Australian Government
Grape and Wine Research and Development Corporation

GrapeLinks
Viticultural Knowledge Management

Benchmarking W- Victorian Shiraz Season 04/05



REPORT

To GRAPE AND WINE RESEARCH & DEVELOPMENT CORPORATION

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Abstract

A benchmarking study was carried out in six Shiraz vineyards in the Grampians and Pyrenees Regions of West- Victoria.
The aim of the project was to explore new ways of vineyard scoring and fruit quality assessments, to find common pointers for good grape and wine quality outcomes for a full bodied Shiraz wine style, to produce a manageable monitoring system for annual use by grapegrowers and to enable viticulturists and winemakers to change practice which may lead to better vineyards, better grapes and better wines and to raise issues for further surveys and research trials in W-Victoria.

New vineyard scoresheets designed by GrapeLinks placed greater emphasis on veraison measurements of vine balance, vigour, bunch leaf cover and leaf health as well as early cane lignification in order to give growers a chance for timely adjustments if needed.
Berry Sensory Assessment (BSA) was carried out in all vineyards at approx.12.5 Bé and pre-harvest. BSA training was held for all growers involved.

Electronic data loggers were bought by some of the growers and installed in a representative spot of the vineyard in the canopy at the bunch zone for the observation of veraison to harvest daily bunch zone temperatures.

Observations of phenological dates as well as information on location, slope, aspect, row orientation, trellis type, rootstock, clone, row and vine spacing as well as water management were collected.
Berries from randomly taken bunch samples (separated into seeds and skins) were analysed for weights, anthocyanins, flavonols, total phenolics Bé, TA and pH by Myrrhee Consulting.

A series of workshops designed to assist grape growers in the regions to better understand the monitoring programme was conducted. These workshops were attended by an average 20 grape growers of which many have applied parts of the monitoring programme in their vineyards. Workshops included soil and irrigation analysis, two Berry Sensory Analysis workshops, vine balance practical session and a tutored review of 8 wines from the 2004 vintage.

It was a small beginning. It is anticipated that, like other regions undertaking similar projects, the second and third year of the project will see additional participants as well as refinements to the monitoring programme.

1. Background

Previous benchmarking work in the area

The benchmarking survey of Shiraz vineyards in Victoria started in Central Victoria in 20001/02 encompassing 24 vineyards, with follow-up surveys in 2002/03 and 03/04. (GWRDC RITA Project No's RT 01/27-3, RT02/12-3 – RT02/15-3, *Rolley 2003, Lowe, 2004*).

The studies used a score sheet system developed and kindly made available by Southcorp to assess the vines visually and taste the berries pre harvest. Each region had a field coordinator to ensure that data gathering was relatively uniform. Bunch samples were sent to Myrrhee Laboratories for analysis of berries concerning their weight, skin weight, seed weight, Baumé, colour and phenolics in skins and seeds.

In 2003, three North East Victorian (Alpine Valleys, King Valley) Southcorp growers participated in that project (RT02/37-4).

In 2004 a RITA project was undertaken by North East Victorian regions which allowed a greater number of growers and winemakers to participate, and encompassed all five Geographical Indicator (G.I.) regions of the NE Victoria Wine Zone as well as vineyards within the confines of North East Victoria but not in a registered G.I., referred to as "other" (GWRDC RITA Project No. 03/22-4).

The aim of the studies was to investigate, vine plants and the resulting fruit and wine (if possible) in order to find correlations between growing practices and fruit quality and ultimately wine potential. It was also aimed at possibly finding quality factors in vines and grapes that could reliably predict wine quality.

A summary of the outcomes of all RITA Shiraz benchmarking projects was undertaken by GrapeLinks and published in Australian Viticulture January/Feb 05.

Important outcomes and conclusions:

Variability:

Central Victoria studied the variability of the measured parameters (standard deviation of the mean with 3 sampling locations of 20 samples) and higher than usual variability was recorded for shoot lignification pre harvest, leaf condition pre harvest, grower estimated berry size, field estimated colour and measured phenolics in seeds. *This shows that pre harvest assessments of shoot lignification and leaf condition may need larger sample sizes and berry parameters might be better analysed than field tested.* Extreme variability was found in the judgment of shrivel, grower rated bunch exposure and mouthfeel of sugar/acid balance. *A standardized method to assess berry aromas and flavours is needed and has been done in the present study through BSA done by the field coordinator. Sampling has a crucial importance in these studies and Precision Viticulture methods would be beneficial to select representative sampling locations.*

Seasonal variation:

In central VIC, in a cold year, the degree of cane lignification at harvest correlated with wine or berry quality, in a warm year all canes had caught up with lignification by that time. *It is better to assess cane lignification at veraison which was done in the present study, and good climatic records are needed to verify trends over several vintages.*

Regional variation:

In the 03 Central Victorian study regions of which wines reached scores above 15 also produced wines with below average scores. *This means that a cooler region (Bendigo) does not automatically mean a better wine and a warm region (Swan Hill) can make good wine with adapted management. Locations within the regions (French "climats") and management practices are more crucial than the region (traditional French "terroir").*

Wine quality:
In Central VIC in 2002 wines were commercially made by Southcorp and assessed by their grading system. In 2003 identical small batch wine making from the Central VIC benchmarking study was possible via CSU (to pilot their facility) and wines could thus be scientifically compared. In this study, the best scores were obtained when wines had **soft tannins and high flavour complexity with spicy and plummy notes.**
Only in small batch winemaking wines can really be compared to grapes and vineyards, but as this is very expensive other ways must be found to somehow establish a continuum between vineyard, fruit and wine in commercial vineyards. In the present study young wine and commercial samples were analysed and compared to fruit results and vineyard climate and management.

Berry quality and wine score:
Correlation of wine scores and grape parameters in Central VIC was highest for **anthocyanins** (r=0.68) and **skin phenolics** expressed /g berry fresh weight (r=0.54). **Baumé** shows a trend to be associated with higher wine scores albeit with much scatter, wine scores of below 15 were achieved when Baumé was low. *Here wine style will matter for final product quality, so target style will be included in this study.*
Yield was not significantly related to wine quality, scores above 15 were achieved with 3-18t/ha. *Vine balance (fruit/active leaf area) may be more decisive and has been included in the vineyard scoresheets of this study.*
In Central Vic all wines which had scores above 15 had **berry weights** below 1.1g. *In this study it will be investigated whether berry weight or proportion of skin matters, as heavy berries may have many seeds and little skin which may not deliver may skin related compounds.*

Vineyard parameters and wine score:
Leaf layer number over bunches had a good correlation (r^2=0.47) with wine quality in 2003, but not in 2002.
It must be seen in the context of climate: Bendigo produced two top wines with rather exposed bunches in the warmer year, many vineyards reported only one leaf layer and wine quality was from 14 to 16. Therefore we decided to assess leaves on the different sides of the canopy separately and do proper temperature monitoring in the bunch zone.
Leaf condition correlated somewhat with the wine score in the warm year but not at all in the cool year. *It shows something about the wine water status and together with other vineyard assessments will be indicative of plant stress.*
In the **"light on fruit"** rating those vineyards with either not enough or too much had wine grades below 15.5. *In the present study this aspect received high attention due to the involvement of cool sites and warmer sites.*
The extent of **cane lignification** (shoot periderm) before harvest only highly correlated with wine scores (r^2=0.7) in a cold year, less so in a warmer year (r^2=0.37).
We therefore decided to assess cane lignification earlier, at veraison to have a better discrimination.
Berry colour bleeding from skins correlated highly with wine score (r^2=0.63 in 2002 and r^2 =0.43 in 2003) or berry anthocyanin levels (NE-VIC). *This is a good field indicator if assessed by the same person. Better indicators are BSA scores which are included in this study.*
Ripening speed can tell about site and management factors of the vineyard. *It was considered important to include phenological dates in the present study.*

Harvest date plays a big role for quality factors in berries. *As in all studies harvest was at the discretion of the winemakers, and often depended on acid loss or other developments in berries. It means that physiological cause and effect cannot be drawn from phenology (time to harvest).*

Berry parameters of relevance for wine:
Berry size correlated higher with wine judgements in 2002 (r^2=0.66) than in 2003 (r^2=0.34) and more in warmer regions than in colder regions. Very big berries did not result in good wine scores. *This could be due to seasonal and regional variations but also to a learning curve of the growers involved. In NE VIC 2004 berry size was also a determining factor, but in the present study berry* ***weight*** *will be used for correlations as field determined size was too similar.*

