Participation at 18th International Symposium G*i*ESCO, Porto, Portugal 7th-11th July 2013



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Executive Summary

Catherine Kidman travelled to Porto, Portugal to attend the 18th International Symposium G*i*ESCO where she presented a poster **"The effect of water stress on the reproductive performance of Shiraz (*Vitis vinifera*) grafted to American *Vitis* rootstocks"**

Participation at G*i*ESCO gave Catherine the opportunity to make and renew contacts with international viticultural researchers that will facilitate future collaboration in research, particularly with reference to rootstocks and irrigation studies. Attendance to the conference gave Catherine the opportunity to learn from research in many fields of plant physiology.

A highlight of the symposium was the mix of lectures and practical excursions, a particular highlight was a visit to the Alto Duoro wine region and associated tours and viticultural lectures in vineyards of the region.



Background

G*i*ESCO is an internationally renowned conference focussed on both basic and applied viticultural topics.

Started as a European group by Alain Carbonneau and colleagues, G*i*ESCO originally focused on training systems and ecophysiology, and has since evolved to encompass these themes plus basic and applied viticulture.

The 18th G*i*ESCO in Porto was unique in that it allowed attendees to visit two UNESCO World Heritage Sites, ALTO DOURO WINE VALLEY and PORTO HISTORICAL CENTER, and to know the latest advances in Viticulture and Portuguese wine production.

This was a unique opportunity for me to present the results from my research to an international viticultural community, to interact with renowned viticultural researchers and to establish contacts that will hopefully lead to collaboration and/or further research in the viticultural field.



Objectives

- To present results obtained from the GWRDC funded project "P3106" **The effect of water stress on the reproductive performance of Shiraz (Vitis vinifera) grafted to American *Vitis* rootstocks** at the 18th International Symposium, GiESCO 2013 held in Porto (Portugal)
- To obtain feedback and networks/collaborations from the international scientific community at the 18th International GiESCO symposium, Porto, Portugal
- Meet key researchers and academics from different universities and research institutions throughout Europe and USA and discuss their experience with rootstocks : Key focus areas include:
    1. Grapevine reproduction
    2. Drought / climate change
    3. Quality / rootstock relationship
    4. Carbohydrates, reproduction and rootstocks
- Communicate outcomes of symposium to industry through journal articles, regional grower meetings to the Limestone Coast Grape and Wine Council, Coonawarra Grapegrowers Association and through the completion of my PhD.

Project outputs and performance targets:

Output	Performance Targets	Date
1.Paper to be submitted to the American Journal of Enology and Viticulture	Paper submitted to high impact scientific journal	Completed Feb 2013
2.Poster or Oral presentation and symposium proceedings paper publication	Paper publication in conference proceedings	Completed August 2013
4. Seminar to Limestone Coast Grape and Wine Council Technical Group	On conference attendance and visit to associated vineyards in Porto, Portugal	Completed September 2013
5. Seminar to Coonawarra Grapegrowers Association	On conference attendance and visit to associated vineyards in Porto, Portugal	Completed September 2013

Presentations of interest from G*i*ESCO, Porto, Portugal

In July 2014, Catherine Kidman (Figure 1) travelled to Porto in Portugal to attend the 18th G*i*ESCO symposium. The main conference and lecture series took place from the 9th until the 11th of July at the Faculty of Sciences of the University of Porto. Almost 250 international academics, researchers and professionals were present. The conference covered key areas of viticultural science that brought together approximately 200 presentations (oral and poster) from 17 different countries.

The conference was broken up into sessions of the following themes:

- **Methodology and Ecophysiology**
- **Water Relations**
- **Mountain and hot regions Viticulture**
- **Environment: Climate and soil**
- **Vineyard Management, Yield, Quality**
- **Training Systems**
- **New concepts and advanced technologies in Viticulture**
- **General Viticulture**
- **Territory management. Sustainable viticulture**

While tours were organised to the following destinations:

- **WINES OF PORTUGUESE REGIONS */ VINS DE RÉGIONS PORTUGAISES: VINHOS VERDES***

- **WINES OF PORTUGUESE REGIONS */ VINS DE RÉGIONS PORTUGAISES: DOURO, TRÁS-OS-MONTES***

- **Visit to Port Wine Cellars**



Figure 1 The Duoro wine region From L-R Catherine Kidman and Roberta DeBei.

