Participation to the 18th International Symposium GiESCO 2013 (Group of international Experts of vitivinicultural Systems for CoOperation). Porto – Portugal.



FINAL REPORT to GRAPE AND WINE RESEARCH & DEVELOPMENT CORPORATION

Project Number: GWT 1219

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Research Organisation: The University of Adelaide

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1. Aim of the travel

The GWRDC grant GWT 1219 was intended for travelling to:

- The University of La Rioja (UoLR), Logrono (Spain) for visiting collaborators Prof. Javier Tardaguila and Dr MPaz Diago
- Porto, Portugal, to participate to the 18th International Symposium GiESCO 2013.

The aims of this travel were:

- To participate to the 18th International Symposium GiESCO 2013 (Group of international Experts of vitivinicultural Systems for CoOperation) from July 7th to 11th at the "Faculdade de Ciências da Universidade do Porto" – Portugal.
- To present the innovative canopy management tool, the "canopy architecture App" that the University of Adelaide has developed with results obtained from the GWRDC funded project "UA 08/03".
- To visit the world's renowned Douro wine Region in Portugal
- To visit Prof. Javier Tardaguila at La Rioja University, Spain, to discuss and review on the previous GWRDC funded project (GWT 1117) outputs, to discuss the potential extensions of the collaboration and review papers to be submitted to the Australian Journal of Grape and Wine Research.
- To present a seminar on the results obtained during my stay at the University of La Rioja in 2012 at the same university

2. Summary

The 18th International Symposium GiESCO 2013 was held from July 7th to 11th at the "Faculdade de Ciências da Universidade do Porto" – Portugal.
The topics of discussion for this conference included:

- Methodology and Ecophysiology
- Water relations
- Mountain and hot regions viticulture
- Environment: climate and soil
- Vineyard management, yield and quality
- Training systems
- New concepts and advanced technologies in Viticulture
- General viticulture
- Sustainable viticulture
- Precision viticulture
- Mechanical harvesting and spraying
- Mechanical winter and summer pruning
- Mechanization systems, automation and economics

More than 200 delegates attended the conference. About 60 oral presentations and 150 posters were discussed for a total of over 200 papers published in the two volumes conference proceedings.

A very informative tour of the Douro wine region was also organised.

Key discussions, interesting conference presentations and possible collaborations will be discussed in greater detail later on this report.

As part of this project, I spent one week at the University of La Rioja (UoLR) to work collaboratively with the viticulture group led by Prof. Javier Tardaguila. During my previous visit to the same group in 2012 I have been working on hyperspectral imaging (HI) applied to grapevine physiology. Findings from the work conducted in 2012 demonstrated that it is possible to build a calibration for the prediction of grapevine water potential from whole-canopy non-invasive HI taken outdoors. The objective of this second visit was to summarise the results in a scientific paper to be submitted to the Australian Journal of Grape and Wine Research. Also, the results have been presented at the 9th International Symposium on grapevine physiology and biotechnology that was held in Chile in April 2013.

3. Travel itinerary and activities outline

Location	Activity	Dates
Logrono (Spain)	Work at the University of la Rioja	July 01-05
Porto-Lisbon (Portugal)	18th International Symposium GiESCO 2013	July 07-13

4. Project outputs

Output	Performance Targets	Date
Present the canopy architecture App at the GiESCO conference as a talk	Talk Given	Completed
Submit a paper for the GiESCO symposium proceeding	Paper submitted	Completed
Present a seminar at The University of La Rioja	Seminar presented	Completed
Submit a paper to the Australian Journal of Grape and Wine research	Paper submitted by Nov 2013	Delayed

One of the expected project outputs have been delayed due to difficulties in co-ordinating data sharing and analyses. Parts of the paper have been completed however part of the results and discussion are still incomplete. Also the Spanish collaborators have conducted more measurements with the HC during last vintage and images are being analysed.

5. Visit to collaborators at the University of La Rioja (Spain)

Thanks to the previously funded travel scholarship from the GWRDC (GWT 1117) I spent five weeks at the University of La Rioja to work with Prof. Javier Tardaguila and Dr MPaz Diago on the application of Hyperspectral imaging (HI) to viticulture.