Skin Phenolics
In the Central Victorian study there was a good correlation between **berry phenolics** (per g berry FW) and **wine score.** In the NE VIC study of 2003/04 when some outliers were not included there was a linear relationship between total **phenolics** in berries and total **phenolics in young wine** - expressed as g fresh weight. *Various sources in the literature (see in Somers, 1998) have established a relationship between phenolic content of red wines with their quality and storage potential. Somers states that in many cases phenolic contents of berries is related to that in wine. This was considered for the analysis of young wine in the present study.*
Many parameters in last year's study were correlated to phenolics **per g fresh weight** in berries as this was considered one of the close links between grape quality factors and wine rating. *Fresh weight is delivered at cellar door. In the present study calculations were also based on a per g skin basis. Relations of skin thickness or amount to berry fresh weights were examined.*

Anthocyanins
In all four studies anthocyanin concentrations of berries were in all sites and years generally **highly related to the concentration of total phenolics**. *However there are outliers of very unripe or shrivelled berry samples which make colour assessment not always the ideal quality parameter. Also the curve in the 04 NE VIC study showed that highest anthocyanins were found at phenolics levels below the expected values which may point to a benefit of dappled light for colour preservation (high flavonols which are produced as sunscreens lead to high total phenolics) and to the fact that in the high colour bracket some berries with lower than expected anthocyanins can still produce wines of high quality. This relationship is examined in detail.*

Flavonols
Analysing the raw data from Central and N VIC of the last 3 vintages it became clear that **low phenolics in berries co-occurred with low flavonols**. Highest phenolics were associated with above average flavonols especially in cool locations. *It seemed that high insulation favoured the flavonol production. Therefore exposure of bunches was more intensely investigated.*
In Central and NE VIC moderate amounts of leaf layers over bunches at harvest seemed to result in highest flavonols – too exposed bunches and too shaded bunches had less flavonols per g berry FW. Row orientation and location also seemed to determine flavonol and total phenolic content. *In the present study bunch temperatures were measured as a further indicator of exposure, and to examine whether light or warmth determined berry quality.*

Berry aroma
No studies on berry aroma were done in the past investigations. *Berry Sensory Assessment was included for the first time to deliver data on aroma ripeness and skin and seed ripeness which have a large influence on the taste and aroma of wine.*

All previous studies showed that:

No single quality factor can be universally declared for vineyards or berries pointing to a potential for quality wine in Shiraz. *However scoresheets for vines and grapes can be very helpful to detect mismanagement or point to cause and effect for good quality.*

Quality depends on wine style. *Target style must be included in scoresheets.*

To find groups of quality pointers new scoresheets are required so that no time is wasted looking for unimportant features. *The present study has adapted scoresheets to the findings of past years. However it includes veraison assessments to allow timely management changes and a formalised Berry Sensory Assessment to allow a better communication between grape growers and winemakers.*

Verification of those groups is needed between seasons and locations. *These is a work in progress and as the growers and winemakers are better trained to manage and judge vines and grapes we will need more sophisticated methods of vineyard and fruit scoring.*

Quality pointers cannot be determined by general statistical analysis only. As in the commercial situation there are outliers due to extremes in locations, climatic events and management practice. *There will rarely be a high correlation coefficient between dependent variables and single vineyards must be able to see their position within the scoring system for many parameters.*

Determining dependent variables requires physiological knowledge. *Consulting is required as false cause –effect conclusions can be very costly to the vineyard operators.*

Cause-effect relationships must be established on single vineyard basis in particular for those lying off the trendline of statistical correlations. *Only this method leads to adoption of best practice for all and a chance for the realisation of the full potential for the resulting wine.*

Winemaker – grapegrower cooperation is crucial, in particular for flavour descriptors of berries*. BSA will help to establish this link.*

Myths about some perceived quality pointers have been demystified:
Low Yield did not necessarily lead to best wine scores. Lowering yields will only lead to better fruit and wine quality in overcropped vineyards.
High Baumé also does not necessarily lead to good wine quality. There is a range of Bé in the good wine score sector, of course unripe fruit gave bad wine results for full bodied wine styles.
Fast ripening did not always yield good fruit. Harvest decisions were often made either to avoid acid loss in warmer locations or to avoid disease in cooler locations, or due to vineyard and winery logistics.
High colour did not automatically lead to high wine quality. Due to shrivel, overexposure, and other factors anthocyanins/g berry fresh weight was not linearly related to wine scores.
Seed phenolics analysed in berries have no relationship with wine quality as phenolic quality (bitter) is more important than quantity (high amounts of releasable seed phenolics point to unripe seeds). *This is a measurement that may be saved next time.*
Vine health and vigour parameters at harvest (basal leaf health, shoot length, laterals etc) may not be decisive of berry quality if no extreme conditions prevail.

2. Material and Methods

Vineyard selection and coding
At the initial grower information day 10 vineyards showed interest in the study. Finally five vineyards from the two regions (3 from the Grampians and 2 from the Pyrenees) participated in the study.
Generally, the vineyards included in the study are considered to produce super premium fruit within their respective regions,

Climatic information
Climatic data was obtained from two sites in the Grampians and the sites in the Pyrenees were covered by average climatic data over 121 years from St. Arnaud weather station 11 km from the sites and long term rainfall data from Moonambel was also utilised.

Site information
Site information was gathered by the field coordinator. A soil and irrigation study day was held with other funding and led to some valuable soil and irrigation application information for some of the sites.

Vineyard characteristics
Information such as planting date, trellis type; row orientation, row spacing and vine spacing, rootstock, clone, pruning method, harvesting mode, irrigation method and general vineyard management practices were recorded in questionnaires and compiled for data analysis.

Vineyard scoring
Scoresheets were developed by GrapeLinks in conjunction with the region, discussed at a grower meeting and accepted for use. They were modified from scoresheets used in the past RITA studies incorporating more veraison measurements and less pre harvest assessments. During the vineyard assessment 20 shoots were selected along the marked rows by the field assessor and the grower at **veraison** and measured for average shoot length, active leaf area (according to *Winter and Whiting, 2004*), number of active leaves, proportion of young to active leaves, number of actively growing tips, average bunch number of shoots, leaf cover on front and back of bunches (noting which side front was facing), the condition of mature leaves and percentage of lignification on the canes.
At harvest the condition of the four oldest and younger leaves was assessed, the leaf cover over bunches was noted and the average bunch weight was recorded. From the active leaf area per shoot and the bunch number and weight vine balance could be calculated *(Winter and Whiting, 2004)*.

Bunch climate
Data loggers (*Tinytag*, Hastings, Port Macquarie) were purchased by some of the growers and attached in the bunch zone, some facing east and some west and measurements were taken half hourly from veraison to harvest. Data were downloaded onto a computer and processed for analysis.
Temperature summations from a base of $0^{o}C$ were calculated from the half hourly readings of data loggers for the period from veraison to harvest.

Berry sensory assessment
Field Berry Sensory Assessment was carried out sometimes twice, before and at harvest choosing 6 bunches and assessing them according to *Winter et al. 2004*. Two hands on activity based sessions were undertaken by the participants to ensure similarity of methodology.

Phenology
Dates of 50% flowering, veraison and harvest were recorded in the vineyard scoresheets and phenology was calculated.

Grape sampling
At harvest 20 bunch samples were selected from each monitor vine from the top, middle and bottom of the fruiting zone of the canopy.
In the 5 weeks leading to harvest 20 bunch samples were collected for berry analysis to measure Brix, titratable acidity and pH.