Summary of selected presentations

Catherine Kidman presented her research poster from her PhD project entitled; **"The effect of water stress on the reproductive performance of Shiraz (*Vitis vinifera*) grafted to American *Vitis* rootstocks"**

Catherine was approached by other researchers to discuss the results presented in both posters and to send copies to other researchers.

Some of the presentations at the G*i*ESCO conference that caught the attention of Catherine and were relevant to the Australian wine industry included:

"Modelling water and sugar flux to developing berries suggests early cessation of sugar accumulation and substantial xylem backflow"

Mark Krasnow, Kenneth Shackel and Mark Matthews

Briefly, the authors constructed a model of the developing berry across 13 varieties which illustrated that sugar accumulation is rapid after veraison but only for 40-50 days, after which sugar accumulation ceases.

A key finding was that sugar accumulation tightly correlated to DAA than GDD.
Berry weight increased steadily from 20 DAA until 96 DAA when maximum weight was reached. After this point berry weight decreased steadily to 130 DAA.
Veraison occurred 60 DAA the amount of sugar per berry increased rapidly until 100 DAA . After this time point sugar accumulation decreased or ceased. Brix continued to rise but due to dehydration and concentration of sugars rather than sugar import.
DAA correlated better to the timing of key phenological events than GDD.
Infers that the window for canopy management is short and governed by DAA if you are wanting to evoke changes to sugar accumulation / importation

"Classification for timing of flowering and veraison of a wide range of *Vitis vinifera* cultivars with the GFV model"

Amber K. Parker, Inaki Cortazar-Atauri, Isabelle Chuine, Rainer W. Hofmann, Mike C. Trought, Cornelis Van Leeuwen

Briefly, the presentation discussed statistical model that predicts flowering and veraison retrospectively using daily mean arithmetic temperatures. The model assumes a phenological stage occurs when ts corresponds to the day when a critical rate of forcing sf is reached at a particular value F* (°C.d)

"Effects of the atmospheric vapour pressure deficit and soil water availability on the diurnal pattern of grapevine stem water potential "
João Gouveia, Pedro Rodrigues, Vanda Pedroso, Francisco Marques, Isabel Alves, Carlos M. Lopes

Briefly, Ψstatus didn't change despite a change in soil water holding capacity. Ψstatus corresponded to both increases in solar radiation (2pm and 4pm) when VPD was at its highest. Non-irrigated was always lower Ψ than deficit irrigated. Soil moisture values didn't affect Ψs. Atmospheric conditions at the time of treatment responsible for changes in Ψs ie VPD 1.86 : -0.66MPa VS VPD 4.01 : -1.05MPa

VPD and decreases in Ψs are independent of available soil water.

Duoro: Peso da Regua

The following summaries have been made from the following presentations:

Douro - a pioneering demarcation António b. Cardoso
Viticulture evolution in Douro region Nuno Magalhães

Contributions for the sustainability of steep slope vineyards. Good agricultural and environmental practices in the upper Douro vineyard world heritage José Pereira, Carlos Pereira, Helena Teles

The climate of the Douro: structure, trends and mitigation and adaptation responses to a changing climate Gregory v. Jones, Fernando Alves

The Duoro region is 250,000 ha's of which 18% (42,202ha) is under vine. 24,600 ha declared world heritage UNESCO site in 2001. The Duoro is significant in that it was the first demarcated wine region in the world (1756). Traditionally a port wine growing region but now this also extends to table wine production. Duoro wine is classified as "Mountain viticulture" and until relatively recently, much of the region was remote and inaccessible. Key red varieties grown include: Touriga nacional, Tinta Roriz, Touriga Franca, Tinta Cao and Tinta Barroca.

