Vineyards for 2025 – Improved industry returns from soil and water research – communication and adoption of research outcomes.

FINAL REPORT to
GRAPE AND WINE RESEARCH & DEVELOPMENT CORPORATION

Project Number: CUT 0901

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Research Organisation: **Curtin University**

Date: **1 August, 2011**

Title: Vineyards for 2025 – Improved industry returns from soil and water research – communication and adoption of research outcomes.

GWRDC project number CUT 0901

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Date: August, 2011

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1) Abstract

The potential adoptable outcomes from the projects within the soil and water initiative were identified via interview with scientists and assessment of project reports. The available materials which could be used to form the basis of extension material were collected and for each project the major potentially adoptable research outcomes were documented. In some instances outcomes were suitable for immediate adoption or already in use by industry (for example the dripper distribution uniformity tool). In many other instances the findings additional research or development may be required prior to extension. It is recommended that extension material includes the review of past related projects and literature.

2) Executive Summary

The potential adoptable outcomes from the completed projects within the soil and water initiative were identified via interview with scientists and assessment of project reports. The available materials which could be used to form the basis of extension material were collected and for each project the major potentially adoptable research outcomes were documented. In some instances outcomes had a high level of utility and were suitable for adoption or were already in use by industry (for example the dripper distribution uniformity tool). In many other instances the findings additional research or development may be required prior to extension. It is recommended that extension material includes the review of past related projects and literature.

The adoptable outcomes were grouped into 4 categories;

- Novel irrigation scheduling techniques and indicators of plant water status
- Increasing soil water availability/resource utilisation
- Rootzone, soil health and cover crop management
- Cultivar/rootstock specific irrigation management

it is recommended that for each adoptable outcome extension material is developed for dissemination by the innovators network and educational institutions. Furthermore, it is recognised that there are considerable resources of information from related studies (in Australia and elsewhere) in the literature and previous studies that relates to outcomes identified in this project. As such, it is also recommended that extension materials include reviews of the literature and where appropriate these reviews identify areas of potential further research.

3) Background

Combined pressures of statutory change, climate variability (and long term climate change) and intra-industry competition make water a key determinate of sustainability for the Australian wine industry. Future viticulturalists will be increasingly required to justify their access to water through the development of formal water use efficiency plans in order to comply with local area statutory water resource management plans which in turn reflect Federal Government requirements (as required by the National Water Initiative). Furthermore, export market access issues associated with environmental sustainability will bring pressure to bear on wineries to ensure that grape suppliers conform with basic environmental management requirements (as recognised by the Winemakers Federation of Australia – leading to the development of the ENTWINE - Australian Wine Industry Environmental Stewardship program) many of which are associated with optimal resource utilisation by vineyards.

The Soil and Water Initiative generated a wealth of knowledge for the Australian wine industry. During the annual review of the initiative in 2008 researchers and industry representatives acknowledged that dedicated support for the identification of adoptable outcomes would greatly benefit the industry. Likewise, concern was expressed over the lack of an effective mechanism to disseminate information and findings following the conclusion of the Soil and Water Initiative.

This project sought to engage with researchers to clearly define and describe the adoptable outcomes from each project within the Soil and Water initiative. Recommendation for aggregation of outcomes was made where appropriate/possible and the supporting information (existing presentations and industry reports/tool kits/reference materials suitable form the basis of technology transfer) obtained for reference.

This project has led to a larger project which has focussed on the development of extension materials suitable for dissemination through the GWRDC Innovators Network and educational institutions.

The overall aim of this project was to maximise industry return for investment in the Soil and Water Initiative by ensuring that adoptable research outcomes are identified and documented

along with an assessment of the resources which may be utilised by industry in the development of an extension program.

4. Project Aims and Performance Targets

Year 1	Output	Due Date mm/yy	Activities
a	Interim report identifying and describing adoptable outcomes, their utility and identify existing resources.	12/2009	Review project materials, interview researchers and describe adoptable outcomes. Assess outcome utility and identify existing resources which may be suited to contribute to a technology transfer program. Summarise and prepare interim report
b	Final report providing recommendations to GWRDC on the structure of a technology transfer and communication program.	06/2010	Aggregate similar research outcomes. Obtain industry input on aggregation and utility assessments. Formulate and report on a recommended structure for technology transfer and communication.

5. Methods

This project had two phases

Phase 1

To identify and describe adoptable outcomes research proposals, progress and final reports (and any documents available from review meetings) were reviewed followed by a combination of direct email and telephone communication with researchers. Were appropriate, face to face meetings were utilised to help facilitate information exchange. Individual adoptable outcomes were then summarised on the basis of a) description of the outcome and b) potential applications.