During my first visit we have been able to obtain good calibrations between spectra extracted from the HI and vine water status (stem water potential=Ψs) despite the limited number of images available for analysis. However, Dr Diago has been acquiring more HI to be paired to Ψs during the last two vintages. More information about the project and our findings can be found on the previous travel report. Part of the results obtained in 2012 has been presented to the IX International Symposium on Grapevine Physiology and Biotechnology that was held in Chile in April 2013. Paper: Assessment of grapevine water status by ground-based hyperspectral imaging. Diago MP., De Bei R., Millán B., Poni S., Gatti M., Bernizzoni F., Tyerman S. and Tardáguila J.

The focus of my visit to The University of La Rioja this year was to plan and start writing a paper to be submitted to the Australian Journal of Grape and Wine Research. The paper is unfortunately still in preparation, we are confident we could submit it in the next six months. However major progress and improvement of the data analysis have been made.

My visit also served to consolidate the collaboration between the University of Adelaide and The University of la Rioja.

6. International Symposium GiESCO

The GiESCO, Group of International Experts of Vitivinicultural Systems for CoOperation, started more than 20 years ago as a group of European researchers interested in viticulture and precisely in trellising and canopy management. Since that time the interests of the group have expanded and now the GiESCO Symposium serves as a forum for the discussion of all aspects of grapevine physiology, vineyard management and other topics.

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More than 200 delegates attended the conference. The oral presentations were 60 and 150 posters meaning a total number of 200 papers published in the conference proceedings.

A summary of what I believe where the most interesting papers is presented below:

Modelling water and sugar flux to developing berries suggests early cessation of sugar accumulation and substantial xylem backflow.
Mark N. Krasnow, Kenneth A. Shackel, Mark A. Matthews

ABSTRACT
A model of the developing berry was constructed with data from published studies as well as 13 varieties grown in Davis, CA (USA). The model shows that sugar accumulation is rapid after veraison, but only for 40-50 days, after which sugar accumulation ceases. Sugar accumulation was more tightly correlated to days after anthesis (DAA) than to growing degree days (GDD). Based on the modelled sugar flux, and a published phloem sap concentration for grapes, xylem backflow from the berry must be substantial.

The author emphasised that 100 days after anthesis (DAA) is a critical moment for berry development, according to the author at this stage i) sugar accumulation stops, ii)berry weight starts decreasing, iii) sugar per berry reaches the maximum.
Since sugar accumulation seems more linked to DAA than growing degree days (GDD) the authors suggested that all viticultural treatments aimed at altering sugar accumulation in the berries (irrigation, canopy management), need to be imposed very early after veraison. The authors also suggested that this information should be taken into consideration in new

breeding programs. In consideration of the issues of increasing alcohol content in wine breeding programs should select varieties that stop sugar accumulation early, at less than 100 DAA.

Estimating leaf area and leaf area index in VSP trained grapevines under different management systems (Vitis Vinifera L. cv Riesling)

Johanna R. Döring , Vanessa Stöber, Susanne Tittmann, Randolf Kauer and Manfred Stoll

ABSTRACT

The aim of this study was to validate and implement different non-destructive methods of leaf area and leaf area index (LAI) determination in VSP trained grapevines (Vitis vinifera L. cv. Riesling) in a field trial comparing different management systems (i.e. integrated (GAP) and two different organic (European Union Regulation 834/07) management systems).

For leaf area determination of primary and secondary shoots the models of Mabrouk and Carbonneau (1996) and of Lopes and Pinto (2005) were evaluated. Indirect measurements of LAI were conducted using the LAI-2200 Plant Canopy Analyzer (Li-Cor, Lincoln, NE, USA). Direct leaf area was measured using LI-3100 Area Meter (Li-Cor, Lincoln, NE, USA).

The model of Mabrouk and Carbonneau (1996) showed reliable results for secondary shoots. The correlation between direct and estimated leaf area of primary shoots of the different management systems was weaker. This was due to shorter internode lengths in the organic compared to the integrated system. Leaf area determination according to Lopes and Pinto (2005) showed to be a very accurate estimate of leaf area for both primary and secondary shoots of the different management systems. The application of the LAI-2200 showed to give an accurate prediction of direct LAI although it underestimated it systematically.

The application of the validated methods showed that vines of the organic treatment had significantly smaller secondary leaf area and a significantly lower LAI compared to the integrated treatment.

The authors compared different methods for indirect/non-destructive measurements of vine leaf area. They demonstrated that the accuracy of different methods depends on the phenological stage in which the measurements are taken due to differences in internode lengths. They concluded that methods based on shoot length are not very accurate since from their findings, shoot length is not closely related to leaf area. They confirmed that the LAI-2000 instrument is suitable and reliable for measuring leaf area on VSP.

