SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

WINE INDUSTRY TASMANIA

Australian Government
Grape and Wine Research and Development Corporation

Management of Eutypa dieback in Tasmanian vineyards



FINAL REPORT to
GRAPE AND WINE RESEARCH & DEVELOPMENT

Project Number: **RT 07/02-5**

Principal Investigators: **Adrian Loschiavo, Mark Sosnowski & Trevor Wicks**

Organisation: **Wine Industry Tasmania**
Sub-contracting agency: **South Australian Research and Development Institute (SARDI)**

Date: March 2008

1. EXECUTIVE SUMMARY

Eutypa dieback is a trunk disease of grapevines that causes yield reductions, gradual grapevine decline and eventually death. Eutypa dieback is caused by the fungus, *Eutypa lata* and is found in cool climate wine regions throughout the world. Eutypa dieback is one of Australia's most important grapevine trunk diseases.

The status of eutypa dieback in Tasmanian vineyards has been unclear, although anecdotal evidence suggested that it was present, but the extent unknown. To increase awareness about the disease in grapevines, a workshop was presented in three wine growing regions of Tasmania in December, 2007. Fifty growers and industry personnel attended the workshops which focused on identification and management of eutypa dieback. Mr Adrian Loschiavo (SARDI) presented information on the recognition and identification of eutypa dieback and was followed by Dr Mark Sosnowski (SARDI) who spoke about research on management of the disease. Also of interest to Tasmanian growers was phomopsis cane and leaf spot, botrytis bunch rot, powdery mildew. Dr Trevor Wicks (SARDI) presented information on management of phomopsis and together with Dr Kathy Evans (Uni of Tasmania) also covered botrytis. Visiting student, Mr Craig Austin (Cornell University), presented a New York State perspective of managing powdery mildew, including some results from his own research both in USA and Australia in collaboration with SARDI.

The presenting scientists took the opportunity to visit 28 vineyards which included the regions, Tamar Valley, North East, East Coast, Coal River Valley and Derwent Valley. Growers were consulted about their experiences with eutypa dieback and strategies available for the management of the disease. Foliar symptoms of eutypa dieback were observed in each region and wood samples were collected and returned to the laboratory at SARDI for analysis. The presence of *E. lata* was confirmed by morphological identification and molecular confirmation all five wine regions visited in Tasmania from seven grapevine cultivars. This constitutes the first official record of eutypa dieback in Tasmania.

2. BACKGROUND

Eutypa dieback is one of the most important trunk diseases of grapevines in Australia. The disease, caused by the fungus *Eutypa lata*, results in yield reductions, gradual vine decline and eventually death. *E. lata* is distributed throughout most cool climate wine regions of the world. Failure to control the disease leads to severe economic losses, primarily as a consequence of decreased yields, reduced longevity of the grapevines and increased vineyard management costs (Mahoney *et al*. 2005). In South Australia, eutypa dieback has been estimated to cause yield losses of at least 860 kg/ha and 740 kg/ha for Shiraz and Cabernet Sauvignon, respectively (Wicks and Davies 1999). In Californian vineyards, losses due to eutypa dieback have been estimated at $260 million (Siebert 2001).

Surveys have shown the disease is widespread in many of the premium winegrowing areas of Australia including South Australia and Victoria (Wicks, 1975; Highet and Wicks, 1998) and in some vineyards, over 80% of vines are infected (Sosnowski *et al.* 2004). A recent survey in the Adelaide Hills revealed the extent of eutypa dieback in this region and through workshops and publications has prompted growers to act early before the disease causes major economic losses (Loschiavo *et al*., 2007). Eutypa dieback has not been officially recorded in Tasmania, although anecdotal evidence suggests the disease occurs in some vineyards and has caused economic losses. Furthermore, Tasmanian growers are, generally, not familiar with the foliar symptoms of the disease or appropriate management strategies.