Of the ~40,000 ha there is an average block size of 1.3 has per operation with the majority of operators selling their fruit through cooperatives

There are three main areas of the Duoro: Baixo Corgo- which lies to the west and has the highest rainfall and yields and produces in general lighter styles, Cima Corgo- which is in the east characterised by a drier climate, low yields producing a more concentrated style of wine and Duoro Superior- the driest of climates and where the higher quality vineyards are planted.

The climate is in general classified as Mediterranean; cold winters, hot summers and low rainfall. The maximum altitude permitted to grow grapes is at 650m. The Duoro is surrounded by mountain basins, which is important for viticulture and the climate changes as you head east with higher humidity, while north facing sites are typically 2°C cooler than south facing. For every 100m increase in elevation, there is approximately a 45mm increase in rainfall and a 0.6°C drop in temperature.

An aridity index (I= (Tx100)/ R (T=temperature, R= rainfall) for the period of time in question) is used to classify port on a scale of A through to I. The more you move from west to east in the Duoro, the higher the amount of "A" vineyards. For any one property there may be differences in aridity and therefore there may also be different parcels of fruit picked from within the vineyard. Port in particular requires a high aridity index and irrigation is generally not required to grow grapes of their desired style.

The climate of the Duoro as summarised by **Greg Jones** highlighted elevation ranges between 1410m and 48m. This project summarised climate season indices using woldclim spatial climate database at 1km resolution. They summarised an increase in extreme temperature and fewer cold events, minimum temperatures are warmer rather than maximum temperatures increasing.

The oldest vineyards are planted on traditional terraces supported by dry stone walls, this is typically cost prohibitive and they typically can only host one or two rows of vines. The soil was brought up from the river and backfilled to account for the steep hillsides. Patamares (platforms) are more modern

terraces which are cut into the mountainside using earth moving equipment (we visited a vineyard where across the river we could see this equipment) this is relatively inexpensive, quick but prone to erosion and therefore, any new replants must comply with legal requirements with a maximum gradient of 30% can be vertically planted up a hillside.

Soils of the region are typically Schist slate like rock, this soil has reported good water retention properties, the humidity allows the vines to grow in the arid conditions however yield is restricted as a consequence.

"Grapevine yield variability: contribution of grape load and effects of the previous season's growing conditions"
Nicolas Guilpart, Aurélie Metay, Christian Gary

Yield variation due to:

60% bunch no, 30% berry no, 10% berry weight. Initiation and differentiation of inflorescence is impacted by temperature, light and water. The potential number of bunches of the current year is determined by water and nitrogen stress of the previous year flowering period. The authors tried to correlate number of bunches per shoot with pre-dawn leaf water potential and nitrogen content at flowering. The authors concluded that potential yield of current year is determined at flowering in the previous year with pre-dawn and nitrogen content of the previous year than the content of the current year.

Conclusion

Attendance at the G*i*ESCO conference provided an ideal opportunity for me to make and renew contacts that will facilitate future collaboration in research and career. It also gave me the opportunity to show the results of my research to international researchers. Finally it allowed me to learn from other kinds of viticultural research in different fields that can be applied to my viticultural work and future research.

Acknowledgments

The author would like to acknowledge the support by the Grape and Wine Research and Development Corporation and Treasury Wine Estates who co-funded the associated costs and travel to attend and present at the 18th G*i*ESCO conference in Porto, Portugal.