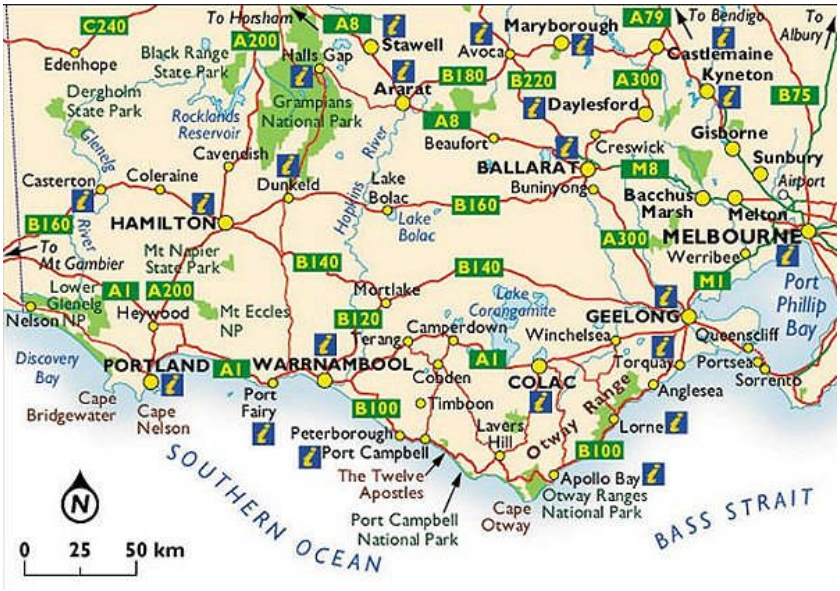
Grape analysis
Three grape samples per vineyard in labelled plastic bags were delivered to Myrrhee Consulting Services. The samples consisted of 25 small bunchlets (of 10 or 12 berries each) collected across the chosen transect. Fifty berries from each sample were then selected for berry weight assessment. The berries were then dissected completely separating skins and seeds from residual juice and pulp.
The skins and seeds were then weighed to assess their percentage weight relative to that of the whole berry. The whole of the remaining berries from the 25 bunchlets was then crushed to mimic winery conditions to assess juice Baumé, pH and TA.
The skins and seeds were placed separately in a weighed amount of extracting solvent (1:1 methanol : water with 2% HCl) and left in contact for 12 h at room temperature. Then the skins were thoroughly pressed in the solvent and the seeds well mixed with the solvent. Aliquots of each sample were diluted appropriately for spectrometric analysis. Anthocyanins in skin extracts were measured at 250 nm and results were presented as absorption units per unit skin weight or berry weight using the percentage of the skin to the rest of the berries for calculation. Skin and seed total phenolics were measured at 280 nm and the flavonol component of the skins was measured at 360 nm. Data are presented as averages. The values for anthocyanins per g FW were converted to mg/g berry weight according to a conversion factor.

Wine assessments
Had not been made at the time of reporting.

3. Results

The area

The vineyards are situated in the area around Ararat



They are located in hills and mountain ranges.



Fig. 2: View over the desiccated fields in February to Mt. Langi Ghiran vineyard In front of the Mountain Range.

The climate

Average climatic data for the Grampians were obtained from the single vineyards (as further below).
For the Pyrenees data from the 212 year average from St Arnaud (22 km away) and average data (44 years) from Avoca (15 kms away from TT).

Tab. 1: Average Maxima, Minima, Rainfall and Evaporation for the Region.

Climate Summary						
	Grampians			Pyrenees		
	Maximum	**Minimum**	**Rainfall**	**Maximum**	**Minimum**	**Rainfall**
July	10.9	3.6	51.3	12.3	3.4	55.1
August	13.4	4.4	65.8	13.9	4.2	56.8
September	14.8	5.1	68.0	16.9	5.7	49.8
October	19.8	6.3	19.5	20.3	7.6	49.0
November	21.4	7.6	61.8	24.3	9.8	34.3
December	24.7	10.1	63.5	27.5	12.1	29.9
January	26.4	11.0	38.5	29.4	13.5	27.8
February	24.7	12.1	83.5	29.1	13.8	27.6
March	23.2	8.9	7.0	25.8	11.7	28.0
April	23.5	8.6	17.0	20.7	8.6	37.5
May	16.1	4.6	11.5	16.1	6.1	53.1
Total			487.25			448.9

Wind run is usually from South to South East – cold winds can be a problem. Occasional north winds during Nov, Dec, Jan & Feb can dry soils and the vines causing short term dehydration and moisture loss to leaves which desiccate and fall prematurely.

The Pyrenees wine region is significantly warmer than the Grampians. This can add to the complexity of the wines made across the regions and explain the need to extend the ageing of wines.

Spring frosts are a risk in the SP1 and TT vineyards. Severe frost (< 0°C) frequency is 1.7 in Sept and 0.1 in Oct and light frost frequency (0 – 2.2°C) occurs from March to Oct in the Avoca area.

Light spring frosts (0 – 2.2°C) are common in the Ararat region between March and December. The spring frost frequency is 5 days per month in September and October with 2 days in November. Frosts are also a risk in SP1 in April with a frequency of 2 days per month.

As the vineyards in the Grampians rise above the valley floor (200 m) the risk of frost is significantly reduced.

The daily maxima are generally higher in the Pyrenees (St Arnaud 121 year average) than in the Grampians (Hyde Park vineyard SP1 and Mount Langi Ghiran MTL). The max. temperatures did not exceed 29 degrees in the Pyrenees and not 27 in the Grampians.

Fig. 2: Maximum temperatures in this season W Vic.

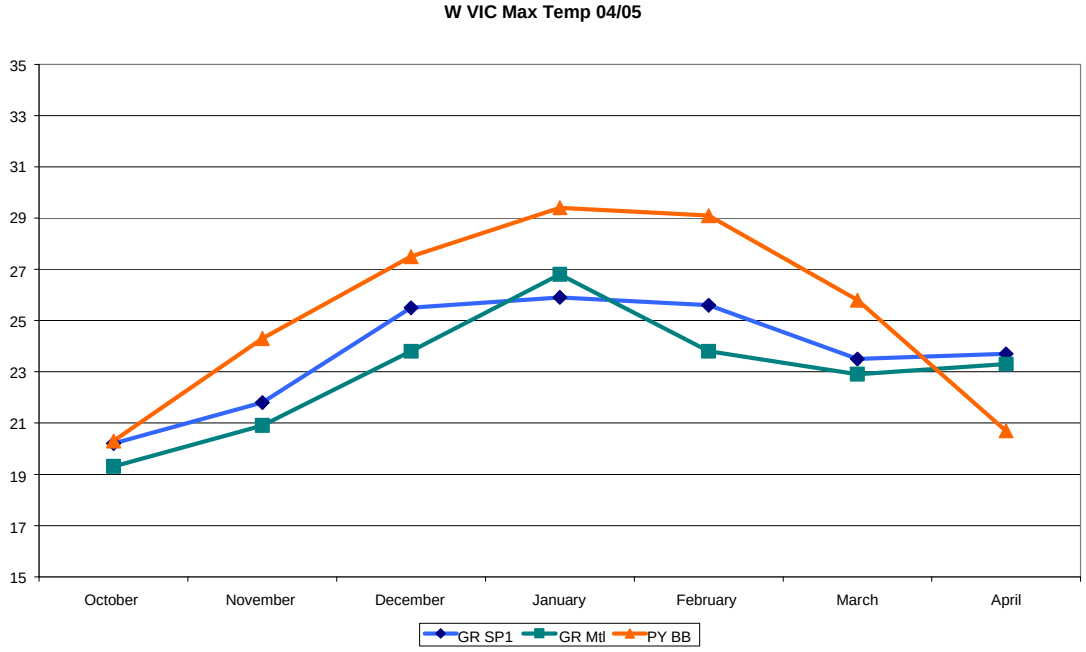
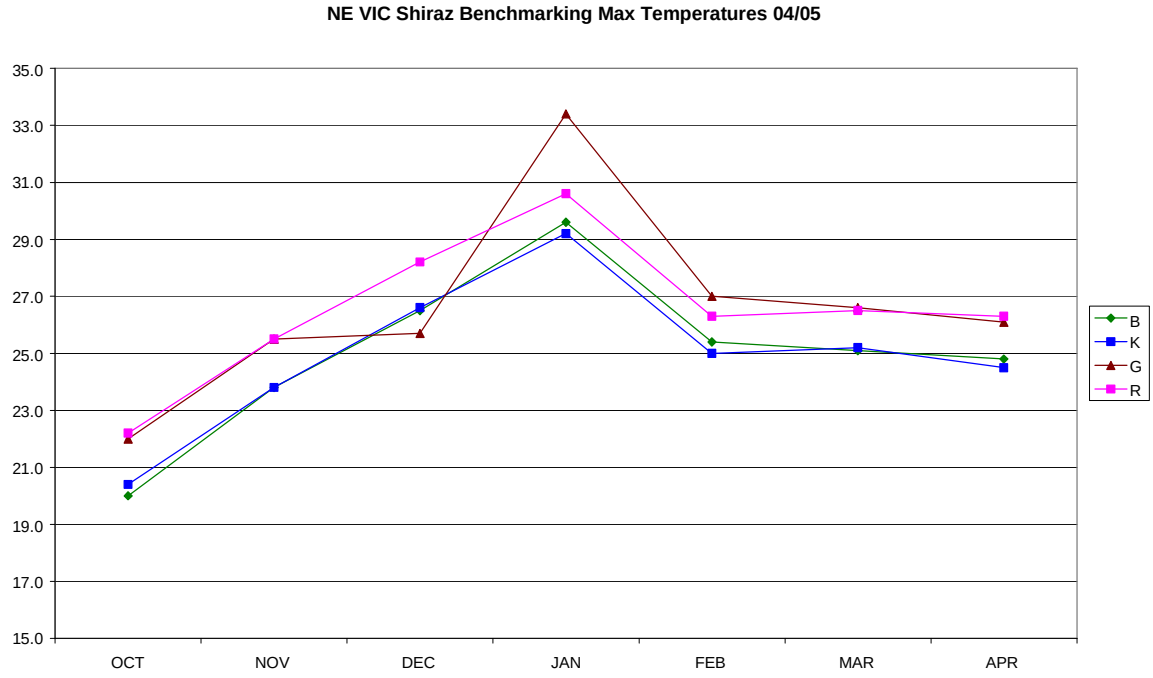