E. lata infects open wounds via air-borne and rain splashed spores. Infection causes necrosis and staining of woody tissue, often wedge-shaped when viewed in cross-section. Vines affected by eutypa dieback may also display characteristic foliar symptoms including stunted shoots with cupped, chlorotic leaves with tattered and necrotic margins. Foliar symptoms may take between 1 and 8 years to appear after infection. While *E. lata* can be isolated from the infected wood, the fungus cannot be recovered from affected green tissue (Moller and Kasimatis 1981). *E. lata* is hosted by many cultivated tree crops including apricot, apple and cherry (Carter 1991). These alternative hosts are commonly grown in Tasmania and may serve as sources of inoculum for infection of grapevines.

3. OBJECTIVES

The primary objective was to deliver workshops to growers in the North, East and South of Tasmania to improve knowledge and awareness of eutypa dieback including recognising symptoms and understanding management options.

Secondarily, to confirm the presence and distribution of eutypa dieback in Tasmania.

4. METHOD

Growers were advised of 'grapevine disease workshops' being held in the Tamar Valley, East Coast and Derwent Valley wine regions via a mail out by Wine Industry Tasmania (see flyer attached). The workshops were conducted from 3-7 December, 2007 and primarily presented information on eutypa dieback. Mr Adrian Loschiavo (SARDI) delivered a presentation on the identification of eutypa dieback including recognition of foliar, bunch and wood symptoms. Following this, Dr Mark Sosnowski (SARDI) presented results of research which has been conducted over the past 8 years in projects CRV 03/06S & SAR 06/01. This included information on the spread of *E. lata*, foliar symptom variation and management of vines through wound protection and remedial surgery. Both eutypa dieback presentations are attached as appendices.

On advice from the Wine Industry Tasmania committee, presentations were also delivered on other diseases of concern to local growers. Dr Trevor Wicks (SARDI) presented up-to-date information on management of phomopsis cane and leaf spot and botrytis bunch rot and visiting student Mr Craig Austin (Cornell University, USA) presented a New York perspective on powdery mildew management. Both Wicks and Austin were supported by SARDI to join in on the workshop. In the Derwent Valley, Dr Kathy Evans (University of Tasmania) also joined the workshop to update growers with recent research findings on botrytis.

Whilst travelling between workshops and regions, Loschiavo, Sosnowski, Wicks and Austin visited several vineyards to discuss eutypa dieback management with growers and look for vines displaying eutypa dieback foliar symptoms. Cordons and trunks were cut to expose any stained, wedge wood symptoms and samples were returned to SARDI for isolation of *E. lata* and confirmation using molecular techniques developed in CRV 03/06S (Lardner *et al*. 2005).

5. RESULTS/DISCUSSION

Workshops were held at Rosevears in the Tamar Valley, Swansea on the East Coast and in Hobart in the Derwent Valley. Fifty growers and industry representatives attended the three workshops, with 90% of the grower community in attendance at the east coast workshop in Swansea. All presentations were received well at workshops with much interactive discussion between attendees and the panel (Fig. 1A). The use of samples taken from the vineyard assisted in recognition of characteristic symptoms and gave growers an appreciation of the problem they may face without appropriate management. In the Derwent Valley, at the end of the workshop attendees were taken into the vineyard to observe eutypa dieback symptoms and the process of remedial surgery to remove infected wood (Fig. 1B). Feedback from attendees, regarding Tasmanian vineyard management which may impact on eutypa dieback, was taken on board by the SARDI team and will be considered in the development of further research on management of this important disease of grapevine.



Figure 1. A. Presenting information to attendees in the Derwent Valley and B. Demonstrating the process of remedial surgery in the vineyard.

