines infected with *eutypa* dieback are often small (right) and berries ripen unevenly (left).

Photograph: Mark Sosnowski, SARDI



Figure 5 Small cupped leaves with necrotic margins are symptoms of *eutypa* dieback, not seen in *botryosphaeria* dieback.

Photograph: Mark Sosnowski, SARDI



Figure 7 Fruiting bodies on dead, diseased wood with charcoal appearance.

Photograph: Mark Sosnowski, SARDI

Distribution

Eutypa lata and species of *Botryosphaeriaceae* have been the recent focus of research in South Australia and New South Wales. A total of nine species of *Botryosphaeriaceae* have been collectively found throughout winegrowing regions of SA and NSW. In SA research revealed up to 100% of grapevines, in some vineyards, to be affected by *eutypa* dieback. *E. lata* appears to be more widespread in NSW than first expected and has been isolated, along with other diatrypaceae fungi, from the Central Ranges, southern NSW and Big Rivers districts. While *E. lata* tends to favour cool climates with a high annual rainfall, most *Botryosphaeriaceae* fungi are more suited to warmer conditions.

Accurate identification of the causal agents of trunk disease is important in order to determine management recommendations to reduce the impact of grapevine trunk diseases in the vineyard.

It is also important to determine if trunk disease pathogens are present in a vineyard because infected vines can be asymptomatic. Visible symptoms of trunk disease, can take three to eight years to develop.

Management

Botryosphaeria dieback and *eutypa* dieback can only be managed by removing infected wood.

Where cordons are affected, remove dead wood as well as 10cm of healthy tissue and retrain new canes to regain vigour and productivity (Figure 8).

Where the disease has progressed into the crown or further into the trunk, extensive reworking may be required. Remove dead wood as well as 10cm of healthy tissue and train up water shoots to replace missing grapevines thereby regaining vigour and productivity (Figure 9).

It is important to *remove all infected plant material from the vineyard* to reduce the risk of re-occurrence.

Prevention

Avoid pruning during and following wet weather as spores are released after rain for up to:

- 2 hours for Botryosphaeriaceae; species and
- 36 hours for *E. lata*.

Prune early in winter when spore production is low or late in the season when wounds are less susceptible and heal more rapidly with the onset of higher temperatures.

Apply a paint and/or fungicide (Table 2) to all large cuts.



Figure 8 Infected wood has been removed from these grapevines, large cuts painted with protective wound treatment and new shoots trained as replacement cordons.

Photograph: Cathy Gairn



Figure 9 Infected wood has been removed from diseased grapevines and shoots trained to replace trunk and cordons.

Photograph: Sandra Savocchia

Table 2 Fungicides tested as pruning wound treatments to protect grapevines against trunk diseases.

Product	Active ingredient	Use
Greenseal™	tebuconazole	Registered for preventative control of <i>Eutypa lata</i> when applied to pruning wounds.
Vinevax™	<i>Trichoderma harzianum</i> (biological control agent)	
Garrison®	cyproconazole + iodocarb	Provided more than 50% disease control of botryosphaeria dieback and eutypa dieback in recent field trials.
Shirlan®	fluazinam	
Folicur®	tebuconazole	

Grapevine Trunk Disease

survey undertaken by the National Wine and Grape Industry Centre



Project	Distribution of trunk disease pathogens associated with grapevine decline in Australia
Where	Wagga Wagga, NSW
When	2007–2011
Collaborators	Wayne Pitt, Yu Qiu, Nicola Wunderlich, Chris Steel and Sandra Savocchia, NWGIC, Mark Sosnowski, SARDI and Florent Trouillas, University of California, Davis USA.
Funding	Grape and Wine Research and Development Corporation-funded Wine Growing Futures program of the National Wine and Grape Industry Centre

Background

To clarify the occurrence and distribution of trunk disease pathogens for some of the major grapevine regions in Australia, a large survey was conducted. It included some of the main grapevine growing regions of SA and NSW (Table 3).

Aims

The aims of this survey were to:

1. Determine the identity, prevalence and distribution of Botryosphaeriaceae fungi in NSW and SA vineyards;
2. Determine the occurrence of Botryosphaeriaceae fungi on grapevine tissue other than wood

during different reproductive stages; and

3. Establish whether *E. lata* occurs in NSW vineyards.

Methods

4. Ninety-one vineyards across NSW and SA were surveyed for the distribution of Botryosphaeriaceae fungi. A total of 2239 diseased

wood samples were collected by drilling into cordons and trunks of symptomatic grapevines (Figures 10 to 12).

5. Two hundred grapevines from two vineyards in the Hunter Valley with a history of botryosphaeria dieback were surveyed over two growing seasons for the incidence of Botryosphaeriaceae fungi

Table 3 Wine regions included in the survey of grapevine trunk disease pathogens in New South Wales and South Australia.