Fig. 3: Comparison: Max Temperatures NE Vic 04/05 (B=Beechworth, K = King Valley, G= Grampians, R=Rutherglen, Alpine Valleys not available)



The summer temperatures are typified by warm day temperatures and cool nights. The diurnal range in Dec, Jan, Feb and March in both regions is high. This large diurnal range is said to lead to slower ripening of the bunches and intensification of the flavour profiles in both wine regions.
Tab. 2

	Diurnal range Av daily (max –Min)	**BB**	**MtL**	**Avoca**
Oct	SP1			
Nov	14.3	14.5	13.2	14.5
Dec	15.4	15.4	13.7	15.2
Jan	15.4	15.9	15.4	15.6
Feb	11.3	15.3	13.9	15.6
March	15	14.1	13.7	14.3
April	15.1	12.1	14.7	12

There are interesting site variations amongst the vineyards in this project typified in the Great Western data where one vineyard (SP1 data) experienced a warm spike in temperatures compared to MtL. The differences are most likely linked to site location as the SP1 data relates to a north facing vineyard (a warm vineyard site) and the MtL data is from an east facing vineyard, representing a cooler site.

Fig. 4: A weather station at a Mt. Langi Ghiran vineyard



Fig. 5: Minimum temperatures this season in W Vic Shiraz Vineyards

Also with respect to night temperatures the Pyrenees are warmer (caution - this is average over 121 years). Hyde Park (SP1) had a warm night period in February not observed at MTL.

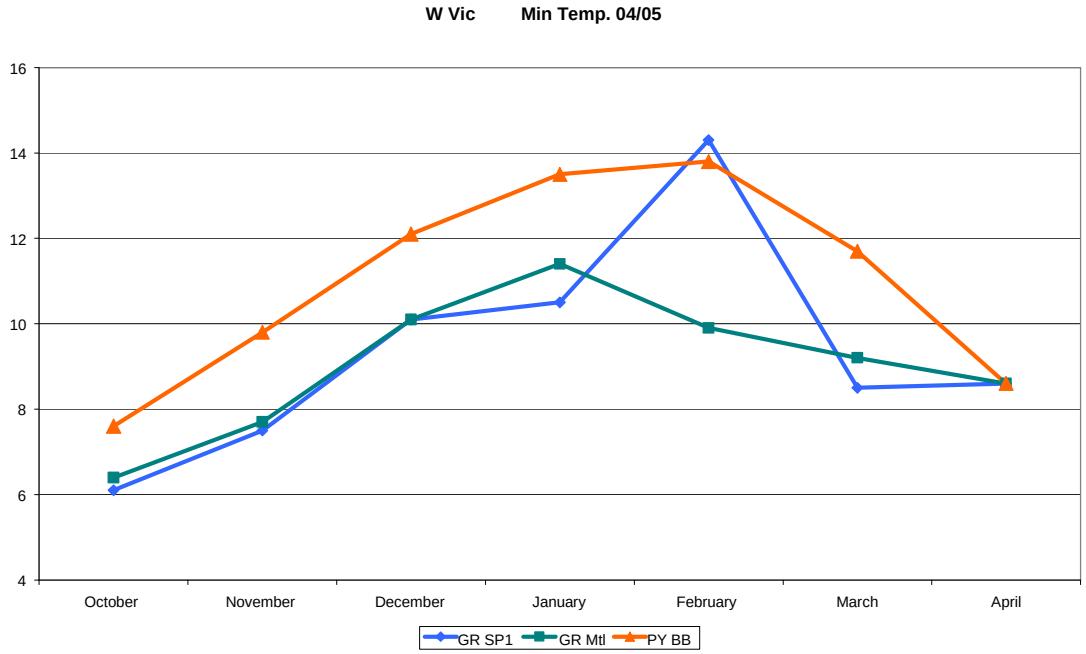
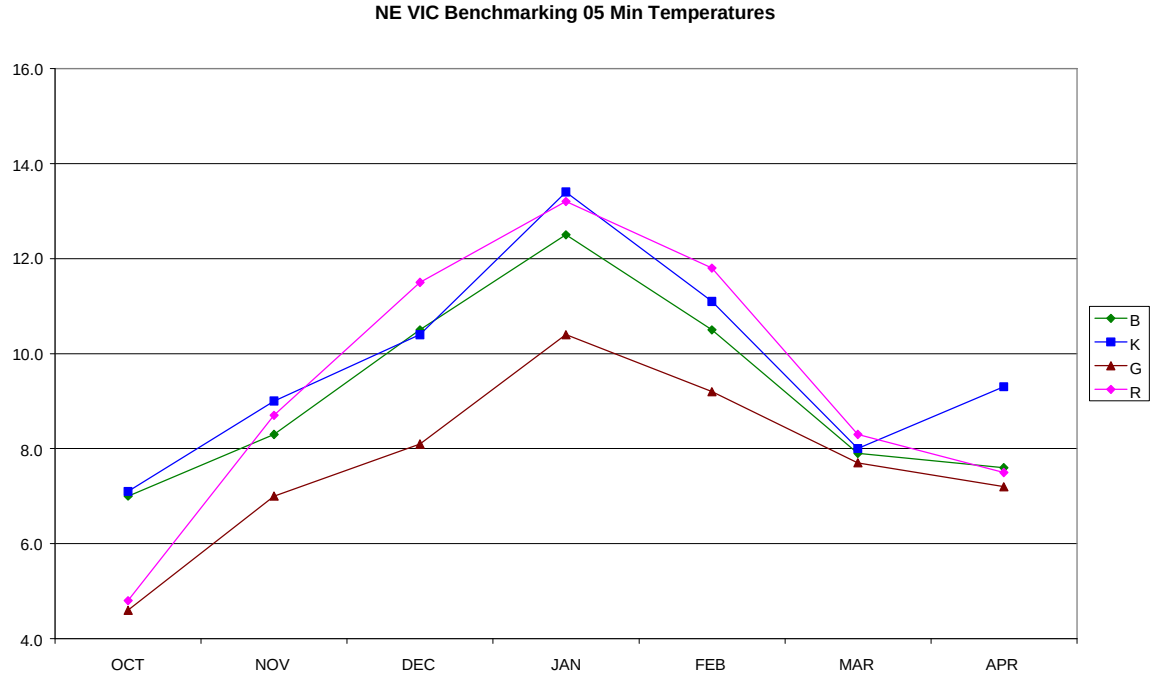


Fig. 6: Comparison: Night minimum temperatures in NE Vic.



Rainfall

Rainfall in the Grampians (measured at Hyde Park vineyard and Mt Langi Ghiran) is generally moderate (Fig. 7) compared to NE VIC (Fig. 8) It would have been good to have not average but real data for the BB vineyard. The wettest months are July, August and September with regular intense summer thunderstorms experienced in January and February in most years. In recent years both regions have experienced rainfall in the lowest 10 decile recorded. The intense summer rainfall periods have provided significant water to dams that have facilitated 1-2 additional opportunities to irrigate vineyards and maintain vine health over the season.