Wood samples were collected from 28 vineyards and an apricot orchard with 20 samples (Table 1) identified as *E. lata* by morphological characteristics of cultures grown on agar (Carter 1991). Molecular analysis has confirmed the presence of the fungus in Tasmania. Positive samples with *E. lata* were collected from vines aging between 18-35 years and from cultivars including Pinot Noir, Chardonnay, Pinot Gris, Shiraz, Cabernet Sauvignon, Cabernet Franc and Sauvignon Blanc. Many of these vines had

large pruning wounds which had previously not been protected. One positive sample was retrieved from an apricot tree. Five regions were sampled; Tamar Valley, North East, East Coast, Coal River Valley and Derwent Valley and *E. lata* was confirmed in each of the regions. In a shade house at SARDI, potted Grenache vines have been inoculated with Tasmanian isolates of *E. lata* to confirm infectivity. This is the first confirmed report of eutypa dieback in Tasmanian vineyards.

Table 1. Samples collected in Tasmanian wine regions and confirmed with *E. lata* in the laboratory.

Sample	Region	Cultivar
TAS24	Tamar Valley	Cabernet Sauvignon
TAS25	Tamar Valley	Cabernet Sauvignon
TAS19	Tamar Valley	Chardonnay
TAS8	Tamar Valley	Sauvignon Blanc
TAS17	North East	Chardonnay
TAS18	North East	Pinot Noir
TAS28	North East	Sauvignon Blanc
TAS1	East Coast	Cabernet Sauvignon
TAS2	East Coast	Cabernet Sauvignon
TAS7	Coal River Valley	Apricot
TAS16	Coal River Valley	Cabernet Franc
TAS5	Coal River Valley	Cabernet Sauvignon
TAS14	Coal River Valley	Cabernet Sauvignon
TAS21	Coal River Valley	Chardonnay
TAS22	Coal River Valley	Pinot Gris
TAS4	Coal River Valley	Pinot Noir
TAS11	Coal River Valley	Pinot Noir
TAS15	Coal River Valley	Shiraz
TAS27	Derwent Valley	Cabernet Sauvignon
TAS29	Derwent Valley	Pinot Noir

6. OUTCOME/CONCLUSION

Workshops were delivered in three major wine regions of Tasmania and were well received by attendees. Growers showed increased confidence in their ability to recognise the symptoms of eutypa dieback and how to prevent or manage the disease. As a result of these workshops, eutypa dieback is less likely to reduce yield and productivity of vines in Tasmania.

The presence of eutypa dieback has been confirmed in Tasmania and the disease was prevalent in all the regions visited. Future workshops highlighting the importance of eutypa dieback management have been requested by industry personnel and will ensure adoption of preventative strategies to maintain the competitiveness of the Tasmanian wine industry in the production of high quality wine for the world market.

This is the first confirmed report of *E. lata* in Tasmania and publications will be prepared and submitted to an industry journal and peer-reviewed scientific journal.

7. ACKNOWLEDGEMENTS

We would like to thank Allison Williams (WIT) for organising the workshops and growers and industry representatives for attending the workshops, for their interaction and enthusiasm and the local hospitality that was extended to the visiting presenters. Also thanks to the GWRDC for their investment into this project through the Regional Innovation and Technology Transfer program.



Figure 2: A. Loschiavo, Sosnowski and Wicks inspecting eutypa dieback symptoms in the Tamar Valley, B. Three symptomatic Chardonnay vines in a vineyard in the Tamar Valley, C. Characteristic foliar symptoms on Pinot Noir vines in the North East, D. Symptomatic Cabernet Sauvignon on the East Coast, E. Symptomatic Cabernet Sauvignon in the Coal River Valley, F. Cross section of an infected trunk showing wedge-shaped staining, G&H. Trunk cankers and I. Dead branches on eutypa dieback-affected apricot tree.