In the process of describing outcomes, application and utility supporting information was obtained and if possible copies obtained.

Phase 2

In phase 2 adoptable research outcomes were assessed and aggregated to develop recommendations on the focus of extension materials. – due to the delay in this project phase 2 has overlapped with the subsequent project CUT 1001 (reported separately).

6. Results and Discussion

Phase 1

The major adoptable outcomes of each project have been summarised on the following pages. For each project the potential adoptable outcomes have been nominated along with a short description of the major findings. The level of prior testing has been noted along with steps required to facilitate industry uptake. The resources collected as part of the project are also listed.

Vineyard water use - adapting to change

Project Number: CSL 04/02

Date: 1 Feb 2005 - 30 Jun 2009

Chief Investigator: Dr John Hornbuckle

Project Supervisor: Evan Christen

Research Institution: CSIRO Land and Water

Documents available : CSL04-02.pdf
Documents needed:

Adoptable outcome	Description	Prior testing	Steps to implementation	Scope of application	Resources available.
1. *IrriGATEWAY – SMS service*	A low cost, practical irrigation management tool which determines and predicts vineyard water use using satellite sensing and weather stations data and regularly delivers the information to the vineyard managers via SMS messaging	Conducted highly successful trial 2008/09 ; 70 growers using it at present	Satellite sensing and weather station data access need to be setup using GPS and internet. Once service is setup, only mobile phone is required to receive daily detail of irrigation run times required to replenish crop water use. Wider application and promotion needed	Drip irrigated vineyards, no scale limitations Improvement in water use efficiency	http://www.irrigateway.net/tools/sms/
2. I*rriGATEWAY* – Distribution Uniformity Calculator	A web-based irrigation assessment tool useful in the design and management of drip irrigation systems . It provides maps of the dripper application rates, seasonal and instantaneous applied irrigation/fertigation maps, and irrigation system percentage	Website tool functional since 2008,	Require GPS, field dripper flow data and Internet to setup, Website provides report in .pdf providing maps and tables highlighting the irrigation system efficiency and uniformity . wider application and	Drip irrigated vineyards, no scale limitations Improvement in water use efficiency	http://www.irrigateway.net/tools/du/

	distribution uniformity.		promotion needed		
3. Green Marketing	Reduction in water use can form the foundation of a green marketing strategy for industry	Nil	Development of marketing materials for WFA, Wine Australia. Inclusion in ENTWINE criteria and promotion	All regulated water users	
4. Use of auditing/benchmarking tools to assist in negotiation with irrigation water regulators	Increased competitiveness of the wine industry relative to other water users due to the capacity to demonstrate a high level of responsibility and WUE	Nil	Use of extension material to support lobbying and negotiation with Government and privatised water providers. General marketing to demonstrate community/environmental values of the irrigated wine industry	All regulated water users	

Notes

Both website and CSL doc has info to form the basis of a powerpoint presentation

Management options to minimise off-site impacts of nutrients and pesticides

Project Number: CSL 06/02.
Date: 1 Jan 2007 - 30 Dec 2009

Project Supervisor: Kookana, Rai

Chief Investigator:

Staff: Lester Smith
Research Institution: CSIRO Land and Water

CSL 06/02 report from GWRDC

Adoptable outcome	Description	Prior testing	Steps to implementation	Scope of application	Resources available.
1. Understanding of Nitrate pollution of groundwater supplies	Linage between soil disturbance, prior nitrogen application and recent nitrogen application on nitrate leaching. Modified management at the vineyard level is dependent upon the source of the pollutant. Old organic nitrogen that is mobilised during the vineyard establishment phase, less soil disturbance during this process could be the recommendation. Alternatively, if the source of the nitrogen is through the application of fertilisers, then the management implication could be reduced and/or more targeted use.	Undertaken during the life of the project. Limited by drought conditions and lack of drainage.	Further monitoring during higher rainfall and higher irrigation water supply seasons. Maintenance of targeted measurement points for longer term studies.	Irrigated viticulture with a focus on areas that include integrated draining systems. Aquifers of South east Australia	*CSL 06/02 report from GWRDC*
2. Pesticide pollution of ground and surface water	Determination of mobile pesticides and their incidence (low) in drainage water. Ban specific pollutant chemicals - to preserve the 'clean-green' image	Undertaken during the life of the project. Limited by drought conditions and lack of drainage.	Further monitoring during higher rainfall and higher irrigation water supply seasons. Maintenance of targeted measurement points for longer term studies.	All vineyards	*CSL 06/02 report from GWRDC*

