Final travel report for GWRDC

GWT 08/04
“Agro-ecology and organic viticulture research trip”

Project Supervisor: Dr Cassandra Collins
Chief Investigator: Luke Johnston



Commencement Date: 22 June 2009
Completion Date: 24 July 2009

Table of Contents:

1. **Aims of Travel**
2. **Executive Summary**
3. **Geisenheim Research Institute**
4. **Burgundy Study Tour**
5. **GiESCO Conference**
6. **California Study Tour**

1. Aims of Travel

Grant supported to travel to:

- Establish a collaboration with Dr Randolf Kauer and PhD candidate Mr Georg Meissner: Geisenheim Institute.
- Interview organic and biodynamic growers, Burgundy, France.
- 16th International GiESCO Conference UC Davis, Organic Viticulture Conference, Napa Valley, California, USA. [1]

Aims of Travel:

1. To collaborate with Professor of Organic and Biodynamic Viticulture, Dr Randolf Kauer and PhD candidate Mr Georg Meissner on their research trial at Geisenheim
2. To interview organic and biodynamic growers in Burgundy, France about their management practices. Identify perceived differences between conventional and organic practices to include in my PhD research.
3. To attend GiESCO conference at UC Davis
4. To collaborate with Dr Glenn McGourty (UC Davis Extension officer Mendocino and Lake counties) on trial design and current organic viticulture and agro-ecology research in California
5. To attend organic viticulture conference in Napa Valley
6. To create links and develop collaboration with overseas scientists working on organic and biodynamic production systems

The response from the relevant academics in Germany and USA was that the trial design that we have set up in McLaren Vale (Gemtree Vineyard) is the most comprehensive being undertaken in the world. Due to more students supporting the Geisenheim trial, more measurements are being taken, however, the focus is on biodynamic treatments. The GiESCO conference was informative and gave me the opportunity to collaborate with other researchers around the world. The organic viticulture conference was extremely well attended and a good example of how to hold a similar workshop at next year's AWITC.

[1] Initial GWRDC Travel Grant application was to attend an Agroecology conference at UC Berkeley. This conference was cancelled due to the Global Financial Crisis.

2. Executive summary

There were many objectives for this study tour, which required months of preparation in the lead up to leaving Australia. The main reason for visiting Germany was to collaborate with Dr Kauer and Mr Meissner on the organic/conventional/biodynamic trial being undertaken at Research institute of Geisenheim. My visit to France gave me an opportunity to meet with some of the most established and recognised wine producers in Burgundy, all of whom were using biodynamic methods. In the USA I attended both GiESCO conference and a 2 day organic viticulture conference in the Napa valley. During these conferences, I spent considerable time with academics that have been researching organic and sustainable viticulture practices over the past 10 years.

Key findings from discussions with relevant academics and growers, and interesting conference presentations were:

Germany

- The Geisenheim trial is well established, now into its 4th season
- Soil samples are being taken from the mid row area, not from the undervine row
- Different cover crops are used in the different management systems
- Mr Meissner is due to publish his results in the next 6 months
- Few significant differences between treatments have been found, however, the trial is going to continue for another 3 years.
- Organic and biodynamic viticulture in Europe faces significantly different issues to what we experience here in Australia.
- Due to higher rainfall, European growers are less worried about weed competition, often encouraging growth undervine to reduce grapevine vigour
- The Mosel growers interviewed, estimated that using organic practices increased their costs by up to 30%

As my research trial is the first of its kind in Australia, it was necessary to visit the academics at Geisenheim to discuss my trial design, the treatments and the parameters being measured. These are discussed in greater detail later on.

France

- Most top level growers in Burgundy have converted to biodynamic management under the consultancy of Pierre Mason
- The strength of the biodynamic movement in Europe is growing considerably, but could be dampened if the European Union ban the use of Copper
- Burgundian growers are claiming that biodynamic practices are improving wine quality and expression of Terroir
- The majority of vignerons interviewed said that their wines had ‘more fruit, appeared tighter in the mid palate and showed more balanced phenolic on the finish’

After interview many growers/winemakers, it is obvious that they are adamant that using biodynamic methods have improved their wines. Some growers saw improvements soon after converting. Wines made from the treatments will be tested

by a descriptive analysis panel. A similar process is being undertaken at the Geisenheim trial.