References:

Catherine M. Kidman, Sandra M. Olarte Mantilla, Peter R. Dry, Michael G. McCarthy and Cassandra Collins
The effect of water stress on the reproductive performance of Shiraz grafted to rootstocks pp 495-504

Appendix

THE EFFECT OF WATER STRESS ON THE REPRODUCTIVE PERFORMANCE OF SHIRAZ GRAFTED TO ROOTSTOCKS

L'EFFET DU STRESS HYDRIQUE SUR LA CAPACITE REPRODUCTRICE DE SHIRAZ GREDDE SURE DES PORTE-GRAFFES

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Summary

An experiment was conducted in the Barossa Valley, South Australia to examine the effects of rootstock on reproductive performance of Shiraz (*Vitis vinifera* L.) in the absence of irrigation. Irrigation applied to control treatments was between 0.6ML/ha-1.3ML/ha across three seasons.

The absence of irrigation strongly influenced vine growth and performance.

Yields were reduced in unirrigated treatments due to a reduction in bunch number, bunch weight and berry weight rather than fruitset.

Unirrigated Ramsey was the only rootstock able to maintain a comparable yield to irrigated rootstocks.

In contrast, unirrigated own roots performed well in the first season but not in the second and third seasons when water stress caused a negative effect on yield

Résumé

Une expérience a été menée dans la Barossa Valley, Australie du Sud pour examiner les effets de porte-greffe sur les performances de reproduction de Shiraz (Vitis vinifera L.) en l'absence d'irrigation. Irrigation appliquée pour contrôler les traitements était entre 0.6ML/ha-1.3ML/ha sur trois saisons.

L'absence d'irrigation fortement influencé la croissance de la vigne et de la performance.

Les rendements ont été réduits dans les traitements non irriguées en raison d'une réduction du nombre de peloton, le poids du régime et le poids des baies plutôt que nouaison

Non irriguées Ramsey était le seul porte-greffe en mesure de maintenir un rendement comparable à des porte-greffes irriguées.

En revanche, ses racines non irriguées ont bien performé dans la première saison, mais pas dans les deuxième et troisième saisons où le stress hydrique causé un effet négatif sur le rendement

Keywords: fruitfulness, fruitset, reproductive performance, water stress

Introduction

Increased climate variability is likely to result in grape growing regions being forced to operate with reduced water availability.

Early and late season water deficits have been shown to be detrimental to the development of both the current and the following season's crop

Early season water deficits can interfere with pollination and fertilization and can cause poor fruitset and/or abscission of inflorescences (Alexander 1965, Keller 2005) and result in fewer berries per cluster (Rogiers et al. 2004).
Rootstocks may help alleviate the effects of water stress during flowering and berry development.
An experiment was conducted in the Barossa Valley, South Australia (Figure 1) to examine the effects of rootstock on reproductive performance of Shiraz (*Vitis vinifera* L.) in the absence of Irrigation (Table 1).

Materials and Methods

The study was established at Nuriootpa, South Australia, Australia (34˚48'S, 139.01°'E). The vineyard was planted in 2001 at 3m x 2.25m row and vine spacing
Vines were unirrigated or irrigation applied was between 55 to 110 mm/ha across three seasons, based on measures of pre-dawn leaf water potential (Ψ_{pd}).
Vegetative and reproductive parameters were measured by assessing the following:

- Pruning weights
- Bud fruitfulness
- Flower number
- Coulure Index (CI)
- Millerandage Index (MI)
- Bunch weight
- Berry weight
- Fruit yield per meter of cordon.
- Fruitset indices were calculated according to formulae in Collins and Dry (2009) (Figure 2).

Results and Discussion

Water stress (Ψ_{pd} >0.8 MPa) was exhibited in the unirrigated vines from veraison onwards (figure 3).
Zero irrigation reduced yield by 25% in 2008/2009, 22% in 2009/2010 and 23% in 2010/2011 (Figure 4).
Yields were reduced due to a reduction in bunch number, bunch weight and berry weight rather than any effect on fruitset and berry number.
A strong inverse relationship (r^2=0.936) between fruitset and CI was observed. This appears to be a good indicator of disruption to reproductive development for Shiraz.
A cumulative effect of zero irrigation was most notable in Shiraz than in rootstock treatments (Figure 5).
The cumulative effect of drought of season one and two severely affected yield and yield components for unirrigated Shiraz. In contrast, unirrigated Ramsey was able to maintain comparable yields with irrigated Ramsey in seasons two and three.
1103 Paulsen unirrigated in every season was associated with the lowest yields.
Although rootstock type appeared to have some effect on reproductive performance, this was inconsistent and season had a greater influence than either rootstock type or irrigation.