Optimising canopy function to increase yield while maintaining wine aroma with efficient use of resources

Project Number: CSP 05/01

Date: 1 Oct 2005 - 30 Jun 2009

Project Supervisor: Clingeleffer, Peter

Chief Investigator:

Staff: Everad Edwards

Research Institution: CSIRO Plant Industry

Documents available: CSP 05/01 report to GWRDC

Adoptable outcome	Description	Prior testing	Steps to implementation	Scope of application	Resources available.
Targeted deficit irrigation strategies – can RDI be pushed harder	Comparison of long term effects of control, deficit and prolonged deficit irrigation on vines. Long term RDI did not lead to progressive decline in vines. If pushed then yield declines – however, vine carbohydrate status was maintained. RDI an d prolonged deficit treatments gave increased colour – especially in early years of the trial.	Major field trial, conducted with industry over a 4 year period.	Further industry trials to extend findings and more glasshouse and controlled conditions to understand the mechanisms behind the interaction between phenology and water deficits.	Red grape varieties (predominantly). Large scope for application especially in years of highly restricted water supply	CSP 05/01 report to GWRDC presentations
Impact of heat waves on vines during prolonged periods of water deficit.	Study of impact of heat waves on vine performance during reduced irrigation (10 , 25, 50 and 100% of control values). Study has demonstrated the extent of leaf loss, transpiration values and leaf temperature during periods of high atmospheric temperature.	Field trial conducted with industry and some glasshouse experimentation.	Investigation into the capacity to mitigate leaf damage with pre-heat wave irrigation	Red grape varieties (predominantly). Large scope for application especially in years of highly restricted water supply	CSP 05/01 report to GWRDC presentations

Optimising irrigation for different cultivars

Project Number: CSP 05/02

Date: 1 Jul 2005 - 30 Jun 2009

Project Supervisor: Loveys, Brian

Chief Investigator:

Staff: Marissa Collins

Research Institution: CSIRO Plant Industry

Other project Number: CSL 01-01 (first two years) SAR 04-04?
Documents available: Insights into varietal and rootstock pp.pdf, CSP 05/02 report to GWRDC

Adoptable outcome	Description	Prior testing	Steps to implementation	Scope of application	Resources available.
Ranking of responsiveness to high VPD amongst 9 common varieties of *Vitis vinifera* Infers differences in capacity of varieties to cope with high VPD conditions and hence climate variability. Varieties with responses such as Grenache (high stomatal sensitivity, low water loss) have a lower risk profile than varieties such as Merlot (low sensitivity, high water loss).	Two seasons of data on stomatal conductance LWP, ABA, Vegetative and reproductive growth of 9 varieties in a single block in Barossa. Experiment involved well watered conditions and utilised natural variation in VPD to assess responses to changing conditions. Varieties can be differentiated by Gs response to VPD. Seasonal impacts are VERY important and response differs from one season to the next. May be due to 'conditioning' in spring. Conditioning MAY relate to leaf retention and fine root growth. From most responsive to least: Grenache and Riesling Cab Sauvignon and Sangiovese Shiraz Semillon, Verdelho Chardonnay (maybe), Merlot Leads to variety-specific irrigation eg Grenache can be watered by calendar and Shiraz irrigated	Field trial at Nuriootpa. 2 years, now finished. McLaren Vale with RDI across Grenache, Cabernet Sauvignon, Shiraz. Results differ and so too does the soil type. Chris Soar compared Grenache and Shiraz with RDI and demonstrated VPD-driven differences in responses of Gc.	Further testing across different soil types and consideration of resource utilisation. Further studies w.r.t. interaction between the capacity of genotypes to take up resources and the capacity of different soils to provide soil water. Ie the response of any given genotype may depend on root structure and soil texture. Climate change scenario modelling – from an agronomic perspective.	Wide scope, any irrigated viticulture. Longer term consideration with respect to selection of planting material.	Module 4 from drought response series GWRDC Water and Vine (book from GWRDC) International Grapevine and Biotech conf. PDF of presentation. SW&I 2008 and 2009 presentations. Draft papers (look for later pubs). *Insights into varietal and rootstock pp.pdf,*