USA

- Research presented at the GiESCO conference showed that soil Carbon levels have been severely degraded under conventional vineyard management. Although Carbon levels in California are higher than Australia, it demonstrates the need to change growers practices
- Organic viticulture is continuing to grow in California, currently 25% of grape growers in Mendocino county are using organic techniques. The current average in Europe is less than 3% of vineyards.
- This growth has largely been driven by UC Davis Extension officer Dr Glenn McGourty encouraging growers to change their practices
- Dr McGourty has a minor research trial underway in Ukiah, Mendocino County, researching organic, biodynamic and conventional systems.
- There is considerable interest in the McLaren Vale trial, as academics all around the world value the rigour of Australian research

Another objective of this study tour was to develop contacts with fellow researchers. As my PhD topic is so broad, people from many disciplines have been sought.

Germany

Geisenheim: Professor Randolf Kauer, Mr Georg Meissner, Dr Manfred Stoll, Professor Hans Schultz

France

Dr Thibaut Scholasch

USA

Dr Glenn McGourty, Dr Cliff Ohmart, Dr Paul Schnieder, Dr Markus Keller, Dr Kerri Steenworth, Professor Cesare Intrieri.

Benefits to the industry:

- Identify key issues arising under organic and biodynamic management under both European climatic conditions and those experienced in Australia
- Knowledge on how to overcome such management issues, which can then be related back to growers via journal articles and workshop facilitation at 2010 AWITC
- Ensure the industry has the knowledge and capability to address environmental and sustainability issues facing viticulture under current management systems

This project was supported by the Grape and Wine Research and Development Corporation (GWRDC) and the University of Adelaide (UA).

Project Outputs and Itinerary Outline

Output	Performance Targets	Completed
Improved understanding of organic and biodynamic best practices	Attended Geisenheim trial Attended organic viticulture conference in Napa Valley	Completed June/July 2009
Improvement of PhD trial in Australia	Discussions with many academics about components of my PhD	Completed August 2009
Prepare travel report to GWRDC		Completed October 2009
Journal articles for Australian Viticulture		Submitted October 2009

Itinerary Outline:

Location	Activity	Dates
Germany		
Geisenheim	Discussions with academics	June 22-25
Mosel	Interview growers	June 26-28
Geisenheim	Compare research trials	June 28-July 3
Pfaltz	Stop over	July 4
France		
Alsace	Interview grower	July 5
Burgundy	Interview growers	July 6-10
UK, London	Stop over	
USA		
Uni of CA, Davis	GiESCO conference	July 12-16
Mendocino/Lake County	Discussions with academics	July 17-19
Santa Cruz county	Interview growers	July 20-21
Napa Valley	Organic Viticulture conference	July 22-24
Lodi county	Discussion with academics	July 24

3. Geisenheim Research Institute

The primary reason for visiting Dr Kauer and Mr Meissner was to look at their organic/biodynamic/conventional trial at the Geisenheim Research Institute. This trial is similar to my PhD trial established at Gemtree vineyards in McLaren Flat in 2008.

The first time such a trial was undertaken was at Geneva research station, New York State in the early 1990's. This trial focussed on the native American variety Concord, which is often used for grape juice production. While the design of this trial gives a good template to follow, the results have to be carefully interpreted as they may not necessarily relate to *Vitis Vinifera* varieties.

As far as we know, the Geisenheim trial is the first of its kind to be conducted on Riesling. Therefore, it was extremely important to collaborate knowledge on trial design, definitions of treatments, sampling techniques and various measurements being undertaken. Early on in my visit, I did a presentation of my project to the staff and post graduate students at Geisenheim.

Following this presentation, I discussed the differences between the two projects in detail with Dr Kauer and Mr Meissner. Due to both having busy schedules, this couldn't be achieved concurrently. A number of minor differences between the projects became apparent. These are summarised in Table 1.