Continuous measurements of grapevine water status in an irrigated vineyard under changing weather conditions

Daniel Hessdörfer, Arnold Schwab, Bernd R. Gruber

ABSTRACT

The objective of the study was to test the feasibility of stem and shoot hygrometers for the continuous and nearly non-destructive assessment of grapevine water potentials in the field under varying environmental conditions. The experiments took place in a drip-irrigated steep slope vineyard of the wine growing region Franconia (Germany). The experimental site is characterized by calcareous soil and has an average annual precipitation of ~550 mm.

The recording intervals covered by one sensor installation were in the range of several weeks. The measured stem and shoot water potentials showed a close correlation to ambient VPD during the day, thus confirming the weather dependency of midday water potential measurements in contrast to measurements at predawn. While predawn water potential in the non-irrigated control treatment steadily decreased, even small amounts of water applied by drip irrigation always resulted in short-term recoveries of predawn and midday water potential.

Water potential measurements conducted with a Scholander chamber as reference method and those acquired with in-situ hygrometers were in good agreement at the time of predawn water potential. However, at midday the values from the hygrometers were slightly underestimating actual plant water status. In general, the stem

hygrometers allowed continuous water potential measurements but for precise results they required accurate installation with contact to the measured tissue and careful isolation against weather influences.

The authors obtained really good correlations between the measurement of vine water status with stem hygrometers and midday water potential (R^2=0.82). Hygrometers allowed the continuous monitoring of water status over a period of 2 to 3 weeks (if the installation is properly executed). The cost one of these probes is about 1500 euros.

Application of anti-transpirant under greenhouse conditions of Grapevines (Vitis Vinifera cv Riesling and Muller-Thurgau) reduce photosynthesis

S. Tittmann, V. Stöber, M. Bischoff-Schaefer and M. Stoll

ABSTRACT
The increasing temperatures, caused by the global change, lead to an earlier onset of developmental stages, changes in productivity and physiology of different crops and will challenge the growers in the future. Depending on the seasonal conditions the onset of flowering is approximately 10 days earlier compared to the long term average and the ripening phase is elongated. Berries are able to accumulate photosynthates over a longer and warmer time period. The sugar content in the berries increases and results in higher alcohol contents in wines. The aim of this study was to investigate the effect of anti-transpirants (AT, Vapor gard - VG and NuFilmP - NuF) on photosynthesis under greenhouse conditions to possibly translate this approach to field conditions altering the sugar accumulation in the berries. Therefore a greenhouse experiment was conducted with potted Riesling and Müller-Thurgau grapevines. With non-invasive techniques (gas exchange, chlorophyll fluorescence and Multiplex®) the physiological state of potted grapevines was measured. Plants showed a reduced photosynthesis rate, stomatal conductance and total soluble sugars (under field conditions, data not shown) compared to control plants. It is proposed that spraying of anti-transpirant can be a new tool to regulate the sugar content in the berries as an alternative to mechanical defoliation.

The authors demonstrated that the use of anti-transpirant reduces stomatal conductance, photosynthesis and leads to a lower sugar content in the berries. This might be a useful tool to be used in Australian vineyards in an attempt to reduce alcohol content in wine.

Berry size and maturity affect phenolic extraction into Pinot Noir wines

M. Lafontaine, M. Stoll and H.R. Schultz

ABSTRACT
Berry skin and seeds differ in their phenolic content, structure and accumulation dynamics during maturation. Therefore a change in berry size or maturity level may affect their contribution to wine composition. Grapes of Pinot noir (clone Gm1-1) grafted on SO4 rootstock from an established vineyard at Geisenheim (Germany) were segregated into different size groups at harvest over three seasons to investigate phenolic extraction into wine using a micro-scale fermentation technique. The segregation showed that wine tannin concentration increased whereas anthocyanin concentration decreased with increasing berry size but groups differed in sugar concentration. When sorting berries according to their total soluble solids (density), wine tannin concentration decreased with increasing Brix; however berry size decreased concomitantly, making a final conclusion difficult. In order to test the effects of size and maturity independently, berries were first segregated into diameter size groups and then each group into different density subgroups. A shift towards higher sugar concentration with decreasing berry size was observed. When considering one population of similar berry size, a higher anthocyanin extraction into wine was observed under increasing Brix, corresponding to an increase in alcohol content of the wines. For the same density subgroup, wines produced from smaller sized berries showed higher anthocyanin extraction compared to wines from larger sized berries probably as a result of the greater skin to juice ratio during the fermentation process. A lower tannin extraction into wine was observed with increasing Brix. For the same Brix population, wines produced from smaller sized berries showed lower tannin concentration compared to wines from bigger sized berries. Seed number per berry and seed tannin concentration increased with berry size, which in fact may explain the higher tannin extraction with increasing berry size.