	by demand.				
High night temperatures limits recovery during peak heat loads	Heat tent work. Impact of short term elevated temps on water use in grapevines. Undertook physiology. Leaf gas exchange, LWP, Chl Fluorescence (year 1). Night transpiration measures, leaf temp, Shiraz had capacity to compensate by incr Gc and transpiration. Increase in night temp (second year) resulted in negative impact on Pn. Ie overnight heating reduced capacity to cope with temp. Temp spike of 42 deg for 3 days limits industry application.	Field trial at Nuriootpa but to be repeated with higher heat loads in 2010 plus water deficit – more realistic. Will include a pre-and post-veraison treatment. Var Cab Sauv and Semillon.	Further field trials are required with higher heat loads.	Warm inland production areas and cooler areas in the context of a changing climate.	
Preparing vineyards for upcoming heat events. Demonstration of the importance of having a high soil water content prior to the start of a peak heat period and resource utilisation during the heat period will be limited by the past irrigation history (ie irrigation during the event may be wasted). Irrigation strategy to prepare vineyards for predictable heat events associated with variable climates	Variety comparison across irrigation treatments (chardonnay and cabernet). Plasticity of response to irrigation and VDP. Manipulation of VPD within licor leaf chamber. Response to VPD differs among irrigation treatments. Irrigation during a heat period may therefore not create a positive response if the vines enter the period under stress.	Oxford landing SARDI/WIC ongoing	One more season of data to provide proof of concept.	Warm inland production areas and cooler areas in the context of a changing climate.	SWI 2009 presentation and GWRDC climate change meeting (October).

Optimising the recovery of vine performance following irrigation during extended periods of water deficit

Project Number: CUT 05/01

Date: 1 Jul 2005 - 30 Jun 2009

Project Supervisor: Gibberd, Mark

Chief Investigator:

Ayalsew Zerihun

Research Institution: Curtin University of Technology

Documents available : CUT 05/01 report

Adoptable outcome	Description	Prior testing	Steps to implementation	Scope of application	Resources available.
Understanding the impacts of vine vigour on resource utilisation under conditions of extended water deficit	Detailed assessment of vine water uptake relative to vine vigour and leaf gas exchange. Water uptake has been assessed by sap-flow and also soil water depletion Results show that there is little point in irrigating poor performing vines and irrigation scheduling should take account of median or stronger performing vines. Results include the assessment of financial return on irrigation application.	4 years of field trials at experimental site	Development of guidelines for the use of highly restricted irrigation volumes. Broader testing of guidelines in Western Australia and other predominantly rain-fed production areas	Predominantly rain-fed production areas and areas of high irrigation volume during periods of drought. 'Mothballed' vineyards	CUT 05/01 project report. Presentations to industry and conferences SWI steering committee presentations Published papers
Impact of irrigation on vine physiology during periods of extended water deficit	Detailed understanding of leaf physiology and vine performance during periods of water deficit including the dynamics of recovery following the	4 years of field trials at experimental site Range of experiments	Further field trials at a broader range of locations. Incorporation of findings relating to peak temperatures	Predominantly rain-fed production areas and areas of high irrigation volume during periods of drought.	CUT 05/01 project report. Presentations to

	application of highly restricted irrigation volumes.	under controlled environment conditions	and grapevine leaf function. Inclusion of data in models relating to climate change projections for the wine industry	'Mothballed' vineyards	industry and conferences SWI steering committee presentations Published papers

Managing Soil and Water to Target Quality and Reduce Environmental Impact

Project Number: DPI 04/04

Date: 1 Jun 2005 - 30 Sep 2009

Chief Investigator: Dean Lanyon

Project Supervisor: Ian Goodwin

Staff:

Research Institution: Department of Primary Industries, Victoria

Documents available: DPI_04-04.pdf

Adoptable outcome	Description	Prior testing	Steps to implementation	Scope of application	Resources available.
Aerial imagery for spatial variability analysis	Use of aerial imagery to identify/ differentiate vineyard management blocks in terms of yields and quality. Enabling differential harvesting techniques to increase wine quality. Determination of the underlying drivers of spatial variability.	Significant volume of research (for grapes and other crops) some grower uptake for use in differential harvesting	Promotion needed to turn this technique into 'industry practice'	All vineyards minimum site size determined by aerial photographing, GIS limitations Improvement homogeneity of quality of harvested fruit parcels	DPI_04-04.pdf
Aerial imagery for water use variability	Use aerial imagery to measure canopy cover as a proxy for spatial variation in water use. Use the data to differentiate vineyard management blocks in terms of water requirements thus implement differential irrigation and save water.	Some uptake for use in differential irrigation	Promotion needed to turn this technique into 'industry practice' Further R&D to extend the technology into nutrient management synergy with CSL 0404 IrriGATEWAY tools	All vineyards minimum site size determined by aerial photographing, GIS limitations Improvement in water use efficiency and, potentially nutrient application efficiency (via fertigation) reducing	DPI_04-04.pdf