Conclusions

The absence of irrigation strongly influenced vine growth and performance.
Yields were reduced in all seasons due to zero irrigation.
Yield was reduced due to a reduction in bunch number, bunch weight and berry weight rather than fruitset.
Ramsey was the best performing rootstock and maintained yields similar to irrigated treatments.

Shiraz unirrigated experienced a cumulative decline in yield for season 2 and 3.
1103 Paulsen unirrigated in every season was associated with the lowest yields.
These findings may have significant consequences for rootstock choice in grape growing regions faced with future drought and water allocation issues.

Acknowledgments
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Keller, M. 2005. Deficit Irrigation and Vine Mineral Nutrition. American Journal of Enology and Viticulture 56: 267-283.

Rogiers, S.Y., J.M. Hatfield, and M. Keller. 2004. Irrigation, nitrogen and rootstock effects on volume loss of berries from potted Shiraz vines. Vitis 43: 1-6.

Tables

Rootstock	Parentage
Shiraz (clone BVRC30)	*V. vinifera*
110 Richter	*V. berlandieri x V. rupestris*
1103 Paulsen	*V. berlandieri x V. rupestris*
140 Ruggeri	*V. berlandieri x V. rupestris*
99 Richter	*V. berlandieri x V. rupestris*
Ramsey	*V. champinii*