Grapevine yield variability: contribution of grape load and effects of the previous season's growing conditions

Nicolas Guilpart, Aurélie Metay, Christian Gary

ABSTRACT

The grapevine yield may be highly variable over years, even in the same plot with the same cultural practices. The determinism of yield formation of grapevine is complex as it takes place over two consecutive years, starting around flowering at year n-1 with the initiation and differentiation of the inflorescences of year n in the latent buds. Therefore forecasting grapevine yield is still a challenge for grape growers. In this study the following hypotheses, based on a review of literature, were tested: (i) the number of bunches per vine (NBv) is the yield component that accounts for the main part of yield variability, and (ii) the potential NBv of current year (year n) is determined by water and nitrogen stresses experienced by grapevine around the previous year (year n-1) flowering period. These hypotheses were tested on two grape varieties, shiraz and aranel, over three and six years, respectively, in Languedoc-Roussillon, south of France. For each variety different treatments were applied each year, i.e. chemical or mechanical weeding, grass cover, irrigation and/or fertilization. The considered yield components were NBv, number of berries per bunch and berry weight. They were measured once at harvest. Hypothesis (i) was tested by performing a multiple linear regression analysis for each variety. NBv accounted for around 58 % of yield variability for cv. shiraz and 20% for cv. aranel. Hypothesis (ii) was tested by looking for correlations between the number of bunches per shoot (NBs), the predawn leaf water potential (ψpredawn), and the leaves nitrogen content (LNC) around flowering. Our results show that NBs of year n is well and better correlated with ψpredawn and LNC of year n-1 than those of year n. This study shows that the potential yield of year n is settled around flowering of year n-1 through bud fertility (NBs). This potential could be assessed by measuring or estimating water and nitrogen stresses. This early information could be used to adapt pruning practices depending on the target yield of the next year.

Limited internal hydraulic conductance is preventing excessive water use of minimally-pruned vines even under conditions of good water supply.

Bernd R. Gruber and Hans R. Schultz

ABSTRACT

The objective of the study was to test the feasibility of a conversion of vineyards with vertical shoot positioning (espalier type) to minimal pruning with 50 % of the original plant density with regard to their water relations under non-irrigated conditions. The experiment took place in a south-exposed steep slope vineyard of the Rheingau region (Germany (50 °N, 8 °E) with an average annual rainfall of 526 mm and a potential evapotranspiration of 795 mm (Penman-Monteith). The tested cultivar was 'White Riesling' grafted onto '5C' rootstocks.

Hydraulic conductance was assessed by combining diurnals of leaf and stem water potential with xylem flow measurements (by means of custom-made Granier-type sensors). Daily water use per vine was significantly higher in minimal pruning, yet maximal water flow rates were similar in both systems. Maximum values of hydraulic conductance turned out to be similar as well, with minimally-pruned vines operating closer and more often at this limit due to differences in leaf area and canopy structure. Thus, while water use of conventionally-pruned grapevines was highly correlated with evaporative demand, water use of minimally-pruned vines was already beginning to saturate at potential evapotranspiration rates of about 3 mm per day. Overall, water use per unit soil surface in minimal pruning during summer was not higher than in the control treatment despite its at least similar energy absorption throughout the growing season. This hydraulic limitation already occurred under conditions of good water supply as e.g. in spring.

This finding is of practical importance in all viticultural situations (partially) dependent on soil water reserves during the vegetation period. Since the rapid and voluminous development of its canopy is a key feature for minimal pruning, this limitation prevents excessive water use early in the season which otherwise might result in severe water shortage during the ripening period.

At the conference I presented two papers:

1. **DEVELOPMENT OF A SMARTPHONE APPLICATION TO CHARACTERISE GRAPEVINE CANOPY ARCHITECTURE**
   R. De Bei, C. Pozo, S. Fuentes

2. **INFRA-RED THERMAL IMAGE ANALYSIS FOR GRAPEVINES**
   C. Poblete-Echeverria, S. Fuentes, **R. De Bei**, S. Ortega-Farias, M. Diago, J. Tardaguila

There has been a lot of interest from other scientists about the LAI Canopy App. Thanks to the visibility this conference has given to my work I have now established collaborations with Dr Jorge Prieto from INTA Mendoza, Argentina, Dr Federica Gaiotti from CRA, Conegliano Italy and Dr Nino Pisciotta from The University of Palermo, Italy. The aim of these collaborations is testing the LAI App in different environments and on different training systems. The collaborators are providing canopy pictures and measurements of leaf area index taken with traditional methods so that I can compare to the results obtained by analysing the images with the LAI App.