8. BUDGET RECONCILIATION

Budget	Funding approved by GWRDC		Actual Expenditure
Air fares	$1,690		$1,690
Accommodation	$1,100		$1,100
Vehicle hire + fuel	$607		$607
Venue hire	$625		$625
Meals/expenses	$978		$978
Total	$5,000	**Total**	$5,000
GST	$500	**GST**	$500
Total funds requested from GWRDC	$5,500	**Total funds expended**	$5,500

9. REFERENCES

Carter, M.V. (1991) The status of Eutypa lata as a pathogen. Monograph – Phytopathological Paper No. 32. (International Mycological Institute, Surrey, UK).

Highet, A. and Wicks, T. (1998) The incidence of eutypa dieback in South Australian vineyards. *The Australian & New Zealand Grapegrower & Winemaker*. Annual Technical Issue, 441a, 135-136.

Lardner, R., Stummer, B.E., Sosnowski, M.R. and Scott, E.S. (2005) Molecular identification and detection of *Eutypa lata* in grapevine. *Mycological Research* 109, 799-808.

Loschiavo, A., Sosnowski, M. and Wicks, T. (2007) Incidence of eutypa dieback in the Adelaide Hills. *The Australian & New Zealand Grapegrower & Winemaker*, 519, 26-29.

Mahoney N, Molyneux RJ, Smith LR, Schoch TK, Rolshausen PE, Gubler WD (2005) Dying arm disease in grapevines: Diagnosis of infection with *Eutypa lata* by metabolite analysis. *Journal of Agriculture and Food Chemistry* 53, 8148-8155.

Sosnowski, M., Creaser, M. and Wicks, T. (2004) Managing eutypa dieback of grapevines by remedial surgery. *The Australian & New Zealand Grapegrower & Winemaker*, 488, 35-39.

Wicks, T. (1975) The dying arm disorder of vines in South Australia. *Agricultural Record*. Department of Agriculture of South Australia 2: 14-20.

INVOLVED WITH VITICULTURE?

Then you're invited to a

GRAPEVINE DISEASE WORKSHOP



Presentations and vineyard visit on:

EUTYPA DIEBACK

(Mark Sosnowski and Adrian Loschiavo, SARDI)



With presentations on management of:



POWDERY MILDEW & BOTRYTIS



(Trevor Wicks - SARDI, Craig Austin – Cornell Uni. USA, Kathy Evans – Uni. Tas (Coal River Valley only)

North: Rosevears Waterfront Tavern on Monday 3rd December, 2007 from 3-6 pm (including drinks and nibbles.

East: Swansea Bark Mill on Wednesday 5th December, 2007 from 3 – 6pm including drinks and nibbles.

South: Moorilla Estate, on Friday 7th December, 2007 from 9.30am until 12 noon including morning tea.

NB If growers have any leaves or shoots that they have concerns with, please feel free to bring them along as samples. These samples can then be assessed by the presentation team and discussed with you "on the spot".

BOOKINGS ARE ESSENTIAL!

Bookings can be made by calling Allison Williams on 03 6223 3770 or emailing mail@winetasmania.net.au

Wine Industry Tasmania (WIT) members – Free!
Non-members - $20 per person

Provided with kind support from: Grape and Wine Research and Development Institute (GWRDC), South Australian Research and Development Institute (SARDI) and Wine Industry Tasmania (WIT)

Australian Government
Grape and Wine Research and Development Corporation

SARDI
SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

WINE INDUSTRY TASMANIA

Identifying eutypa dieback



Adrian Loschiavo,
Research Officer, SARDI



Background

- Eutypa dieback caused by the slow growing fungus *Eutypa lata*
- Mostly found in areas with rainfall > 350 mm per annum
- Affects woody plants, especially trees
- Wide host range (88 species)
- Australian native species not affected



Eutypa dieback

Cherry (Prunus avium)



Eutypa dieback symptoms on a cherry tree



Apricot (Prunus armeniaca)