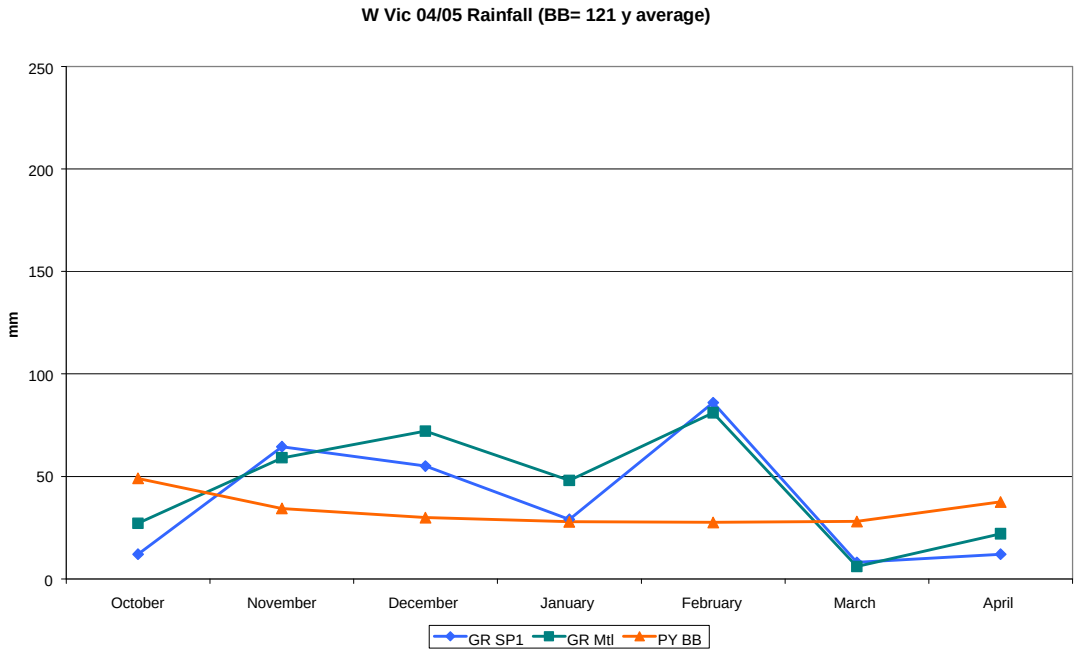
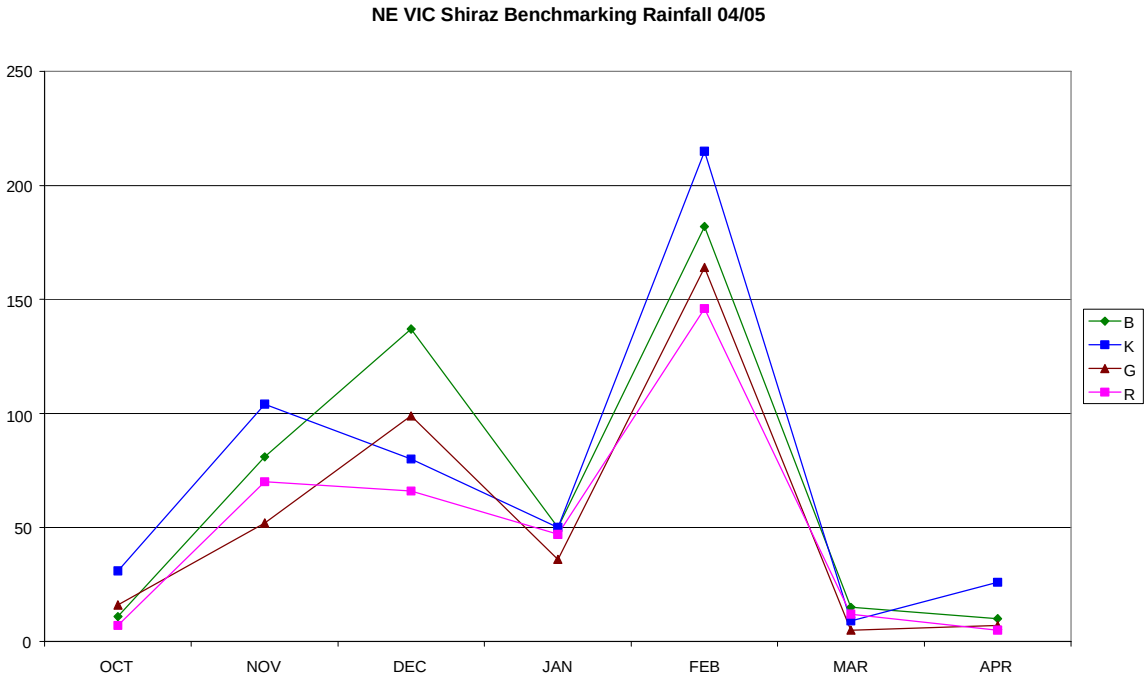


Fig. 7: Rain data for three of the five sites (BB =10y average).

Fig. 8: Comparison: Rainfall in NE VIC 05



The vineyards

Vineyards chosen are small, mature, on own roots with low yields, on hills and on slopes of various severity with mainly E-W rows.
Three of the vineyards are planted to a Great Western Shiraz clone which is believed to be from vines planted in 1864. Four of the vineyards are machine harvested and the BB vineyard hand harvested. Crop levels vary from 3 t/ha for SP1 to 8.5 t/ha at the MR vineyard. Average root depth is 100 cm across the vineyards.

The Grampians Wine Region vineyards studied herein represent a range of climatic zones across the region.

SP1 is an old vineyard with vines planted in 1961 from the original vineyards planted in 1864. The vine cordons have been raised three times since planting from 30 cm trunk height, through 60 cm to the present cordon height of 1000 cm. Row orientation is east – west on a north-facing slope. The vines are spur pruned. This vineyard is located at 240 m altitude and subject to regular frost in spring and autumn. Vintage is early April.

MR was planted in 1999 and represents a young vineyard in the Grampians. Wine region. It is trellised to 1.1 metre cordon height with a pair of foliage wires. This vineyard represents a mid altitude vineyard in the area. The vineyard is at 328 metres elevation on a 30% north facing slope. Row orientation is east – west. The vineyard is spur pruned. It is deemed to be above the frost line. Vintage is mid April.

MtL is a middle aged vineyard in the Grampians Region and is likely the coolest vineyard of the area. The vines are trellised to a 1 metre cordon with a pair of movable foliage wires. The vines are arched cane pruned. The vines were planted in 1968 when the vineyard was rejuvenated. The block aspect is North – South (over a rise) and row orientation is east – west. Site elevation ranges fro 342 metres to 358 metres up a 7% slope. This cool vineyard site is usually harvested in May in any given vintage.



Fig. 9: A row of vines with arched cane canopy – MTL vineyard

The Pyrenees vineyards represent a vineyard in the north of the wine region and a vineyard that is central to the Pyrenees Wine region.

BB was planted in 1996. It has a single wire cordon at 1 metre with a vertically shoot positioned canopy utilising 2 sets of foliage wires. This vineyard represents a warm vineyard, by district standards and is relatively vigorous. The block aspect is north – south with row orientation east – west. The block elevation is 200 metres on a slight slope. The vines are spur pruned.

TT was planted in 1970 and is one of the oldest vineyards in the Pyrenees. The block aspect is north with row orientation east – west. The elevation is 420 metres on a 12% slope. The vines are cane pruned with a single wire cordon. The vines are allowed to sprawl.

Tab. 3: Vineyard information

Code	Region	ha	Average t/ha	Elevation	Aspect	Row orientation	Slope (%)
SP	Grampians	8.5	3.00	240	N	E-W	2
MTL	Grampians	6.1	4.75	350	NS	E-W	7
MR	Grampians	1.3	8.50	328	N	E-W	30
TT	Pyrenees	2.9	7.94	420	N	E-W	12
BB	Pyrenees	0.9	4.01	200	NW	N-S	0.5-2

Code	Planted	Pruning	Trellis type	No of cordon wires	Row Spacing	Vine Spacing	Rootstock	Clone
SP	1961	spur	single wire	1	3	2	Own roots	SP1 clone
MTL	1968	arched cane	VSP	1	3	1.8	Own roots	GW
MR	1999	spur	VSP	1	2.5	1.8	own roots	BVRC30
TT	1970	cane	Sprawl	1	3.3	1.7	Own roots	GW
BB	1996	spur	VSP	1	3.3	2	Own roots	na

Fig. 10: Class A pan to measure evaporation, in the distance a dam.