At this conference I had the opportunity to discuss my work with the most prominent researchers in the area of viticulture, grapevine physiology, climatology applied to grapevine. I gained some positive feedbacks about my work and also new ideas to be applied in this coming season. In particular from a conversation with researchers from CSIRO in Adelaide who attended the conference, it appeared that the hygrometer technology for monitoring vine water status is available in Adelaide. I might be able to borrow the equipment and conduct some experiments comparing the results with those obtained using Near-Infrared technologies. Also, the viticulture group led by Dr Cassandra Collins at the University of Adelaide will start a pilot field-trial in January 2014 to study the effect of the anti-transpirant vapour-gard applied at veraison on the physiology and wine characteristics of Shiraz and Semillon based on the methodology described by Tittman et al. at this conference.

I can provide full papers from this conference to anyone interested upon request. Please contact me at roberta.debei@adelaide.edu.au

7. Visit to the Douro Wine Region

The Douro wine Region is the oldest regulated winemaking region in the world, located in the North-East of Portugal, within the Douro river basin (Figure 1). The total area is about 250000 ha and it is divided into three sub-regions: Lower Corgo, Upper Corgo and Upper Douro. The total vineyard area in the whole region is about 45000 ha. The soil for the region is schistose with some granite. The climate is classified as Mediterranean, with very cold winters and hot and dry summers. The region is protected from the cold and humid winds from the Atlantic by two main mountains, the Marao and the Montemuro.

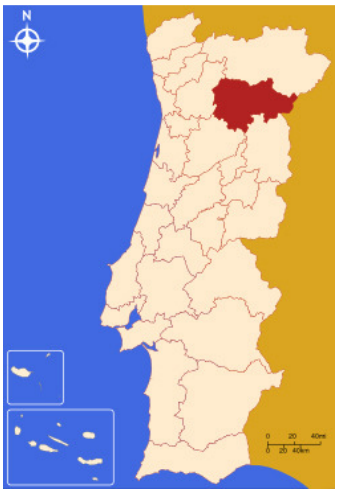


Figure1: Map of Portugal showing the location of the Douro wine region

The Douro is regarded as one of the most beautiful wine regions in the world. Characteristic of the viticultural landscape are the sculptured terraced hillsides were the vines are grown on bare and dry soils (Figure 2). The region is renowned for the production of fortified port wines even though interesting still whites are also being produced. During the study tour we tasted a broad set of products, including some high quality wines from indigenous varieties. Blending indigenous variety is very common.



Figure2: typical terraced hillsides along the Douro River where vineyard is planted.

Traditional techniques seem to still be predominant especially when it comes to vineyard practices due to the impossibility of mechanization in such a difficult environment. Due to lack of rainfall and high solar radiation the growers pay particular attention to vineyard practices that help maintaining a good microclimate for bunches. The use of shading panels is being tested in different part of the region in order to prevent heat burns on bunches.
During the study tour organised for the conference I visited the winery called "Quinta do Bomfim". This winery and vineyards were situated in the Upper Gorgo, on the North bank of the River Douro (Figure 3).



Figure 3: Façade of Quinta do Bomfim winery.

Vineyards are located on the south facing slopes along the Douro River. The altitude of the Estate ranged from 100 to 340 m asl. The average annual rainfall at the Quinta is about 800mm. 30% of the vineyard is planted with Touringa Franca and 21% Touriga Nacional, another cultivated variety is Souzao. The winery produces mostly Port wines. The average age of the vines in this property is 30-40 year.

8. Outcomes and conclusions

Participating to international conferences is always a great privilege and opportunity for meeting some of the best researchers in the area of interest. This symposium has been a good occasion to renew contacts and make new collaborations. At this GiESCO conference I had the great chance to discuss my research with colleagues working in similar field and I have been able to gather important feedback that will certainly be taken into account in my future research. I am already sharing data with young researchers from Italy and Argentina and we are planning a joint paper to be published next year.

I thank the GWRDC and the University of Adelaide for giving me this opportunity.