				leakage and contamination of soil and ground water Potential increase in management block homogeneity due to better (differential) water and nutrient application Improvement in irrigation design methodology by accounting for soil and root growth variability within management block	
Aerial Thermal imagery for vine water status	Thermal images of vineyards blocks have the potential to identify spatial range in vine water status and simplify ground-based measures (discriminate between grapevines supplied with different levels of irrigation).	Limited due to new application of technology. However, concept is proven	Further R&D of the technology needed, especially in area image analysis. Complements other aerial analyses. Spatial variation in canopy temperature showed that vineyards can have areas where vines are non-stressed despite inadequate irrigation supply. Vice-versa areas with lack of water were also easily identified.	All vineyards minimum site size determined by aerial photographing, GIS limitations Current limitations of this approach are mainly associated with image analysis.	*DPI_04-04.pdf*

Rootzone water, salinity and nutrient management under precision irrigation

Project Number: LWA 05/01

Project Supervisor: Tapas Biswas

Chief Investigator:

Staff: Gerrit Schrale, Sarah Simpson

Research Institution:

Documents available: Soil Salinity fact sheet No2.pdf, Soil salinity fact sheet No1.pdf, NPSI irrigators.pdf,Monitoring_Soil_Salinity_for_Irrigated_Horticulture_fact_sheet.pdf, Root ZoneSalinity_FactSheet.pdf, 20080806winter leaching.pdf; LWA 05/01 report

Adoptable outcome	Description	Prior testing	Steps to implementation	Scope of application	Resources available.
Sampling technique (cost effective and robust) for determination of soil water salinity Adoption of soluSampler in mass scale by a wide range of industries.	Modified suction cup for *insitu* repeated sampling No destructive or expensive soil sampling required. User friendly and robust, *insitu* device. Works at 100 kPa suction. Growers collect at convenience and analyse for salinity, nutrients and pesticides. Sentek is contracted to SARDI to manufacture a) A new method of managing salinity in the field. b) Help growers minimise waste of fertiliser (resource utilisation) c) EMS and monitoring off site impacts d) Timing of end season irrigations to	3000 units existing in industry. Device has been in-house tested by SARDI, VIC DPI, NSW DPI, Sentek for performance, durability and consistency. In 2007 Sentek mass produced and marketed in 33 countries. 2000 units in Aust. Mainly used by commodity industries and env consultants (plus EPA). Heavily used by viti almond, citrus, olive, pistachio and other high value crops and veges (onions, potatoes, cabbage cauliflower). Extensive uptake!	Probe is currently a manual system. Innovative engineering to include an EC sensor for realtime measures of EC. To measure internally to the suction cup. Use of small aquarium pump to initiate suction and maintain suction over time at set intervals. Autosampling and stand alone.	Wide, any irrigated high value crops	3 fact sheets (salinity measuring and management) a) NRM board b) SARDI c) SARDI d) PIRSA rural solutions Manual – Sentek – CRCIF Water and wine factsheet Soil management practice guidelines (incl reference card). All available as PDF's and on the web Soil Salinity fact sheet No2.pdf, Soil salinity fact sheet No1.pdf, NPSIirrigators.pdf, Monitoring_Soil_Salinity_for_Irrigated_Horticulture_fact_sheet.pdf, Root ZoneSalinity_FactSheet.pdf,

	maximise leaching opportunities (with winter rainfall)	New versions appearing on market from other manufacturers.			*20080806winter leaching.pdf*
Determination of the amount of leaching irrigation required for maximum salt leaching	Salinity/leaching calculator. Maximising salt leaching with minimum water. Optimising winter rainfall with supplementary irrigation. Will be a web based software package that utilises average and allowing the input of SoluSampler values for soil salinity (or uses calculated values). Tool will calculate average soil salinity and will determine the leaching requirements based on target yield. Based on Maas-Hoffman relationship and Hoffman van-Genuchten soil salinity relationships. Calculator will take account of third dimension irrigation wetting pattern associated with drip irrigation and is therefore a significant step forward on two dimensional models	Beta version, tested by industry, leading growers (Riverland, lake districts, SE of SA) and two universities (Adelaide and Flinders). Not yet released on Web. But unofficially available now. Waiting on clearance for release (end of Oct)	Review Series of workshops and industry feedback. Benchmark against in-field SolusSmpler data.	Wide, any irrigated high value crops	3 fact sheets (salinity measuring and management) a) NRM board b) SARDI c) SARDI d) PIRSA rural solutions Manual – Sentek – CRCIF Water and wine factsheet Soil management practice guidelines (incl reference card). All available as PDF's and on the web *Soil Salinity fact sheet No2.pdf*, *Soil salinity fact sheet No1.pdf*, *NPSIirrigators.pdf*, *Monitoring Soil Salinity for Irrigated Horticulture fact sheet.pdf*, *Root ZoneSalinity FactSheet.pdf*, *20080806winter leaching.pdf* .