Table 1: A comparison between Geisenheim and Gemtree trial design and testing parameters

Design/Parameter	Geisenheim	Gemtree	Comment
Years of treatments	4	1	
Size	1 ha	10 ha	Allows for more projects to be built into the Gemtree site
Rows per treatment	4	8	More buffer zones
Number of treatments	3 (org, bd, conv)	4 (org, bd, low input conv, high input conv)	Important to differentiate between low and high input
Replicates	4	4	
Org and bd treatments	Using a mixture of allowable inputs	S and Cu	Should reflect general industry practices
BD focus	Sub trial on Preparation 501	No specific BD preparations being investigated	Mr Meissner has worked extensively with BD, and is keen to research BD in greater detail
Compost	On all treatments	+/- compost	This means the Gemtree trial will be able to differentiate the difference between compost and the system
Soil samples	Mid row	Undervine	Treatments are applied undervine
Mid row cover crop	Changes between treatments	Uniformed throughout	Important to sample where the treatment effects are likely to be seen
Measurements	Soil, shoot vigour, yield, grape and wine quality	Soil, shoot vigour, yield, grape and wine quality	Similar measurements are being taken
Other measurements	Using novel bd testing methods such as sensitive crystallisation	Not being used	Mr Meissner believes this shows ‘qualitative’ wine results
Financial analysis	No	Yes	Important aspect for potential industry adoption

Differences in detail:
Although the trials appear to be rather similar, there are many subtle differences that could in fact have a large bearing on the results. These are discussed in detail below. Mr Meissner has practiced biodynamics for a number of years, and as a result is trying to investigate as many of the biodynamic treatments as possible. A sub-section of the trial is being dedicated to different levels of Preparation 501 sprays[2]. Novel 'qualitative' techniques such as sensitive crystallisation are also being employed to test for differences in wine quality. Neither of these will be tested in the Gemtree trial.

Timeframe:
The Geisenheim trial is now into its 4th season. The first 3 years were Mr Meissner's PhD. The trial has received funding to continue for another 3 years, of which Mr Meissner's will undertake as a Post Doctorate research fellow.

Similar to the Gemtree trial, the Geisenheim trial has received much interest and publicity from grape growers, winemakers and wine marketers all over Europe. It was also interesting to note, that the trial is being used as part of an elective subject, 'organic viticulture' to students at Geisenheim. Having such strong student involvement has made the institute look progressive, and meant that many more parameters can be tested, strengthening the trial. As soil properties often take many years to change, it seems reasonable to think that greater treatment effects will be seen in the second 3 year term of this trial.

Experimental Design:
The Geisenheim trial is done on the research institutes facilities and hence is much smaller than the Gemtree one. As the trial doesn't have the +/- compost variable, each treatment is 4 rows, replicated 4 times. The Gemtree trial design has a two row buffer zone between treatments. The additional space at the Gemtree site also means that further investigation in the treatment effects can be conducted.

Treatment definitions:
There are substantial differences between the Geisenheim and Gemtree treatments. Defining each treatment is difficult and can be controversial. In order to define treatments at the Gemtree trial, a sub-committee was established with one grower who uses either, organic, biodynamic and conventional practices to help define each system. It soon became apparent that there is a large variation between conventional growers and it would be necessary to divide this treatment into both a low input and high input regimes.

Dr Kauer and Mr Meissner were very supportive of this additional treatment as they too had found it extremely difficult to define treatments. Due to a lack of space at the trial site, they could only incorporate 3 treatments. The Geisenheim conventional treatment is 'best practice' which includes compost and synthetic sprays. Due to the wetter climate in Germany, conventional growers are more likely to use synthetic chemicals for Downy Mildew and Botrytis, but less likely to use synthetic fertilisers. The opposite is often found in Australia, where commercial conventional vineyard's will often use synthetic fertilisers, and in many cases only use sulphur and copper, which are used in organic and biodynamic systems.

