NATIONAL Wine & Grape INDUSTRY CENTRE

Australian Government

Grape and Wine Research and Development Corporation

Funding for Dr Turner Sutton, a bunch rot expert, to deliver a keynote address at the 17th Australasian Plant Pathology Society Conference, Newcastle September 2009 and to meet with grapevine pathologists.



FINAL REPORT to

GRAPE AND WINE RESEARCH & DEVELOPMENT CORPORATION

Project Number: **GWT 09/01**

Principal Investigator: **A/Prof Christopher C Steel**

Research Organisation: **National Wine and Grape Industry Centre**

Date: **30th November 2009**

Executive Summary and Abstract

This travel grant covered the costs associated with the attendance of Professor Turner B. Sutton from North Carolina State University at the 17th Biennial Australasian Plant Pathology Society Conference (Newcastle, NSW; September - October 2009) and his participation in a pre-conference workshop on bunch rot diseases of grapes. Additionally Prof Sutton travelled to both the Waite campus of Adelaide University and the Wagga Wagga campus of Charles Sturt University to meet with researchers, present his recent grapevine research and explore collaborative research linkages. Prof Sutton also participated in an extension workshop, 'Promoting Vineyard Health' held in the Hunter Valley.

Aside from these research and extension seminar presentations, this travel grant initiated a joint project to investigate the variability in bunch rot fungal isolates from the USA and Australia.

Front Cover Photographs: From left to right: Bitter Rot on Chardonnay caused by *Greeneria uvicola*, Ripe rot on Cabernet Sauvignon caused by *Colletotrichum acutatum* and Grey Mould on Mueller Thurgau caused by *Botrytis cinerea*. (Sources: Chris Haywood, NSW I&I, Tony Somers, NSW I & I and Markus Keller, Washington State University, respectively).

PROJECT OVERVIEW

Travel details

Name and Contact Details of Travel Grant Applicant

Name	Assoc Prof C C Steel
Postal Address	National Wine and Grape Industry Centre School of Agricultural and Wine Sciences Charles Sturt University Locked Bag 588 Wagga Wagga NSW 2678
Telephone	02 69 33 2721
Fax	02 69 33 2107
E-mail	csteel@csu.edu.au

Name and Contact Details of Travel Grant Recipient

Name	Prof Turner B Sutton
Postal Address	North Carolina State University Department of Plant Pathology 2518 Gardner Hall Box 7616 Raleigh NC 27695-7616, USA
Telephone	(919) 515-6823
Fax	(919) 515-8795
E-mail	turner_sutton@ncsu.edu

Itinerary

Monday 21st September 2009
Depart USA

Wednesday 23rd September to Sunday 27th September 2009
Meetings at the University of Adelaide including presentation of The Robert Symons Lecture 2009

Sunday 27th September
Travel Adelaide to Newcastle

Monday 28th September 2009
Attendance at pre-APPS conference workshop on Biology and management of organisms associated with bunch rot diseases of grapes. Delivery of a presentation on sub-tropical bunch rots of grapevines in the US.

Tuesday 29th September to Thursday 1st October
Attendance at the 17th Biennial Australasian Plant Pathology Society Conference, (Newcastle) and delivery of a presentation on bunch rot epidemiology

Friday 2nd October
Attend grape grower extension workshop organised by Tony Somers, NSW Department of Primary Industries and presentation of a grower-focused seminar on bunch rot management.

Saturday 3rd October
Inspect vineyard field sites used in the NWGIC Winegrowing Futures program and travel to Wagga Wagga

Sunday 4th October Free Day in Wagga Wagga

Monday 5th October (Public Holiday in NSW) Free Day in Wagga Wagga and social interaction with researchers from the NWGIC.

Tuesday 6th October
Meetings with the Vine Health group at CSU, other plant pathologists on campus (Chris Steel, Suren Samuelian, Sandra Savocchia, John Harper, Melanie Weckert & Lindsay Greer). Meeting with Duncan Farquhar, National Viticulture Extension Officer

Wednesday 7th October
Further meetings with the Vine Health group and other researchers in the NWGIC
Meet with Prof Jim Hardie, NWGIC Research Director
Seminar presentation on Pierce's Disease to staff of the NWGIC

Thursday 8th October
Return travel to the USA

Project Objectives

The objectives of the travel grant were as follows.