Irrigation

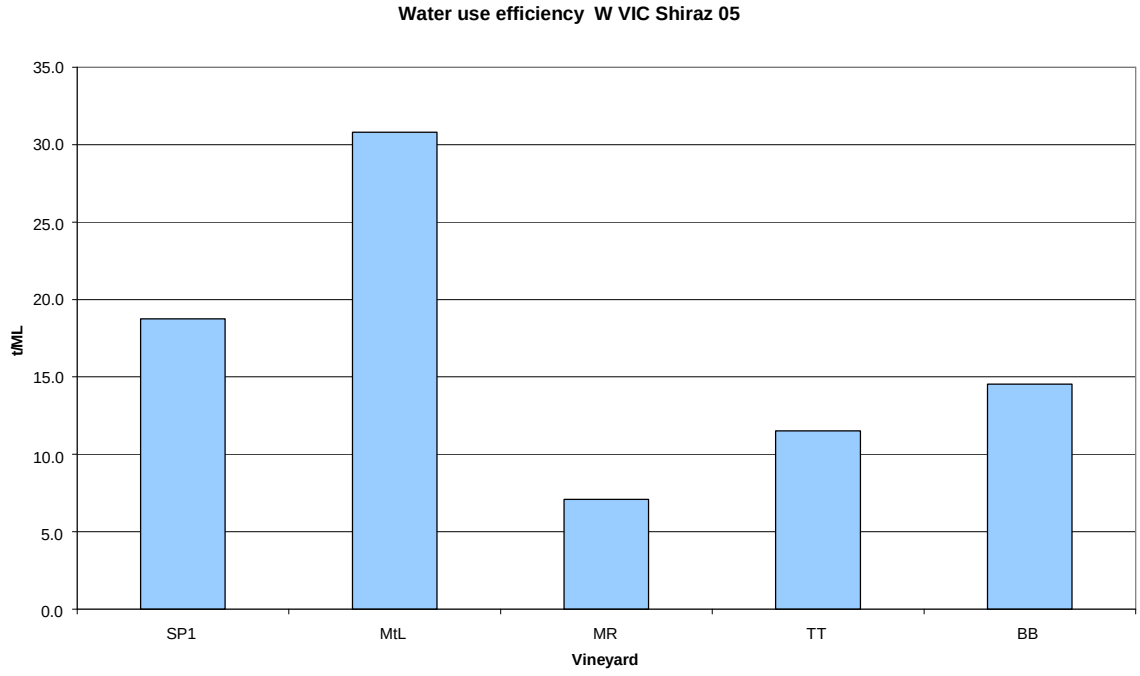
All vineyards were irrigated. The annual volume of irrigation applied is low by industry standards. However, SP1 and BB are basically dry grown vineyards with only 1 or 2 irrigations applied annually. This practice explains the low crop levels of these vineyards when compared with the 3 irrigated vineyards. As we have no exact data on the rainfall this season in the Pyrenees, WUE may not reflect irrigation versus fruit production. No pattern of water use is apparent between the vineyards however all vineyards apply RDI practices caused by necessity (lack of stored water) rather than as a deliberate policy. The data presented, taking into consideration the different dripper outputs, dripper spacings and application rates show generally, that for these vineyards low water (ML per Ha) application rates leads to low tonnes/Ha.

Tab. 4 Irrigation in the vineyards

Code	Irrigation:	Emitters (m)	output (L/hr)	water source	Harvest method	Topography	Soil condition	root depth cm
SP	drip	0.6	2.3	freshwater dam	Machine and hand	Flat	poor	80
MT	drip	0.5	1.6	dam	Machine	Undulating	*	105
MR	drip	0.6	2.3	recycled	Machine	Sloping	*	*
TT	drip	1	4	dam	Machine and hand	sloping	poor-dry	*
BB	drip	2	4	dam	Hand picked	flat	very dry	120

Code	Vines/ha	Dripper l/hr	Dripper spacing	Litres/vine/hr	Total hrs	ML/ha	t/ha	WUE t/ML
SP	1667	*	*	*	*	0.16	3.00	18.8
MtL	1852	1.6	0.5	5.76	20	0.21	6.57	30.8
MR	2222	2.3	0.6	6.9	74	1.13	8.0	7.1
TT	1782	4	1.7	7.8	50	0.69	7.94	11.5
BB	1515	4	2	4	28	0.17	2.47	14.5

Fig. 11: Water use efficiency of the 5 vineyards with respect to irrigation applied and fruit produced for each ML of water.



Soils

Soil information was derived from a workshop conducted during the season and from existing soil reports provided by a range of professional soil scientists.
The data indicates that the vineyard sites are predominately on red brown soils with a high clay component that have good water holding capacities. Most soils are weakly acidic. Soil depth varies but is greater than 100 cm at all sites. These vineyards regularly experience drought conditions in summer hence visible roots in all layers are described as few.

Tab. 5 Soil information

	Horizon	depth	texture	pH 1:5 water	colour
SP1	A1	10	sandy loam	5.14	dark brown
SP1	A2	42.5	sandy loam	5.48	light yellow brown
SP1	B1	65	light clay	5.1	yellow brown
SP1	C	100	med clay	*	yellow brown
MtL	A	20	FSCL/SL	6	7.5YR3/4
MtL	A2	36	LS/FSCL	6	7.5YR6/3
MtL	B	104	CL	5.5	7.5YR4/6
MtL	C	104	ZCL	5	7.5YR7/8
TT	A1	*	*	7	Light red brown
TT	A2	*	*	5.6	Red Brown
TT	B	*	*	6	Reddish grey
BB	A1	15	clay loam	5.75	med-brown
BB	A2	40	light clay	6.0	grey/brown/orange
BB	B1	80	heavy clay	6.25	red/brown/orange
BB	C	180	heavy clay	6.5	orange - brown

	Horizon	gravel %	Mottling	Carbonate reaction	Visible pores	Roots	Slaking	Dispersive	Salinity (EC) dS/m
SP1	A1	5	no	no	many	many	no	stable	0.03
SP1	A2	5	no	no	many	few	yes	stable	0.06
SP1	B1	10	yes	no	few	nil	slake	stable	0.07
SP1	C	20	yes	no	few	nil	slake	stable	*
MtL	A	22	no	no	*	*	yes	slight	0.049
MtL	A2	0	no	no	*	*	no	no	*
MtL	B	20	no	no	*	*	no	no	0.055
MtL	C	85	no	no	*	*	no	no	*
TT	A1	*	no	no	*	*	no	no	2.63
TT	A2	*	no	no	*	*	no	no	0.26
TT	B	*	no	no	*	*	no	no	0.33
BB	A1	0	no	no	*	Few	no	no	*
BB	A2	0	no	no	*	Few	yes	minor	*
BB	B1	0	no	no	*	Few	yes	no	*
BB	C	0	no	no	*	none	yes	partially	*

Soil Management

The vineyards in this project experience a range of different soil management practices typical of any cross section of vineyards in Australia. The soils benefit from the addition of organic matter. SP1 applies mulch at 125 m³ per hectare whilst TT uses annual cover crops to add organic matter. Undervine herbicide practices are similar as similar weed species are apparent in both regions. Key vineyard weeds are marshmallow, wireweed and willow herb hence the use of glyphosate and glyphosate blends as the main weedicide in most years. All vineyards slash the mid row area to control weed growth several times and rely on summer drought to prevent additional weed growth.