[2] Preparation 501 is quartz buried in a cow horn over the summer months

The organic treatment at Geisenheim includes mechanical weed control (similar to Gemtree) and novel disease control such as oils, bicarbonate of soda and sulphur and copper. There is growing concern that the European Union will outlaw the use of copper as residues are often over the required threshold in many grape growing regions. Dr Kauer expressed great concern that this would be very difficult for the organic viticulture industry. Organic and biodynamic growers are currently allowed to use 4kg/ha of copper per year (averaged over 4 years).

The biodynamic treatment is similar to the organic but includes the use of the preparations 500-508. Mr Meissner has a strong biodynamic background, previously working and consulting to vineyards in South Africa, France and Germany. Mr Meissner has implemented a sub trial, investigating the effects of the silica preparation 501. This is being applied between 2 and 4 times per year, to see what differences it brings to the vine and wine quality.

Soil Sampling and cover crops.
Interestingly, soil samples are being taken in the mid row region, where as soil samples are being taken in the undervine/herbicide strip at the Gemtree trial. Also surprising was the fact that each treatment had a different cover crop planted in the mid row, which would no doubt influence the soil properties. This may also have more of an influence than the "organic, biodynamic and conventional' treatments themselves. Dr Kauer thinks that this gives a better representation of each system, as growers are likely to use different cover crops.

Measurements
Shoot vigour, various yield parameters and vine biomass production are measured and evaluated. At harvest, grapes are being analysed for wine grape quality parameters, and these are then being made into small batch winemaking. Descriptive analysis is being carried out on these wines.

Interestingly wines are being made by both inoculated yeast and natural yeasts. We will inoculate our samples to get consistency throughout the replications.

General Findings:
Shoot vigour has been reduced under organic and biodynamic cultivation. Mr Meissner concluded that this results in a 'better balanced' vine. This may be the case in Europe under wet conditions, however, the same result is unlikely to be accepted in Australia's dry conditions where vines can suffer from shoot vigour. I am currently in consultation with Mr Meissner on some of the differences being found in wine quality. This will form the basis for an article we are writing for Australian Viticulture.

Miscellaneous
While in Germany, I also interviewed a number of Biodynamic producers; Clemens Busch (Mosel), Melsheimer (Mosel), Dr Randolf Kauer (Mittelrhein) and Dr Burklin Wolf (Pfaltz). A summary of my discussions is presented below.

The average number of labour hours per hectare for premium Riesling production in the Mosel is between 700-1000. With relatively low prices in return, 30% of vines in

the past 10 years have been pulled out from this very famous wine region. While interviewing these producers, they estimated that biodynamic cultivation added another 25% labour, mostly needed for weed control, which generally cannot be done by mechanical means due to the high gradient slopes.

The other major issue facing organic and biodynamic growers was disease control. The current season was hot, humid with consistent rain, resulting in a high incidence of Downy Mildew. Dr Kauer showed me Downy incidence which he felt would completely damage his 2009 crop. While a limited use of copper is allowed under organic certification, there is a strong possibility that this will either be totally banned or further reduced. Dr Kauer expressed concern that this may make the production of organic grapes impossible.

One of the positive management practices in Germany was the extensive use of cover crops within both the mid rows and undervine area. A popular blend used is called the 'wolf' mixture, a blend of 40 different species. This is proving to be beneficial to both soil properties and pest management.

Also of interest to growers, was the thought that 6 weeks post soil cultivation, a flush of nitrogen would occur into the vines. This was relayed to me by a number of growers in France and Germany, and hence their last cultivation would be soon after flowering, as they were conscious of having excess nitrogen levels during veraison.



Figure 1: Professor Randolf Kauer in his Mittelrhein vineyard.

4. Burgundy study tour

I spent 5 days visiting many of the great vineyards of the Cote de Beaune, including Comte Amarnd (Pommard), Marquis d'Angerville (Volnay), Michel Lafarge (Volnay), Domaine de Montille (Volnay), Domaine Yves Boyer-Marternot (Meursault) and Comte Lafon (Meursault).