- To allow Prof Turner Sutton from North Carolina State University to present a keynote address at the 17th Biennial Australasian Plant Pathology Society Conference, to be held in Newcastle, NSW in September 2009.
- To allow Prof Sutton to participate in a pre-conference workshop on bunch rot diseases of grapes
- Presentation of international research on ripe rot and bitter rot of grapes to grape growers
- To explore avenues of further research collaboration between grape researchers in Australia and North Carolina State University particularly in the epidemiology and management of bunch rot diseases of grapes.

Outputs (from original grant application)

Output	Performance Targets	Date
1. Knowledge transfer from international expert in the field of bunch rot of grapes	Prof Sutton will meet with grape growers in the Hunter Valley and also with grape researchers working in Australia and New Zealand	October 2009
2. Consolidation of current knowledge on bunch rot of grapes	Prof Sutton will participate at a bunch rot workshop and present a keynote presentation at the APPC in Newcastle	October 2009
3. Industry article produced	Inform industry of outcomes of the visit	28 Feb 2010

A report on these outputs follows.

Summary of outputs from this travel grant

Research and Extension seminars

Prof Turner Sutton presented four research lectures and also presented his research as part of a grape grower extension workshop. Details of these presentations were as follows.

Prof Sutton presented a keynote address at the 17th Biennial Australasian Plant Pathology Society Conference on bunch rot diseases and their management. This conference is the only major meeting of plant pathologists held in the Australasian region on a regular basis. The conference was attended by approximately 280 participants from around the globe and a summary of his presentation is presented in appendix 1.

Prof Sutton also delivered the opening seminar at a pre-conference workshop on the biology and management of organisms associated with bunch rot diseases of grapes held in Pokolbin on 28th September. The title of his presentation was '*The biology of* Greeneria uvicola *and* Colletotrichum *spp. on grapes in SE USA'*. This workshop was attended by 28 grapevine researchers from Australia, New Zealand and the USA. The list of participants and their affiliations are contained in appendix 3 at the end of this report. The majority of these participants also presented seminars on their work which Prof Sutton attended and contributed to the discussion. Prof Sutton's abstract from this workshop presentation is reproduced in appendix 2.

Prof Sutton delivered The Robert Symons Lecture at the University of Adelaide on disease management strategies in grapes and apples. This seminar was attended by approximately 60 people from the University of Adelaide, CSIRO Department of Primary Industries and SARDI.

Aside from his research on bunch rot management of grapes, Prof Sutton has also worked on Pierce's disease, a quarantine disease not present in Australia. Prof Sutton presented a seminar on Pierce's Disease to the staff and students at the National Wine and Grape Industry Centre. This was an opportunity for members of the NWGIC to learn more about Pierces Disease from somebody who is actively conducting research on this topic.

Prof Sutton was also able to interact with grape growers and wine makers through his participation in a grape grower extension workshop held in Pokolbin on 2nd October. This extension workshop was an opportunity for grape growers to learn more about how non-Botrytis bunch rots are managed in a climatic region of the US, similar to the Hunter Valley. This workshop was attended by approximately 25 grape growers, a number of whom were from regions outside of the Hunter Valley. Further interaction with grape growers was also possible when Prof Sutton visited some of the vineyard field sites in the Hunter Valley used in Theme 2 of the Winegrowing Futures Program.

Research discussions

During the course of this travel grant Prof Sutton met with grapevine researchers to discuss current and planned research activities. In Adelaide he met with Drs Ian Dry (CSIRO –PI), Trevor Wicks (SARDI) and Eileen Scott and Amanda Able and their associated research teams from the University of Adelaide. Prof Sutton visited vineyard field sites in the Hunter Valley where techniques for trapping fungal spores in the vineyard were discussed

with Dr Suren Samuelian and A/Prof Chris Steel. These discussions continued with Dr Sandra Savocchia and her research team in Wagga Wagga. Prof Sutton has used various spore trapping devices in the past and some of his methodology will be included in research proposals currently being developed for further funding.