Soil management for yield and quality

Project Number: SAR 04/02

Date: 1 Feb 2005 - 31 Dec 2009

Project Supervisor: McCarthy, Mike

Chief Investigator:

Staff: Dean Lanyon, Shannon Andrews and Caroline Howell

Research Institution: South Australian Research and Development Institute

Documents available: data\Dean Layon.docx *SAR 04/02 report*

Adoptable outcome	Description	Prior testing	Steps to implementation	Scope of application	Resources available.
Demonstration that the effect of mulch lasts for a period of up to 7 years and ripping also for 7 years. That mulch and ripping doesn't have to occur every year.	Experiment compared longevity of ripping (both sides of vine 400 to 500 mm depth) and application of surface mulch. Both mulch and ripping treatments gave lasting effect for at least 7 years. The degree of influence is dependent on soil type and location but all had a positive effect. In drought and saline environment the mulch gave up to a 50% increase in yield depending on location. Mulch was a composed grape marc. Effects on wine properties were studied in the final year of the project. Mulch resulted in a reduction in colour and ripping gave no effect. The effect was not perceived by sensory analysis	Two field trials one at McVale and the other at Langhorne Creek. Another at Clare Valley (surface mulch and ripping) also a saline environment. Showed a positive effect especially for combating salinity (see project CSL 01-01). Adoption of ripping by FGL as a practice for areas with subsoil compaction and mulch for areas of salinity and drought. FABAL John Buckerfield and Kate Webster (ex CSIRO and	Economic analysis based on multi year return. Yield/Quality relationship across the treatments. Yield has increased but colour has decreased. The colour decrease was not perceived by difference testing by consumers. This remains un-resolved. Research could be extended with proviso re quality, soil type and location. Plus the possibility of an initial setback for sites that have roots in the mid-row.	Any compacted or saline vineyard. Although positive results were seen in comparatively unrestricted soils .	Presentations to: a) Science and industry (1 file to select from). Industry articles CSL 01-01 final report. GWRDC final report (in prep). Poster to AWITC.

	(difference testing with consumers). Reduction in Cl- levels in grapes was seem for mulch treatment (yield related). Langhorne Creak had high response to treatments where the soil type was sand to a silty clay loam (duplex). McLaren Vale effect was weaker with some non-significant effect. Final year at McLaren Vale was the most pronounced effect. Soil type at McLaren Vale McLaren Vale le is a heavy clay loam to a sand.	later consultants) past trials with a soil focus.			
Identification of the value of mid-row resources (water, nutrients and stored carbohydrate)	When vines with extensive mid-row roots are first ripped (to 1 m) yield declines and vigour declines for a period of 1 year followed by recovery by year 3. Demonstrates the importance of mid-row vegetation. Highlights the importance of mid-row management to enable better access to resources. Resource utilisation question and for more importance in a drying climate.	Langhorne Creek and Nuriootpa field trials. Coonawarra by Tony Proffitt (for vigour control)	Need to develop a technique to measure root density/presence in mid row. Quantify the importance of – in particular- stored water. Need to demonstrate the role of mid-row roots in utilising stored winter and in-season rainfall.	Most places. Particularly important for predominantly rainfed areas and those with restricted root zones (compaction).	Industry presentation.