Eutypa dieback symptoms on an apricot tree

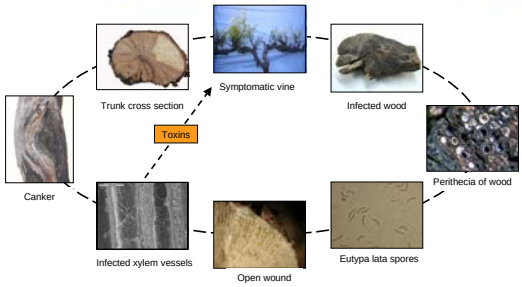


- Almond, apple and black currant also affected
- Pear, peach, olive, roses, fig, lemon and willow host *Eutypa lata* but not affected

Eutypa dieback on grapevines

- Confirmed reports of eutypa dieback in SA, Vic, NSW and WA
- Found through cool climate wine regions internationally
- No known resistance within genus *Vitis spp.*
- Symptoms expressed most readily in Grenache, Shiraz and Cab. Sauv.
- Can affect up to 100% of vines in some old premium red vineyards
- Imparts significant costs to industry
  - Australia - Shiraz alone cost growers $20M p.a. (Wicks & Davies 1999)
  - California - US$260 million p.a. (Siebert 2000)

Disease cycle



Foliar symptoms

Foliar symptoms include:

- Stunted shoots
- Chlorotic leaves
- Cupped leaves
- Necrotic leaf margins



Foliar symptoms



Foliar symptoms



Foliar symptoms



Foliar symptoms

Foliar symptoms:

- May be just one shoot
- Masked by healthy, neighboring foliage later in the season
- Most obvious in spring
- Shoots 30-70 cm



Foliar symptoms





Foliar symptoms



Foliar symptoms



Foliar symptoms



Bunch symptoms

Bunch symptoms include:

- Bunches may not initiate
- Bunches may shrivel and drop off after flowering





Bunch symptoms

Bunch symptoms include:

- Bunches may not initiate
- Bunches may shrivel and drop off after flowering
- Smaller bunch size
- Uneven berry ripening



Similar symptoms

Foliar symptoms may look similar to:

- Bud mite damage
- Salt stress
- Herbicide damage
- Frost injury



Disease progress

2 Nov 2001



22 Nov 2001



1 Nov 2003



26 Dec 2004



Wood symptoms

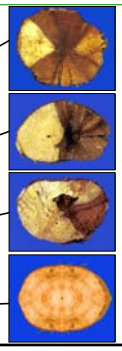
- Cankers along cordons or trunk
- Wedge of dead tissue in cross-section



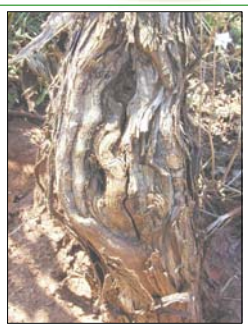


Wood symptoms





Wood symptoms









Managing eutypa dieback



Eutypa dieback research team:

SARDI
Adrian Loschiavo
Mark Sosnowski
Trevor Wicks
Mette Creaser

University of Adelaide
Richard Lardner
Sharmini John
Eileen Scott

Research results

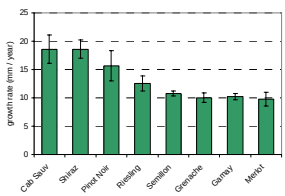
1. Epidemiology
   - Spread of *E. lata* in the field
   - Foliar symptom variation
2. Disease management
   - Prevention
     - Wound protection
   - Control
     - Remedial surgery
3. Summary



Adelaide Hills, South Australia

Spread of *E. lata*





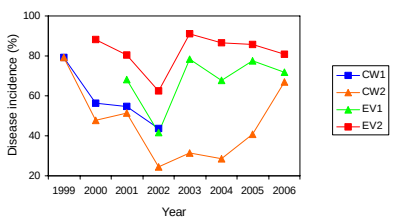
- Max stain progression - 50 mm/year
- Max beyond staining - 75 mm

Foliar symptom variation

- Foliar symptom variation observed between years on same vine
- Phenomenon not entirely understood
- Vines assessed in 12 ongoing monitoring trials