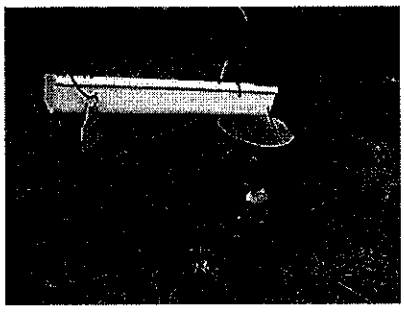
Observations on the susceptibility of grape berries to fungi that normally colonise the wood, such as *Botryosphaeria* spp. and potential control measures were discussed with PhD student Nicola Wunderlich and her supervisory team as were observations on *Botryosphaeria* infections in other fruit crops in Australia and North Carolina.

During Prof Sutton's visit to the NWGIC he met with Dr Melanie Weckert where he discussed research on young vine decline and aspects of root pathology. With Dr Weckert he discussed her research on the bacterial grapevine disease 'bacterial bunch-stem necrosis' caused by *Pseudomonas syringae*. Prof. Sutton has experience with another bacterial disease of vines, Pierces Disease, caused by *Xylella fastidiosa*. Both diseases involve colonisation of grapevine phloem.

In Wagga Wagga research discussions continued on the epidemiology and management of bunch rot diseases with Chris Steel and co-workers. Further discussions took place on the variability of bunch rot isolates, particularly in relation to observations made on *G. uvicola* isolates from Australia and the US. Although isolates from the two countries appear morphologically similar on artificial media, pre-veraison berries appear to be susceptible in the US but not in Australia. These discussions concluded with a proposal to compare isolates from the two countries. Since then an AQIS permit has been granted for the importation of *G. uvicola* isolates from the US. Prof Sutton is now in the process of seeking permission from US quarantine to allow him to receive bunch rot isolates from the research group at the NWGIC in Wagga Wagga. This collaborative research is likely to lead to a joint publication in a peer-reviewed journal and is a direct consequence of this GWRDC travel grant. The grape and wine industry will be informed of this work through an extension article in a wine industry journal to be submitted for publication in early 2010.

Further discussion on future collaborative research included the possibility of staff and student exchanges between Charles Sturt University and North Carolina State University.

1. 

2. 

Photos:
1. Dr Suren Samuelian (L) and Prof Sutton (R) discussing the use and design of spore trapping devices in the Hunter Valley for the monitoring of Botryosphaeria spp as part of the GWRDC / NWGIC Winegrowing Futures Program.
2. Trial spore trapping device for the collection of fungal spores following rainfall events

Appendix 1 - Prof Sutton's abstract from the 17th Biennial Australasian Plant Pathology Society Conference is presented below.

BUNCH ROT DISEASES AND THEIR MANAGEMENT

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INTRODUCTION

Bunch rot diseases are of concern in all regions of the world where grapes are grown but nowhere are they more problematic than in moist and temperate growing regions. Among the most important bunch rot diseases in the southeastern United States are black rot, phomopsis, botrytis, bitter rot, ripe rot, and sour rot. This paper summarizes a series of studies designed to gain a better understanding of the biology and epidemiology of the pathogens that cause bitter rot [*Greeneria uvicola* (Berk. & Curtis) Punith.] and ripe rot [homothallic and heterothallic strains of *Colletotrichum gloeosporioides* (Penz.) Penz. & Sacc. (teleomorph *Glomerella cingulata* (Stonem.) Spauld. & Schrenk) and *C. acutatum* J.H. Simmonds (teleomorph *G. acutata* Guerber & Correll)] and how to manage them.

BIOLOGY AND EPIDEMIOLOGY OF *G. UVICOLA* AND *COLLETOTRICHUM* SPP.

Fruit susceptibility to *G. uvicola* and *Colletotrichum* spp. through the growing season. From 2003-2007 a series of studies were conducted to determine the period during the growing season that fruit were susceptible to infection by *G. uvicola* and homothallic isolates of *C. gloeosporioides.* Fruit of Chardonnay, Merlot, and Cabernet Franc were susceptible to infection by *G. uvicola* from bloom until harvest but were most susceptible just prior to and during véraison. Although fruit were susceptible to *C. gloeosporioides* from bloom to harvest, the period of peak susceptibility was not as obvious. Chardonnay was most susceptible at bloom and véraison, Seyval blanc during bloom, post-bloom, and véraison, and Cabernet Franc at post-bloom, closing, véraison, and preharvest.