Managing grapevines in variable climates: the impact of temperature

Project Number: SAR 05/01

Date: 3 Jan 2006 - 31 Jul 2009

Project Supervisor: Dr Mike McCarthy; Peter Hayman

Chief Investigator:

Staff: Chris Soar, Victor Sadras

Research Institution: South Australian Research & Development Institute

Documents available: *SAR0501*, *Temperature_vines_and_wines.html*

Adoptable outcome	Description	Prior testing	Steps to implementation	Scope of application	Resources available.
Heat wave damage may be related to night rather than just day temperature	Treatments which exposed vines to high night temp resulted in a transient reduction in daytime photosynthesis (Pn) and a delay in colour formation. Micro-climate may be an important issue in this response. Difficult to manage a heat wave response if night temperatures are high (eg lower effect of misting, or shading)	Nuriootpa trial (year 2). Based on 1 year of data.	More research may be required as confidence is comparatively low	Widespread, all areas where day temperatures may be elevated in heat waves. Likely to become more of an issue in a variable environment as predicted for a warming Earth.	Final report and papers (published). Web site Numerous communications to industry and conferences (as per report).
Use of irrigation in buffering heat stress.	Irrigation can be used to maintain canopy functioning and berry growth and development during a heatwave event. Shiraz irrigated prior to heatwave, withstood 3 consecutive days of daytime temperature around or over 40 °C. (no evidence of a decline in Pn or berry TSS accumulation). For an ambient temperature increase of 2 to 4 °C the canopy temperature of well-watered vines only increased by 0.9 °C. Similar to Marissa Collins.	Nuriootpa Field site. In 2009 heat wave the first three days of over 40 deg C the vine appeared to be OK. Anthocyanins maintained in Barossa shiraz exposed to 3day(>40 °C), 2 week (2-4 °C above maxT), 10 days (6 °C higher day and night)	Research into effects of * elevated temperature for water stressed vines. *extended duration of high temp. *Different cultivar sensitivity to heat episodes (stomatal behaviours and water stress responses) – (future project SAR 0901) High confidence.	All irrigated viticulture where subject to current and future heat-wave incidence. Likely to become more an issue in a variable environment as predicted for a warming Earth.	Final report and papers (published). Web site Numerous communications to industry and conferences (as per report).

One week advancement in maturity for 1 °C increase in November temperature.	Demonstrated a robust relationship between mean temperature and length of season to a TSS of 22 °Brix. Shiraz Chardonnay and Cab. Sauv, showed average change of 7 days in time to maturity per °C change in November temperature	Study based on 14 years of data and 18 regions. Utilised a range of sites, Commercial vineyards across the country	None. (future project SAR 0901) Needs to be considered in conjunction with and respect to industry directions. Useful for industry planning and for individual companies/operators.	All	Final report and papers (published). Web site Numerous communications to industry and conf. (as per report).
There are no universal temperature thresholds for wine quality.	Environmental drivers of wine quality vary among regions. Eg for red wine in the Barossa above 36 °C but in M. River critical temperature is very much lower eg 32 °C. Effect of temperature is influenced by soil, crop management and winemaking. This would cast doubt over the conclusions from studies assuming a single temp thresholds for a given variety.	Vintage scores from 4 regions and a minimum of 30 vintages.	none	All	Final report and papers (published). Web site Numerous communications to industry and conf. (as per report).
Prediction of high heat waves based on position of high pressure systems	Synoptic charts and models can be used to predict the incidence of a high heat period in SE Australia . This may enable a growth to apply a preparatory irrigation prior to the onset of heat stress and hence minimise the development of a water deficit (as per outcome 2 above). Includes a number of listed actions (as per final report)	Modelling of past heat wave activity and workshops with industry members.	Decision support tool required to develop weather observations into a risk management protocol. Protocol exists (rudimentary) but decision support tool is not developed.	Eastern states, does not apply to WA. Alternative models would work in WA.	
Plasticity of phenological development determines a variety's capacity to a conditions within a season.	Some varieties are more plastic than others. For example, for the timing of budburst Cab Franc is 30% more plastic than the average and Shiraz is 15% less plastic than the average.	Based on 7 varieties and 19 environments (site x year)	Promising but needs more research.	Consideration for the selection of new planting material for any given site and also for the introduction of new varieties	

	This would imply that the timing of budburst and flowering in response to Environmental variation (site and season) will vary more greatly for Cabernet Franc than for Shiraz and this has consequences for yield and risk management.				