New South Wales		South Australia	
Northern Rivers	South Coast	Riverland	Adelaide Hills
Northern Slopes	Southern NSW	Clare Valley	Eden Valley
Hunter Valley	Big Rivers	Barossa Valley	
Central Ranges			



Figure 10 Removing bark on a trunk to identify cankers in a symptomatic grapevine

Photograph: Sandra Savocchia

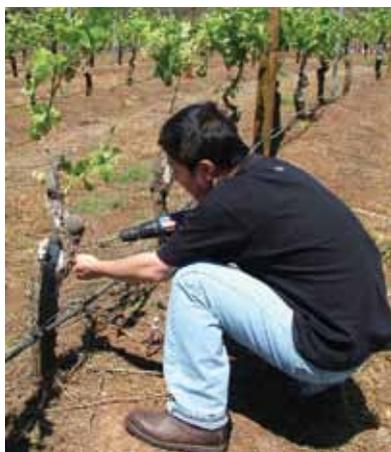


Figure 11 Extracting wood sample from the trunk of a grapevine with a history of botryosphaeria dieback.

Photograph: Sandra Savocchia



Figure 12 Grapevine trunk with canker showing the sample collection point.

Photograph: Nicola Wunderlich

in trunks, from dormant buds, flowers, pea-sized berries and berries at harvest stage.

6. A total of 77 vineyards throughout NSW were surveyed for eutypa dieback. 1866 wood samples were collected from symptomatic vines showing dead spurs, cankers or discoloured vascular tissue.

Isolates from all surveys were identified to species level based on spore morphology and molecular identification via DNA sequencing.

Summary of results

- 1258 fungal isolates belonging to nine different species of Botryosphaeriaceae fungi were found in the eastern Australian wine regions. This survey established the incidence and distribution of these nine different Botryosphaeriaceae species in NSW and SA vineyards (Tables 4 and 5, Figure 13).
- 188 isolates belonging to nine different species of Botryosphaeriaceae fungi were isolated from dormant buds, pea-sized berries and berries at harvest in addition to 142 isolates from

wood. For the isolations from grapevine tissue other than wood the greatest number of isolates originated from dormant buds, followed by berries at harvest stage. Isolations from flowers and pea-sized berries were limited.

- 73 strains of diatrypaceous fungi were collected from vineyards in NSW, of which 12 were identified as *E. lata*. The most northern findings of *E. lata* occurred in Orange (Central Ranges, NSW). The other diatrypaceae species found included *Cryptovalsa ampelina*, *Eutypella* and *Diatrypella*.

Table 4 Trunk disease fungi identified in each wine growing region surveyed in New South Wales.

Fungus	Winegrowing region of NSW						
	Northern Rivers	Northern Slopes	Central Ranges	Hunter Valley	South Coast	Southern NSW	Big Rivers
<i>Botryosphaeria dothidea</i>			✓	✓	✓	✓	
<i>Diplodia seriata</i>	✓	✓	✓	✓	✓	✓	✓
<i>Diplodia mutila</i>			✓	✓	✓	✓	✓
<i>Dothiorella iberica</i>			✓			✓	✓
<i>Dothiorella viticola</i>			✓	✓		✓	✓
<i>Eutypa lata</i>			✓			✓	✓
<i>Lasiodiplodia theobromae</i>	✓			✓			
<i>Neofusicoccum australe</i>		✓	✓		✓		
<i>Neofusicoccum luteum</i>				✓			
<i>Neofusicoccum parvum</i>	✓	✓	✓	✓			✓

Table 5 Botryosphaeriaceae fungi identified in each wine growing region surveyed in South Australia.

Botryosphaeriaceae species	Winegrowing region of SA				
	Riverland	Clare Valley	Barossa Valley	Adelaide Hills	Eden Valley
<i>Botryosphaeria dothidea</i>					✓
<i>Diplodia mutila</i>		✓	✓	✓	✓
<i>Diplodia seriata</i>	✓	✓	✓	✓	✓
<i>Dothiorella iberica</i>	✓	✓	✓	✓	✓
<i>Dothiorella viticola</i>	✓	✓	✓	✓	✓
<i>Neofusicoccum australe</i>			✓	✓	
<i>Neofusicoccum parvum</i>				✓	

Outcomes for industry

1. The incidence and distribution of nine different Botryosphaeriaceae species in NSW and SA vineyards has been established.
2. Botryosphaeriaceae fungi are also associated with bunch rots, and this highlights the need to treat Botryosphaeriaceae fungi as pathogens of the whole vine.
3. Eutypa dieback is more widespread in NSW than expected. This

survey confirms the presence of *Eutypa lata* in the Central Ranges and southern NSW districts. These regions are cool climate with high annual rainfall, similar to the climate in the Adelaide Hills where eutypa dieback presents a great concern. This pathogen may well be suited to the cooler climate regions of NSW.

Future research

Studies investigating the epidemiology of trunk disease pathogens should be conducted with the aim of developing options for the sustainable management of trunk diseases.