Influence of temperature and leaf wetness on infection of fruit by *G. uvicola.* Detached fruit of *V. vinifera* (cv Chardonnay, Cabernet Franc, and Cabernet Sauvignon) were atomized with a conidial suspension of *G. uvicola* (10^5 spores/ml), placed in moist chambers and subjected to 14, 18, 22, 26, and 30°C for 6, 12, 18, or 24 h of wetting. Optimum conditions for infection were 6 or 12 h of wetting and temperatures ranging from 22.4 to 24.6°C (mean=23.3°C) (1).

Relative susceptibility of cultivars to *G. uvicola* and *Colletotrichum* spp. Fruit of 38 grape cultivars or selections were evaluated for their susceptibility to *G. uvicola* while 35 cultivars or selections were tested for their susceptibility to a homothallic isolate of *C. gloeosporioides* in a laboratory assay

There was a wide variation in the susceptibility of fruit to *G. uvicola.* Fruit of *V. vinifera* were more susceptible than the French American hybrids. *V. aestavalis* Cynthiana was the most resistant to *G. uvicola* (1). There was also a wide range in the susceptibility of cultivars and selections to *C. gloeosporioides;* however; there was not a clear difference between the relative susceptibility of *V. vinifera* and hybrids to *C. gloeosporioides.* Early harvest Cynthiana, Chardonnay, Merlot, Petit Syrah, and Pride were among the most susceptible cultivars to *C. gloeosporioides.*

Population structure of *Colletotrichum* spp. associated with ripe rot of grapes. This study was conducted from 2004-2007 with the objectives of determining the population structure of *Colletotrichum* species in the diverse geographical regions of North Carolina and to examining differences based on host genera. The relative proportion of *Colletotrichum* spp. in a vineyard varied with the cultivar/species present and location (2).

MANAGEMENT

Effect of cane pruning. An experiment was conducted from 2004-2006 on the cultivars Chardonnay, Merlot, and Cabernet Sauvignon in a 12-year-old vineyard in the Piedmont of North Carolina designed to evaluate the effect of cane pruning vs spur pruning on the incidence and severity of bitter rot and ripe rot.. Cordons 1, 2, and 3-years-old were established during the course of the experiment and the incidence and severity of bitter rot, ripe rot and sour rot was compared to the 12-year-old spur pruned vines There was a significant reduction in the incidence and severity of bitter rot and ripe rot in the first year which carried over during the 3 years of the study. Cane pruning did not reduce the incidence of sour rot, but did reduce its severity.

The disease management program for ripe rot and bitter rot in the southeastern US. The backbone of the disease management program in the southeastern US is cultural practices which are designed to reduce the initial inoculum and create an environment within the vine canopy less favorable for disease development. However, a fungicide program beginning at bloom and continuing until harvest is necessary to effectively manage summer bunch rot diseases. Captan, applied on a 10-14 day interval is the principle fungicide used from closing to harvest.

REFERENCES

1. Miranda, J.G. and Sutton, T.B. 2008. Factors affecting the infection of fruit of *Vitis vinifera* by the bitter rot pathogen, *Greeneria uvicola.* Phytopathology 98: 580-584.
2. Whitten Buxton, K.R. and Sutton, T.B. 2008. Biology and epidemiology of *Colletotrichum* species associated with ripe rot of grapes. Phytopathology 98:S170.

Appendix 2 –Prof Sutton's abstract from the pre-conference workshop on the Biology and management of organisms associated with bunch rot diseases of grapes is presented below.

The Biology of *Greeneria uvicola* and *Colletotrichum* spp. on Grapes in the Southeastern United States

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Bunch rot diseases are of concern in all regions of the world where grapes are grown but nowhere are they more problematic than in the moist and temperate growing regions of the world. This paper focuses primary on the biology and epidemiology of bitter rot and ripe rot. The bitter rot pathogen, *Greeneria uvicola* can cause blossom blight, a leaf spot/fleck, and fruit rot. Fruit infection usually occurs on the pedicle, and as the fruit ripen, the fungus grows from the pedicle into the fruit where it eventually colonizes the entire fruit which becomes covered with acervuli. Ripe rot is caused by homothallic and heterothallic strains of *Colletotrichum gloeosporioides* (teleomorph *Glomerella cingulata* and *C. acutatum* (teleomorph *G. acutata*). Ripe rot primarily affects the fruit. Affected fruit become covered with acervuli which produce copious quantities of salmon-colored conidia on their surface. Fruit infected by *G. uvicola* or *Colletotrichum* spp. eventually shrivel and fall to the ground or remain mummified on the rachis.