I was privileged enough to interviewed these producers, all of whom are using biodynamic practices in their vineyards. The average size of a vineyard in Burgundy is less than 5 ha, combined with extremely high prices for wines, makes biodynamic management economically achievable. However, there are still many challenges for biodynamic producers.

Burgundy, like many cooler wine regions in Europe, has extensive pest and disease pressure. Sulphur and copper sprays are consistently used to prevent mildews. However, an additional challenge in Burgundy is weed control. Due to having such low cordon heights (approx 50cm above ground), the producers I interviewed were cautious of having any weed growth, which could potentially grow into the canopy. One grower showed me a batch of wine which following mechanical harvesting, tasted like onion grass. The mechanical harvester had collected much of this grass/weed when harvesting, which intern affected the wines flavour. This is an example of how difficult weed control can be under organic management.

In order to control weed growth, Burgundian producers clean cultivate their soils between 5-10 times per season. Cultivation for weed control in Australia is generally between 2-4 times per year. With planting densities of 10,000 vines per ha, usually, both the undervine and mid-row areas are totally clean cultivated. With soil carbon levels currently over 2% this may not be of great concern now, however, such practices are likely to decrease their carbon levels over time. It is uncommon to see producers using mid row cover crops. So rare was it, that I took a photo when I came across the vineyard below (Figure 2).

Many of the growers interviewed used similar practices and gave standard responses to my questions. I found out later that most of these growers were being consulted to by Pierre Mason, hence the reason for similar responses. Growers understood that cultivation was detrimental to their soil carbon levels, but could see no other alternative for organic weed control.

All of the producers I interviewed felt that since converting to biodynamic production, their wines had more purity of fruit, greater length and a few said that biodynamics resulted in earlier phenological ripening. Similar descriptors have been used by Australian producers. Upon returning to Australia, my supervisors and I have decided that we will measure grape maturity parameters from veraison to harvest, to see if such changes are noticeable between treatments.

During a barrel tasting at Marquis d'Angerville, I tasted wines cultivated under both conventional and biodynamic methods. While these were all from different Premier Cru vineyards, consistently the biodynamic wines showed better fruit, mouthfeel and tannin balance. This emphasises the importance of the Gemtree trial's small batch winemaking and descriptive analysis panel.

Figure 2: A rarity, cover crop used in Burgundy.



Figure 3: Tradition cultivation: both mid row and under vine area.



5. USA. 16th International GiESCO Symposium

The 16th International GiESCO Symposium was held at University of California, Davis on July 12-15, 2009. The symposium was very interesting and relevant to not only my project but for some of the issues facing Australian viticulture. A summary of the most relevant presentations are presented below:

a. Changes in soil carbon distribution and composition down the soil profile in oak woodlands and vineyard soils – Eli Carlisle and David Smart

This study looked at the differences in soil carbon fractions between resident oak woodland vegetation and neighbouring vineyard soils after 30-35 years of cultivation. A variety of soil measurements were taken, including: bulk soil carbon, dissolved organic carbon, microbial biomass carbon, particulate organic matter and soil atmosphere carbon.

The vineyard soil had lower soil carbon, dissolved organic carbon and lower microbial biomass carbon. It was concluded that the conversion of soils to viticulture resulted in 1) altered CO2 movement through the soil and 2) a substantial loss of a large amount particulate organic matter.

This study is relevant to viticulture in all countries, demonstrating the need for growers to understand what practices are detrimental to soil carbon levels.

b. Shifts in vineyard weed seed bank composition in response to organic and conventional weed control practices – Kerri Steenworth et al.

This study compared organic weed control (soil cultivation) to conventional weed control (herbicide), in terms of their effects on weed and seed bank. Differences were noted between the spring cultivation and autumn-spring herbicide, however, one weed specie dominated both treatments. It was concluded that the mid row cover crop strongly affected seed bank composition, more so than the treatments themselves.

c. Diversity and function of mycorrhizal fungi in grapevines – Paul Schreiner

This study looked at the diversity of arbuscular mycorrhizal fungi (AMF) in vineyards, using both classical and molecular techniques. The vineyard site was in Oregon, using Pinot Noir vines. Fungi from the roots of vines did not correspond with fungal species found as spores in bulk soil. The AMF community in roots did not change during the growing season, but differed in soils types.