Tab. 6: Soil management

SOIL MANAGEMENT	SP1	MtL	MR	TT	BB
Mulch	Yes	No	No	No	No
Material	Comp green waste	-	-	-	-
Rate m^3 per ha	125	-	-	-	-
month	Nov	-	-	-	-
Cover crop - Annual	No	No	No	alternate rows	No
Species	-	-	-	Oats	-
rate per hectare	-	-	-	100	-
month	-	-	-	April/May	-
Fertiliser	-	-	-	MAPsingle super	-
rate per hectare	-	-	-	150 kg/ha	-
soil preparation	-	-	-	Cultivate/sod	-
month	-	-	-	April/May	-
Sward - Permanent	Yes	Yes	Yes	alternate rows	Yes
Species	tall fescue	Volunteer	Blockout	native grasses	Sub-clovers, opport. weeds
rate per hectare kg	25	-	25	-	-
month	May	-	May	-	-
Fertiliser	DAP	-	Super M	-	-
rate per hectare kg	50	-	125	-	-
month	May	-	Apr	-	-
soil preparation	herbicide / disc	-	Direct drill	-	-
month	April	-		-	-
Undervine Herbicides	Yes	Yes	Yes	Yes	No
Target Weed	capeweed, marshmallow, wireweed	Willow herb	winter weeds, wire weed, mallow	Wire weed/native grasses	-
Chemical	Glyphosate	Glyphosate	Glyphosate	Glyphosate	-
rate L/ha	5	3	2	2.5	-
month	May	Aug	Aug	August	-
month	Aug	Dec	Sept	Dec	-
Chemical	Basta + Goal	-	Spray seed	-	-
rate per hectare L	4	-	3	-	-
month	Oct	-	Nov	-	-
month	Jan	-	Feb	-	-
Herbicide Spot Spraying	Yes	-	Yes	Yes	yes
Target Weed	marshmallow	-	Couch/fat hen	-	couch
Chemical	Glyphosate	-	Glyphosate	Glyphosate	Glyphosate
rate L/ha		-	1	2.5	1.5
Chemical	Goal	-	-	_	-
rate L/ha	spike	-	-	_	-
Month	Nov	-	-	Dec/Jan/Feb	May
Mid Row Management	Yes	Yes	Yes	Yes	yes
Slash	Yes	Yes	Yes	Yes	yes
Chemical mowing	No	No	No	No	No
Rate per hectare	-	-	-	No	-
Cultivation	No	No	No	No	No
Soil Amelioration	Yes	Yes	Yes	No	No
Ameliorant	gypsum	Lime	Gypsum	-	-
Rate t/ha	4	1	2.5	-	-
Timing	Oct	Autumn	Autumn	-	-

Vine nutrition

All vineyards apply a type of fertiliser to the vineyard for healthy vine growth but no pattern of fertiliser use is apparent across either regions.
The majority of vineyards apply nitrogen fertilisers to the vines over the growing period. A significant challenge in these regions is maintaining leaf area as ripening occurs hence late applications of foliar fertiliser are a common practice.
Petiole analyses from these vineyards indicate few nutritional disorders, hence low level applications are sufficient to meet vine micro nutrient needs.

Tab. 7 Vine nutrition

	SP1	MtL	MR	TT	BB
Vine Nutrition	No	Yes	Yes	Yes	Yes
Fertiliser	-	Calcium Nitrate	Super M	Multi Mix	Aminogro
Rate kg/ha	-	37	125	4	-
Rate L/ha	-		-	-	6.11
Timing	-	3/12/2004	Apr-04	Nov Post Flowering	2/12/04 to 12/1/05
Application	-	Fertigation	Broadcast	Fertigation	Foliar
Fertiliser	-	Diamond White	Calcium Nitrate	Zintrac	Acadian SSE
Rate kg/ha	-	2.5	40	-	3.06
Rate L/ha	-		-	1.5	-
Timing	-	28/02/2005	May-04	11/11/2004	2/12/04 to 12/1/05
Application	-	Foliar	Fertigation	Foliar	Foliar
Fertiliser		Calcium Nitrate	Calcium Nitrate	Bortrac	
Rate kg/ha		37	40	-	
Rate L/ha		-	-	3.75	
Timing		6/05/2005	Apr-05	11/11/2004	
Application		Fertigation	Fertigation	Foliar	

Pest and Disease Management

All the vineyards in this survey utilize a low impact fungicide programme. The main disease issue for the vineyards is powdery mildew hence the vineyards follow the week 2, 4, 6, 10 Powdery mildew programme recommended by Magarey et al. to manage the major disease risk in the region.

The vineyards occasionally experience insect damage linked to either the Fullers Rose Weevil or Light Brown Apple Moth but rarely do these problems pass threshold levels requiring specific control.

Phenology

Phenology appears to be linked to climatic conditions with the coolest vineyard being the last vineyard to undergo veraison and harvest. Phenological development is slowest in the MTL vineyard, and fastest in the Pyrenees (BB and TT). The warmer vineyards in the Pyrenees tend to earlier veraison and earlier harvest compared with the Grampians vineyards – a trend that was expected. SP phenology is fast despite being in a cooler area which maybe due to poor soils limited irrigation and a higher leaf to fruit ratio; low crop load may be a factor in the SP1 phenological development as low crop and results in a short period from veraison to harvest.

An interesting comparison would be the time taken from budburst to veraison and the length of the flowering process as these processes can affect bunch size and berry number.

Tab. 8 Phenological data

	Fl. -Veraison	Ver-Harvest	Fl.- Harvest
SP1	68	52	120
MtL	82	62	144
MR	74	49	123
TT	62	60	112
BB	66	57	123

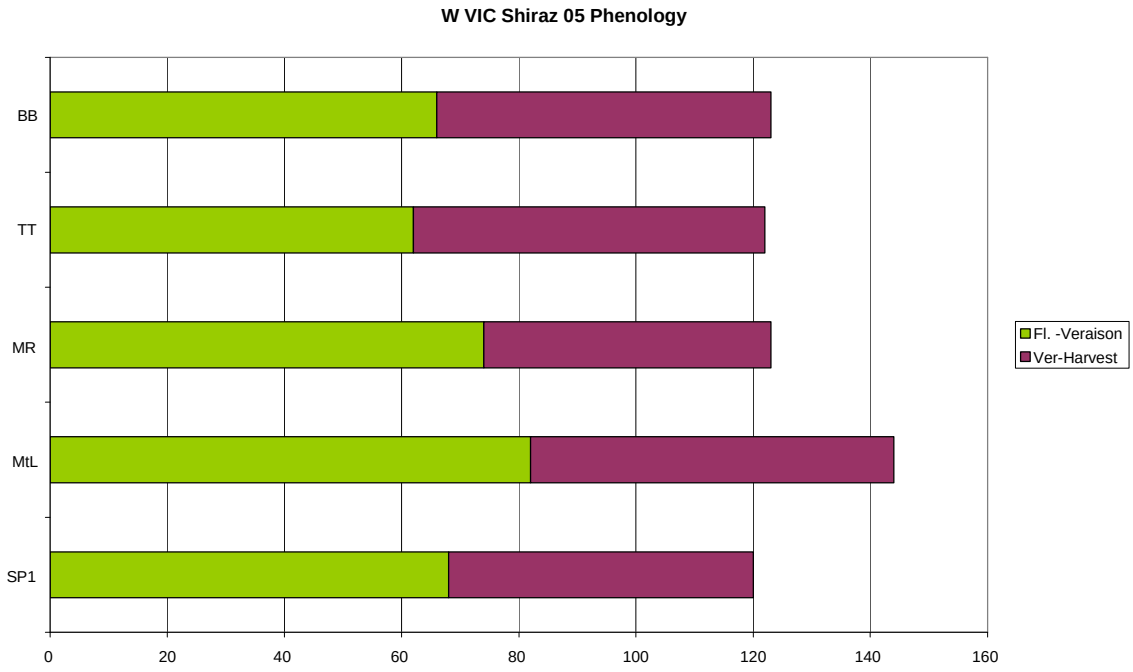


Fig. 12: Speed of development of the crop in the 5 vineyards

Vineyard scoring

Unfortunately the yield at SP1 was affected by frost damage early in the growing season resulting in excessive vegetative growth and reduced crop. Average shoot length is considered adequate at 1 m length with 12 to 15 nodes. All vineyards had shoots of sufficient leaf area to ripen fruit. Few laterals were apparent on any of the shoots in any of the vineyards. There were no growing tips recorded after veraison in any vineyard. The ratio of leaf area to fruit mass is seen as high (*Smart et al., 1990*) for all but MtL.