Table 1. Rootstocks names and parentage used at Nuriootpa

Tableau 1. Les noms des porte-greffes et la filiation utilisés à Nuriootpa

Figures

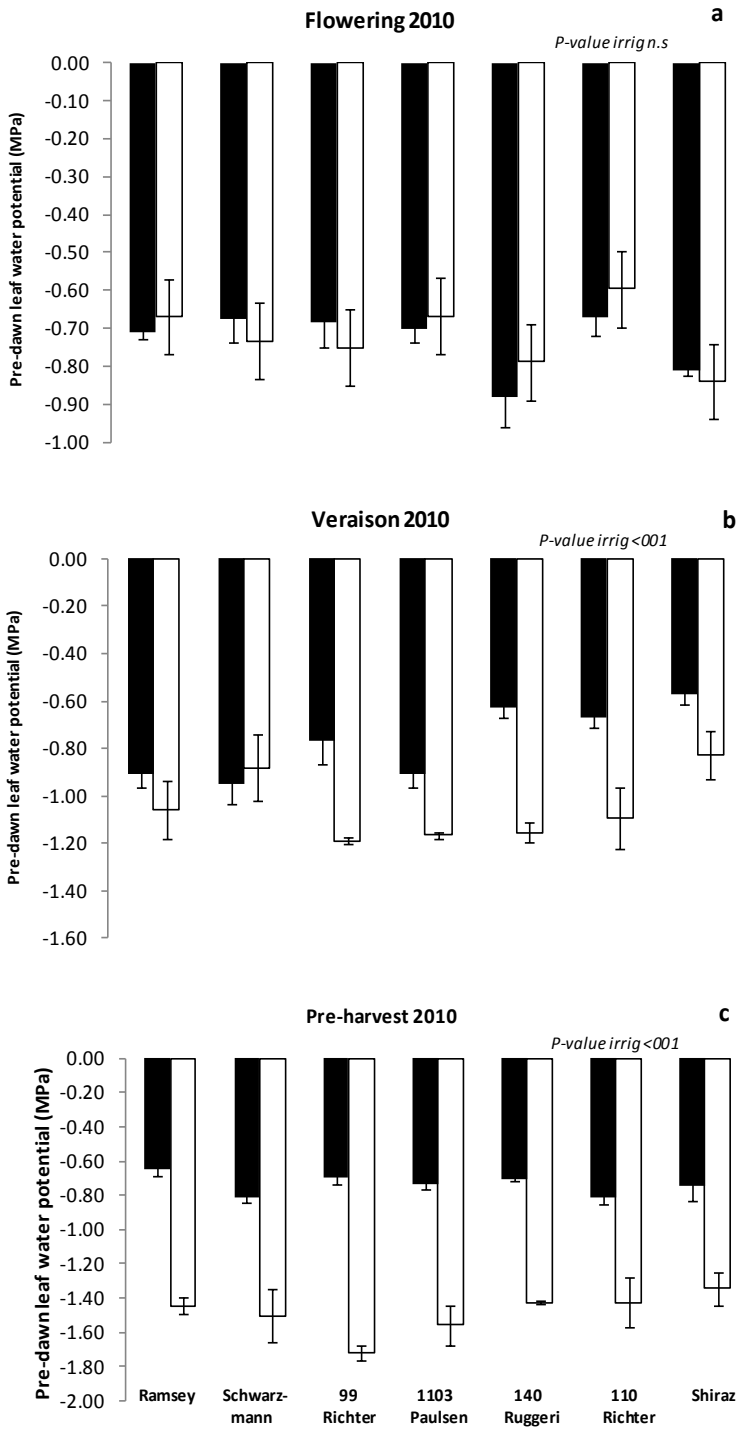

Flowering 2010
a
P-value irrig n.s
Pre-dawn leaf water potential (MPa)
0.00
-0.10
-0.20
-0.30
-0.40
-0.50
-0.60
-0.70
-0.80
-0.90
-1.00
Veraison 2010
b
P-value irrig <001
Pre-dawn leaf water potential (MPa)
0.00
-0.20
-0.40
-0.60
-0.80
-1.00
-1.20
-1.40
-1.60
Pre-harvest 2010
c
P-value irrig <001
Pre-dawn leaf water potential (MPa)
0.00
-0.20
-0.40
-0.60
-0.80
-1.00
-1.20
-1.40
-1.60
-1.80
-2.00
Ramsey
Schwarz-mann
99 Richter
1103 Paulsen
140 Ruggeri
110 Richter
Shiraz

Figure 1. An example of the effect of irrigation treatment on pre-dawn leaf water potential at flowering (a), Veraison (b) and pre-harvest (c) Error bars represent the standard error of the mean (n=15).

Figure 1. Un exemple de l'effet du traitement de l'irrigation sur le potentiel de l'eau feuille avant l'aube à la floraison (a), la véraison (b) et avant la récolte (c) Les barres d'erreur représentent l'erreur standard de la moyenne (n = 15).