Root physiology and vine performance

Project Number: UA 04/03

Date: 1 Jan 2005 - 31 Dec 2009

Project Supervisor: Stephen Tyerman

Chief Investigator:

Staff: Roberta DeBei

Research Institution: The University of Adelaide

Documents available: UA_04-03.pdf

Adoptable outcome	Description	Prior testing	Steps to implementation	Scope of application	Resources available.
Shoot to root signalling to moderate water uptake by roots and improve WUE	Reduction in shoot area (Shoot topping) can reduce root capacity to transport water by 50%. Management technique to induce root-shoot signalling within the vine to improve WUE Est 40% improvement over std irrigation management practices	Field trials	Shoot responses were unexpected and indicate more experimentation is required (requires complimentary research) modest adoption rate expected potential wider benefit (other commercial crops)	Warm climate Irrigated vineyards Common with PRD &RDI (complementary?) Ability to increase/ decrease the capacity of the roots to extract water, depending on the desired outcome.	UA_04-03.pdf
Shoot to root signalling to reduce vigour and improve fruit quality			Research into 'summer pruning' practice used to control vigour (whether de-vigourating vines result in reduced capacity of the roots to extract water). This also has implications for the quantum of irrigation water delivered to vines that have been shoot pruned.	Vineyards practicing summer pruning Water management technique for irrigated vineyards	
Diurnal variability of root capacity to extract water.	Root capacity to extract water varies diurnally and can more than double from pre-dawn to midday. This is accounted for by changed activity of root aquapoprins	Glasshouse trials	Need to carrying out field trials to examine irrigation timing in terms of efficiency of water extraction by roots	This has major implications for irrigation management (timing - early evening irrigation give better results than other times)	

	and is in tune with shoots capacity to use water. Grenache and chardonnay showed contrasting responses when placed under water stress and rewatering regime			cultivar differences must be accounted for	
Salinity tolerance for rootstocks	Salt tolerance in rootstocks can be attributed to major differences in chloride transport across specific membranes within the root. These differences occur in the main roots but not lateral roots.		Further research needed to identifying the transporter genes responsible. This would allow more rapid assessment of salinity tolerance for new rootstocks as well as opening the possibility of genetic engineering of roots stocks for increased salinity tolerance.	New vineyard establishment	

Soil Management for Yield and Quality – Native cover crops

Project Number: SA 02/04

Date:

Supervisor: Michael McCarthy

Chief Investigator:

Staff: Dean Lanyon (CI), Chris Penfold (natives), DAFWA (Colin McDonald, Vivek Bhat); Shannon Andrews (nee Pudney)

Research Institution:

Adoptable outcome	Description	Prior testing	Steps to implementation	Scope of application	Resources available.
The role of native plants in soil and vineyard management. Guidelines for germination, establishment and management of native grasses. Lead genotypes - Wallaby grass and Banthonia	Study has derived methodology to enable industry to seed, establish and manage alternative covercrops (Lead genotypes - Wallaby grass and Banthonia) Comparisons have been made with more traditional cover crop species Development of a roller for breaking over existing covercrops (rather and mowing/mulching). Improves soil water balance. Some potentially for carbon sequestration	Field trials in SA.	water use information needs to be resolved	Anywhere that is not too dry. Careful management would be required for dry sites due to water competition	SA 02/04 report
Impact of covercrops on vine vigour in the Great Southern wine region of WA.	Covercrop width resulted in reduced Spring soil water content and vine vigour Covercrops conferred restriction on spring growth Width of covercrop may have limited excessive veg growth with no adverse impact on yield	Field trials in WA	Broader industry based trials to confirm the stability of findings	High rainfall viticulture areas.	Farm notes Report

7) Outcome/Conclusion

Based on the analysis of each main project the following 4 groupings of adoptable outcomes with potentially high utility were identified. These were included in an application for further funding from GWRDC and are the subject of an ongoing project (CUT 1001).

Novel irrigation scheduling techniques and indicators of plant water status

Irrigation management using effective area of shade.

Dripper distribution uniformity mapper

IrriSATSMS/IrrisatWEB

Increasing soil water availability/resource utilisation

Managing spatial variation in Grapevine Water Requirements

Recovery of grapevines after severe and long term water deficits

Resource utilisation – limits to the use of water under highly restricted conditions.

Rootzone, soil health and cover crop management

Soil structure – ripping and mulch

Covercrops (Great Southern and native species)

SoluSampler plus monitoring of nitrate, salinity and pesticides

Cultivar/rootstock specific irrigation management

Drought tolerance and shoot influences on root hydraulic conductivity

8) Recommendation

The 4 areas of potentially adoptable research outcomes should progress to be developed into extension packages suitable for extension to industry via the innovators network. In doing so it is important to recognise that there is also a large amount of research which has occurred within Australia in the past as well as overseas. The development of extension material around these adoptable outcomes should include a significant component of background information/literature review. Furthermore, the literature reviews should be extended to identify areas which are lacking research effort and gaps in knowledge which may be suitable for further R&D.