I was fortunate to spend considerable time discussing soil biology with Dr Schreiner, and he has since sent me many papers on past research projects his

lab has undertaken. I have sent these papers to my soil biology supervisor, Dr Petra Marschner, who has extensively covered mycorrhizal fungi in her research. Dr Schreiner, like Dr Steenworth will be an important contact for me in years to come.

The GiESCO conference was well attended, and gave me the chance to meet researchers from all over the world.

The conference field trip to Lodi was also extremely interesting as Lodi shares similar conditions with many Australian regions. Former CSIRO forestry entomologist Dr Cliff Ohmart now runs the Lodi Winegrape Commission. I not only made contact with Dr Ohmart at GiESCO, but visited him later on in my travels. Dr Ohmart is the author of the Lodi Winegrower's workbook, which was the first and most established viticulture 'sustainability' programme around the world. His work is now the template for other sustainability programmes. I spent a whole day discussing this programme, and how it differed to organic practices and certification. Dr Ohmart gave me a copy of the sustainability programme manual to use for further references.

Dr Ohmart said that Australia was doing some wonderful research, but also encouraged for more of this research to be relayed to growers by way of 'extension officer' roles, similar to what is set up in California. He said that in order for growers to change their practices, the need not only to visit conferences, but often need aid on the ground in implementing new practices.

Mendocino/Lake Counties
Following the GiESCO conference I spent 3 days with UC Davis extension officer Dr Glenn McGourty. Also joining us was Professor Cesare Intrieri (Bologna University). This was a unique opportunity to visit vineyards both organic and conventional with two extremely knowledgeable people.

We attended a nursery day in which Dr McGourty and Professor Intrieri spoke about soil management and its impact on vine physiology. This was well attended by local growers in Lake county. Following the seminar, we then visited the largest organic vineyard/winery in America, Bonterra vineyards (Mendocino County). Bonterra has been a wonderful advocate of organic research. I shared discussions with Dr Anne Thrupp, who has been involved in much of the IPM research on the property. This research has often been conducted with Professor Altieri (UC Berekely).

During the three days with Dr McGourty, I discussed in detail the Gemtree trial, and discussed the differences with the Geisenheim trial. Dr McGourty is also conducting a smaller trial in Ukiah (Mendocino). Dr McGourty was very encouraging of the Gemtree trial and was keen to see the results, as he felt that they would be relevant to Californian conditions. Dr McGourty also explained that he is bringing out an 'organic viticulture' manual, similar to the one authored by David Madge.

Santa Cruz/Napa Valley
I visited two famous organic/biodynamic producers in Santa Cruz mountains, Ridge and Bonny Doon. Both producers come from different angles, with Ridge taking a more scientific approach, while Bonny Doon shares strong beliefs in biodynamics. I then travelled north to the Napa Valley to attend a two day Organic Viticulture conference at Frog's Leap winery.

The conference discussed various components of the organic system, with emphasis on soil management, cover crops, powdery mildew and local pest management. It was interesting to note that most of the speakers were academics from UC Davis or extension officers. The positive nature of the extension officer role was again demonstrated, with growers keen to use them to help improve and implement new practices. Attending this conference has inspired me to help organise a workshop on organic viticulture with David Madge at next year's AWITC.

Conclusion:

Organic and biodynamic viticulture is increasingly being practiced in Europe and USA. This has prompted research to be conducted into the changes that it brings to soil properties, vine physiology and grape and wine quality. Many growers and winemakers in Europe and USA are convinced that these changes are a positive. However, organic and biodynamic techniques need to continue to develop, especially in the areas of disease and weed management. Alternatives to copper need to be found for the management of Downy mildew, while current weed control on steep slopes is economically demanding. Until this occurs, organic viticulture production is likely to be limited to regions that have low disease pressure, and growers who charge a premium for their wines.