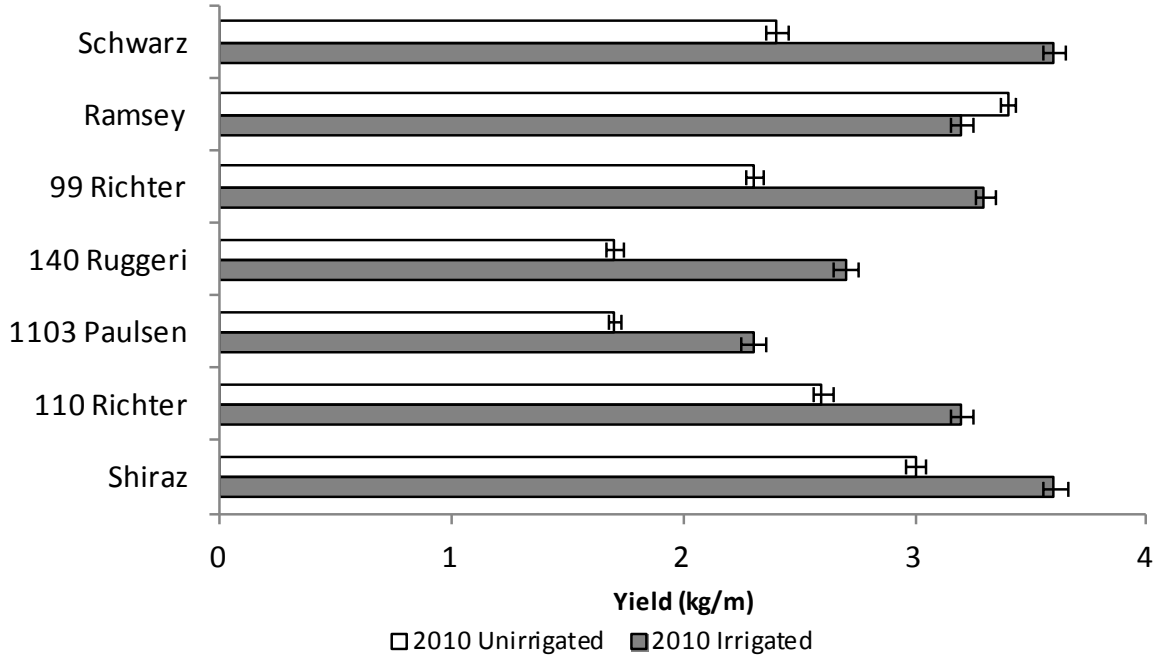


Figure 2.An example of the effect of irrigation treatment and rootstock genotype on yield (kg/m) for the 2010 seasons at Nuriootpa, South Australia. Error bars represent the standard error of the mean (n=21).

Figure 2.An exemple de l'effet du traitement de l'irrigation et du génotype de porte-greffe sur le rendement (kg / m) pour les saisons 2010 à Nuriootpa, Australie du Sud. Les barres d'erreur représentent l'erreur standard de la moyenne (n = 21).



Figure 3 Trial site at Nuriootpa, Barossa Valley, South Australia

Figure 3 site d'essai à Nuriootpa, Barossa Valley, Australie-Méridionale



a



b





c

d

Figure 4a Unirrigated Shiraz vines at Harvest. Figure 4b Irrigated Shiraz vines at harvest. Figure 4c. Unirrigated Shiraz Berries at harvest. Figure 4d Irrigated Shiraz Berries at harvest

Figure 4a sans irrigation des vignes de Shiraz à la récolte. Figure 4b irriguées vignes de Shiraz à la récolte. Figure 4c. Non irriguées baies Shiraz à la récolte. Figure 4d irriguée baies Shiraz à la récolte

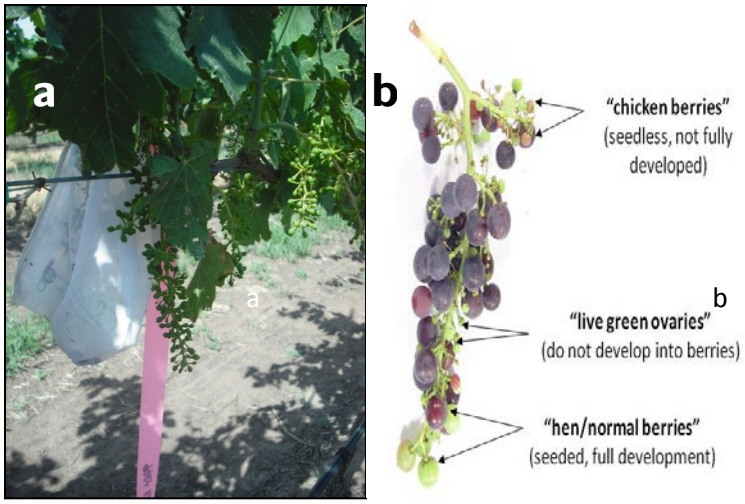


Figure 5 a Inflorescences bagged for flower and berry counts. Figure 5 b Fruitset Indices: seeded, seedless and LGOs

Figure 5 a inflorescences ensachées pour la fleur et le nombre de baies. Figure 5 b nouaison Indices: graines, pépins et LGO