Foliar symptom variation



Foliar symptom variation

Causes of foliar symptom variation

- Dani Shtienberg (Israel)
- Rain in winter and spring
- Temperature in spring
- Relationships need to be confirmed



Foliar symptom variation

Bioassay

- Bioassay technique - induce symptoms in 8 months
- Compared to 3 - 8 years in the field
- Useful in understanding foliar symptom variation



Insertion of *Eutypa lata* mycelium plug



Site sealed

8 months later



Eutypa dieback foliar symptoms

Foliar symptom variation

Current research – effect of environmental stress

- Using new bio assay technique
- Series of controlled environment experiments
- Assess effect of water, temperature and nutritional stresses
- Continue to monitor field trials
- Aim to understand the effect of stress on foliar symptoms



Research results

1. Epidemiology
   - Spread of *E. lata* in the field
   - Foliar symptom variation
2. Disease management
   - Prevention
     - Wound protection
   - Control
     - Remedial surgery
3. Summary



Clarendon, South Australia

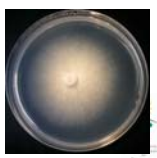
Wound protection

Pruning wound protection

- Benomyl (Benlate®) most effective for wound protection
- Benlate® removed from market in 2002
- Carbendazim (Bavistin®) also effective - currently under review
- No fungicides registered for this purpose
- Seeking alternatives

In vitro fungicide screening

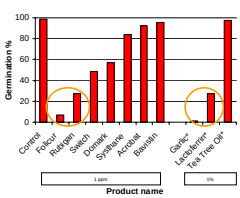
- Many fungicides screened
- Spore germination counts
- Colony growth measurements



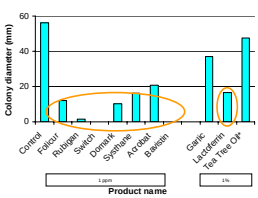
Wound protection

2007

Spore germination



Colony growth



- Testing of promising treatments currently underway in the field

Wound protection



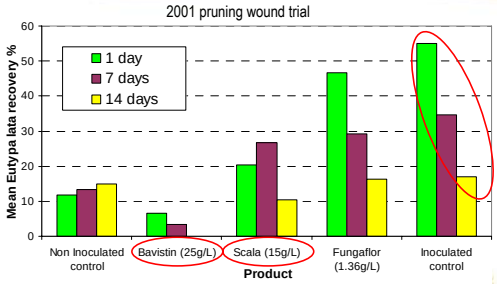
- Vines pruned (2 buds) in winter
- Pruning wound treatments applied with brush
- Wounds inoculated with ascospore suspension

Wound protection

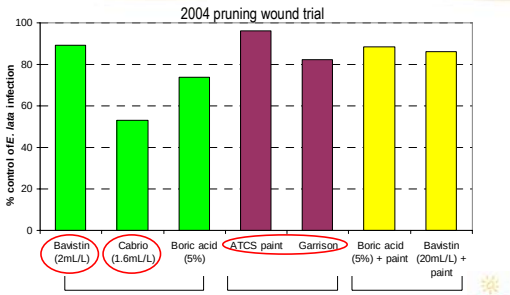


- Treated canes removed the following winter
- Bark removed and samples surface sterilised
- Samples cut into chips and placed on PDA plates
- Incubated for 2-3 weeks and visually assessed for *E. lata*

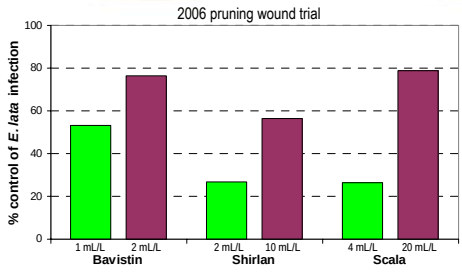
Wound protection



Wound protection



Wound protection



Wound protection

Trichoderma

Vinevax® pruning wound dressing

- Variable results
- After establishment (>24 hours), *Trichoderma* reduces *Eutypa lata* infection on wounds
- Results may be influenced by weather