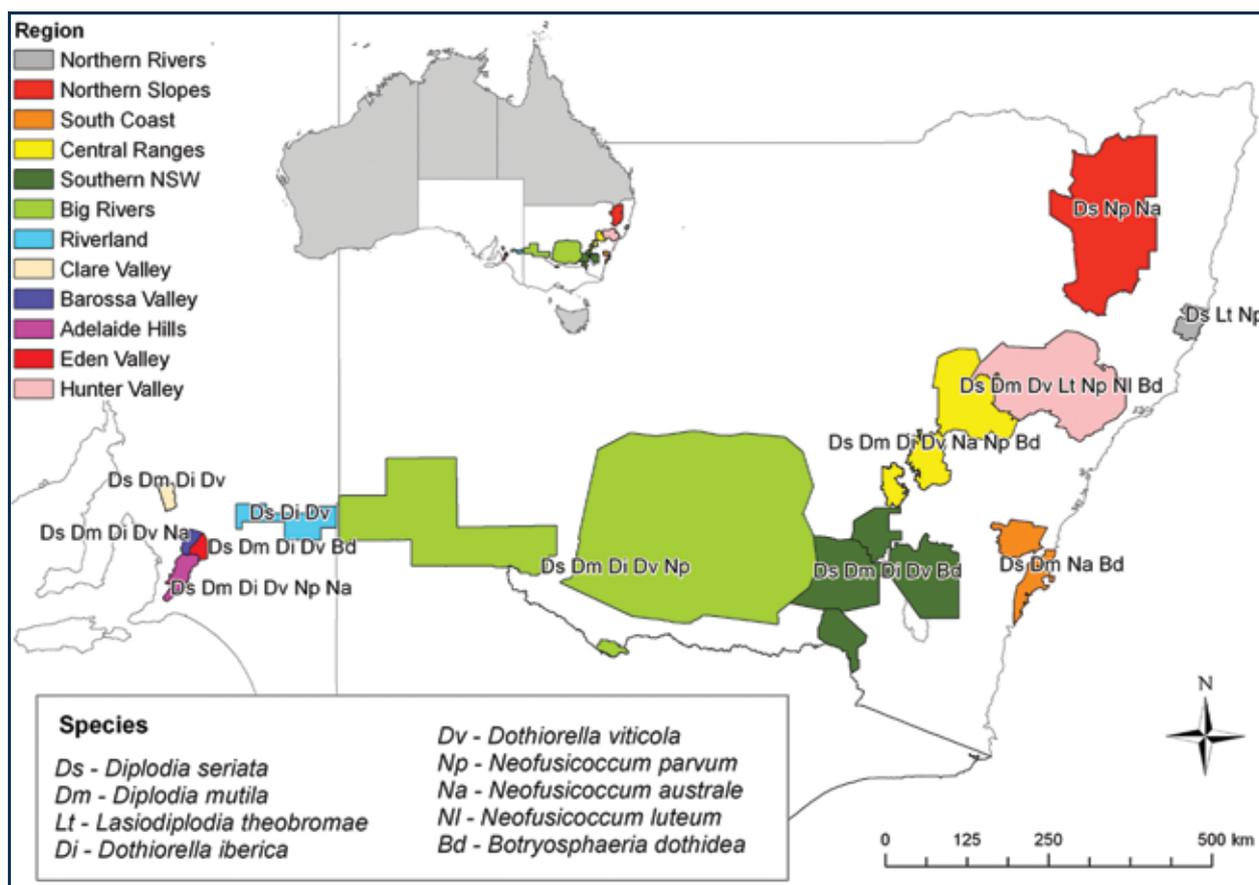


Figure 13 Distribution of Botryosphaeriaceae species found during vineyard surveys of 12 grapevine regions in New South Wales and South Australia.

Further information

www.nwgic.org

Pitt, W.M., Huang, R.; Steel, C.C. and Savocchia, S. (2010). Identification, distribution and current taxonomy of Botryosphaeriaceae species associated with grapevine decline in New South Wales and South Australia. *Australian Journal of Grape and Wine Research* **16**: 258–271.

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Wunderlich, N., Ash, G.J., Steel, C.C., Raman, H. and Savocchia, S. (2011) Association of Botryosphaeriaceae grapevine trunk disease fungi with the reproductive structures of *Vitis vinifera*. *Vitis* **50**: 89–96.

Further information on botryosphaeria dieback in Australia can be found in the NWGIC factsheet *Botryosphaeria dieback– identification and management* available from the NWGIC website.

For information on eutypa dieback see the GWRDC Innovators Network factsheet '*Eutypa dieback*' (http://www.gwrdc.com.au/webdata/resources/factSheet/GWR_068_Eutypa_Dieback_Mangement_Fact_Sheet_FINAL.pdf)



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Disclaimer: The information contained in this publication is based on knowledge and understanding at the time of writing (August 2012). However, because of advances in knowledge, users are reminded of the need to ensure that information upon which they rely is up to date and to check currency of the information with the appropriate officer of the National Wine and Grape Industry Centre or the user's independent adviser.

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