Fruit of Chardonnay, Cabernet Franc, and Merlot were susceptible to infection by *G. uvicola* from bloom until harvest but were most susceptible just prior to and during véraison. Although fruit were susceptible to *C. gloeosporioides* from bloom to harvest, the period of peak susceptibility was not as clear. Chardonnay was most susceptible at bloom and véraison, Seyval blanc during bloom, post-bloom, and véraison, and Cabernet Franc at post-bloom, closing, véraison, and preharvest. Optimum conditions for infection of fruit by *G. uvicola* were 6 or 12 h of wetting and temperatures ranging from 22.4 to 24.6°C (mean=23.3°C).

There is some evidence that isolates of *G. uvicola* vary in aggressiveness. Isolates of *G. uvicola* obtained from *Vitis vinifera* were significantly more aggressive on Chardonnay than those obtained from *Muscadinia rotundifolia.* Variation in aggressiveness of homothallic and heterothallic isolates of *C. gloeosporioides* and isolates of *C. acutatum* was variable over a 3-year study, but *C. acutatum* consistently produced the greatest disease severity on Chardonnay and Cabernet Franc.

The population structure of *Colletotrichum* spp. was found to vary between *V. vinifera* and *Muscadinia rotundifolia* and among locations. Homothallic isolates of *C. gloeosporioides* predominated in *V. vinifera* and heterothallic isolates predominated in *M. rotundifolia. C. acutatum* was more common in vineyards in the cooler mountain growing region and heterothallic isolates of *C. gloeosporioides* were most common in the Coastal Plain.

Cultivars of grapes vary in their susceptibility to both diseases. *Vitis aestivalis* 'Cynthiana', Riesling, and the French-American hybrids Traminette and Chardonnel were among the most resistant to *G. uvicola* while Viognier, Petit Verdot, and Petit Sirah were among the most susceptible. *V. aestivalis* 'Cynthiana' and Merlot were most resistant to *Colletotrichum* spp. while Cabernet Sauvignon and Seyval blanc were among the most susceptible.

Appendix 3 Participants at the APPS Pre-conference workshop on the Biology and management of organisms associated with bunch rot diseases of grapes held in Pokolbin on 28th September 2009.

Last Name	First Name	Organization	State
Beresford	Robert	Plant and Food Research	NZ
Casonato	Seona	Plant and Food Research	NZ
Cleaves	Bruce	University of Queensland	QLD
Edwards	Jacqueline	DPI Victoria	VIC
Emmett	Bob	Department of Primary Industries	VIC
Evans	Katherine	Tasmanian Institute of Agricultural Res	TAS
Fullerton	Robert	Plant and Food Research	NZ
Greer	Lindsay	NWGIC, CSU	NSW
Haywood	Chris	Department of Industry and Investment	NSW
Hetherington	Shane	Department of Industry and Investment	NSW
Hill	Gareth	Plant & Food Research	NZ
Hoksbergen	Karyn	Landcare Research	NZ
Huang	Rujuan	NWGIC, CSU	NSW
Jaspers	Marlene	Lincoln University	NZ
Magarey	Peter	SARDI, Loxton Research Centre	SA
Manning	Mike	Plant and Food Research	NZ
Mundy	Dion	Plant and Food Research	NZ
Pung	Hoong	Peracto Pty Ltd	TAS
Riches	David	DPI Victoria	VIC
Samuelian	Suren	NWGIC, CSU	NSW
Savocchia	Sandra	NWGIC, CSU	NSW
Scott	Eileen	University of Adelaide	SA
Seem	Bob	Cornell University	USA
Steel	Chris	NWGIC, CSU	NSW
Sutton	Turner	North Carolina State University	USA
Viljanen-Rollinson	Suvi	Plant & Food Research Ltd	NZ
Wunderlich	Nicola	NWGIC, CSU	NSW