Vinevax® bio-inoculant implants (wooden dowels)

- *Trichoderma* found 18 cm from bio-implant after 20 months
- In SARDI trials, no effect on heavily infected vines
- Further testing on 'vaccination' effect

Results courtesy of work completed by Sharmini John PhD, University of Adelaide

Wound protection

Fungicides

- Bavistin® (carbendazim) ✓
- Scala ® (pyrimethanil) ?
- Cabrio® (pyraclostrobin) ?

Paints & pastes

- Garrison® (cyproconazole + iodocarb in paste) ✓
- Acrylic (ATCS) paint ✓

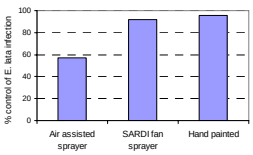
Biocontrol

- Vinevax™ (*Trichoderma* sp.)
  - Wound protection ?
  - Bio-implants ?

Wound protection

Improving application

- Initial evaluation 2005/6
- Several spray equipment types tested
- Bavistin® fungicide used for wound protection





Wound protection

Improving application

- Applied in winter 2007 at Coonawarra, SA
- Three application methods
  - Silvan Turbomiser
  - Croplands Quantum mist
  - Hand painted
- Determined most efficient water rate
- Fungicide (Bavistin®) applied
- Wounds inoculated 24 hours later
- Assessment in winter 2008





Remedial surgery

- Cut out all vine wood infected by eutypa dieback
- Infected wood removed and burnt or buried
- Vine stump to produce water shoot/s to replace missing vine



Cut and train





Train and cut

Remedial surgery



Watershoot production of different varieties (1st season)



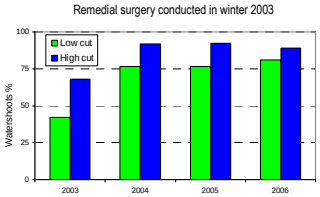
Remedial surgery





Water shoot production on Shiraz (1971 planting)

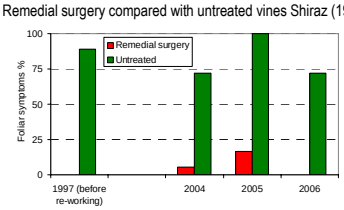
Remedial surgery conducted in winter 2003



Remedial surgery

Cut and Train

Remedial surgery compared with untreated vines Shiraz (1971)



Remedial surgery

Train and Cut



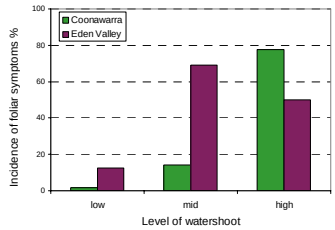
Low

Mid

High

Remedial surgery

Foliar symptoms on Shiraz (1971) 4 years after remedial surgery



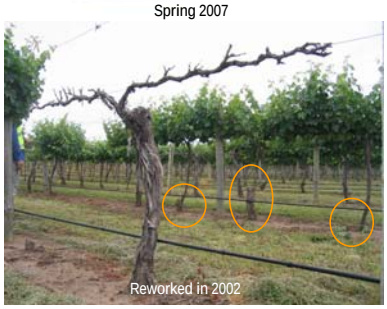
Remedial surgery

Spring 2004



Remedial surgery

Spring 2007



Remedial surgery

- Removing diseased wood is only method of controlling eutypa dieback
- Injections or foliar sprays are not effective



Summary

Eutypa dieback – Australia's most significant trunk disease

Prevention
- Wound protection

Control
- Remedial surgery

Future
- Find alternative wound protectants
- Improve application methods
- Determine effect of environmental stress
- Resistance



Uraidla, South Australia