Tab. 9: Vine balance assessment at veraison

- ***3 =80-120 cm, 4= >120 cm***
-

	av. shoot length *	no. of leaves/ shoot 100cm2	no. of leaves/ shoot 150cm2	no. of leaves/ shoot 200cm2	Av. Leaf area	Leaf removal Y/N?	Bunch number	Shoots per vine	Bunches per shoot	Bunch weight (gm)	g fruit/ shoot	Vine balance
SP1	**3.6**	**5.45**	**4.60**	**5.60**	**2355**	**n**	**26.1**		1.5	**77.9**	**116.9**	**20.1**
MTL	**4.6**	**4.85**	**4.65**	**4.85**	**2153**	**y**	**44.6**	**21.50**	**2.1**	**111.3**	**231.1**	**9.3**
MR	**3.8**	**2.22**	**2.50**	**7.00**	**1788**	**n**	**44.2**	**31.35**	**1.4**	**85.8**	**121.0**	**14.8**
TT	**3.7**	**6.80**	**5.25**	**3.05**	**2078**	**n**	**35.0**	**27.20**	**1.3**	**93.6**	**120.4**	**17.3**
BB	**4.0**	**8.55**	**7.75**	**4.86**	**2698**	**n**	**36.6**		**2**	**79.6**	**159.3**	**16.9**



Fig.13 Shoot development in February, MTL vineyard.

Leaves were healthy at veraison (Tab. 8) Only 1 vineyard performed leaf removal. It is suspected that drought stress caused excess leaf fall early in the ripening process for some of these vineyards. Vineyards differed markedly in their degree of cane lignification with the leafiest vineyard (BB) being the slowest having still green leaves at harvest and a high leaf cover in front of one side of the bunches.

Tab. 10: Leaf health and cane lignification assessment at veraison and harvest

- 5= green, 4= pale green, 3= yellowing, 2= yellow/brown, 1= absent

\# 1=< 20%, 2=21-40%, 3= 41-60%, 4= 61-80%, 5=81-100%

	leaf condition rating 1-5 *	Front Leaf Layer Number (4 vines)	Back Leaf Layer Number (4 vines)	% cane lignification all shoots #	No. growing tips	leaf condition four oldest leaves	leaf condition younger leaves	Front Leaf Layer Number (4 vines)	Back Leaf Layer Number (4 vines)
SP1	5.00								
MTL	5.00	0.75	1.20	4.4	0.3	1.2	4.1		
MR	4.75			3.9	0.0	3.4	4.2		
TT	2.98			5.0	0.0	2.7	3.3		
BB	5.00	1.70	2.00	1.8	0.4	4.2	4.2	4.91	1.40

Yield to pruning weight ratios were calculated from pruning weight taken in winter 2005 and yield at harvest 2005. The measurements were on a whole vine basis. This measurement is a simple assessment of vine balance. Low values are associated with low yield and individual shoot vigour whilst high values are said to co-occur with delayed ripening and reduced quality. The data was corrupted by bunch thinning at veraison on vineyard MR and the effects of frost on SP1. TT and MtL are at the bottom of accepted standards for yield to pruning weight ratios. This is not unexpected given the extent and length of the drought affecting both wine regions.

Tab. 11: Yield to pruning weights

Vineyard	Pruning weight	Yield (kg)/vine	yield/ pruning weight
SP1		2.2	
MTL	1.24	5.1	4.21
MR	1.35	3.8	2.89
TT	0.72	3.4	5.26
BB		2.9	

Fruit scoring

Tab. 12: Vineyard assessment of fruit in the last weeks before harvest.

	Weeks after veraison	Date	Brix	TA	pH	Berry Shrivel	Pulp maturity	Pulp aroma	Skin maturity	Seed Maturity
SP1	1 week	8/03/2005	19.8	13.0	2.92		*	*	*	*
SP1	2 weeks	15/03/2005	22.3	10.8	3.19	*	*	*	*	*
SP1	3 weeks	18/03/2005	22.3	11.0	3.13	*	3	3	3	2
SP1	4 weeks	22/03/2005	23.8	10.7	3.17		4	4	4	3
SP1	Harvest	31/03/2005	25.2	10.4	3.21	*	*	*	*	*
MtL	6 weeks	8/04/2005	*	*	*	*	*	*	*	*
MtL	7 weeks	15/04/2005	23.2	7.4	3.27	*	*	*	*	*
MtL	8 weeks	22/04/2005	*	*	*	*	4	4	4	4
MtL	Harvest	29/04/2005	25.0	*	3.4	*	4	4	4	4
MR	1 week	21/2/05	14.9	18.9	2.82	*	*	*	*	*
MR	2 weeks	28/2/05	17.6	9.4	2.92	*	*	*	*	*
MR	3 weeks	3/07/2005	19.0	11.6	3	*	*	*	*	*
MR	4 weeks	14/3/05	22.6	10.9	3.14	*	*	*	*	*
MR	5 weeks	21/3/05	24.3	10.6	3.16	*	*	*	*	*
MR	6 weeks	29/3/05	25.5	9.1	3.22	1	4	4	4	4
MR	Harvest	4/02/2005	26.6	8.8	3.4	*	*	*	*	*
TT	2 weeks	7/03/2005	21.4	8.9	3.07	*	*	*	*	*
TT	3 weeks	15/03/2005	26.7	7.7	3.32	*	*	*	*	*
TT	Harvest	21/03/2005	26.4	6.1	3.42	1	4	4	4	3
BB	5 weeks	3/03/2005	25.9	*	*	*	*	*	*	*
BB	6 weeks	12/03/2005	28.4	*	*	*	*	*	*	*
BB	7 weeks	19/03/2005	28.9	*	*	2	4	4	4	4
BB	Harvest	29/03/2005	28.8	*	*	2	4	4	4	4

Berries were out in the vineyards generally until their skins and pulp tasted ripe (BSA scores, Tab. 10). This could be afforded as no dangerous acid loss was observed.
The berries reached their ripeness at very different speeds as can be seen from Figs. 11 and 12.

Brix evolution

When looking at calendar dates, the vineyards in the Pyrenees (TT and BB, Fig. 11) had already reached 27 – 28 Brix mid March whereas the Grampians vineyards SP1 and MR still had only 22.5 Brix. They loaded sugar subsequently at a steady rate until harvest, whereas the Pyrenees vineyards did plateau from mid March on with respect to Brix. MTL had only 23 Brix mid April and berries were left hanging and increased Brix steadily for another 6 weeks.

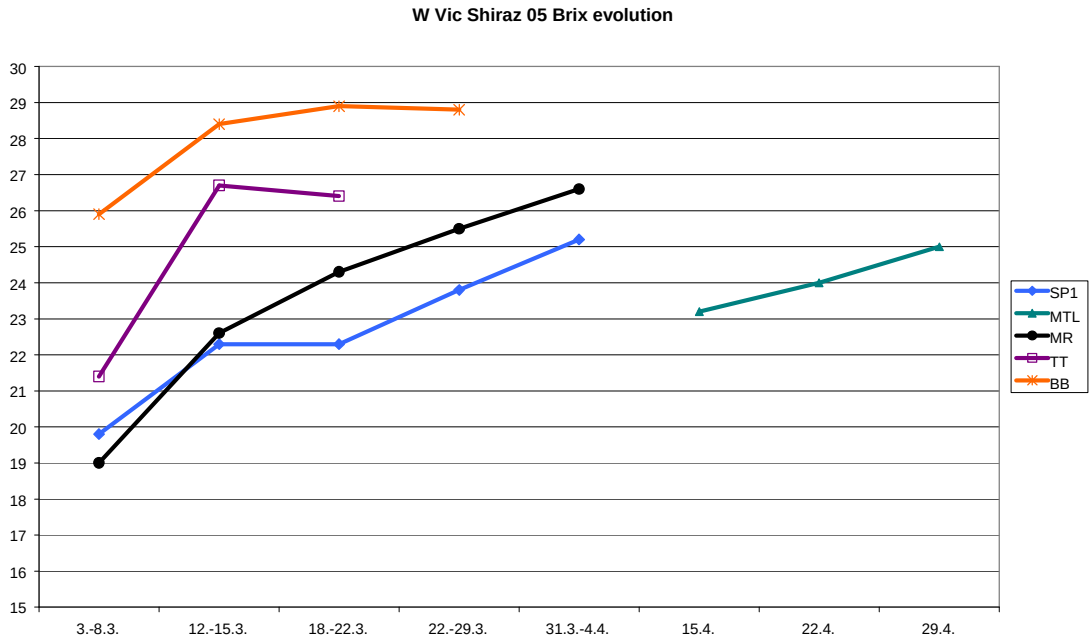


Fig. 14: Brix evolution in the 2 regions is very different with the Pyrenees much faster than the Grampians.

Acid loss

Berries from SP hung on to high acid whereas MR acids dropped to 9 in the last weeks before harvest. TT in the Pyrenees has acid loss but not as drastic as some NE Victorian vineyards.

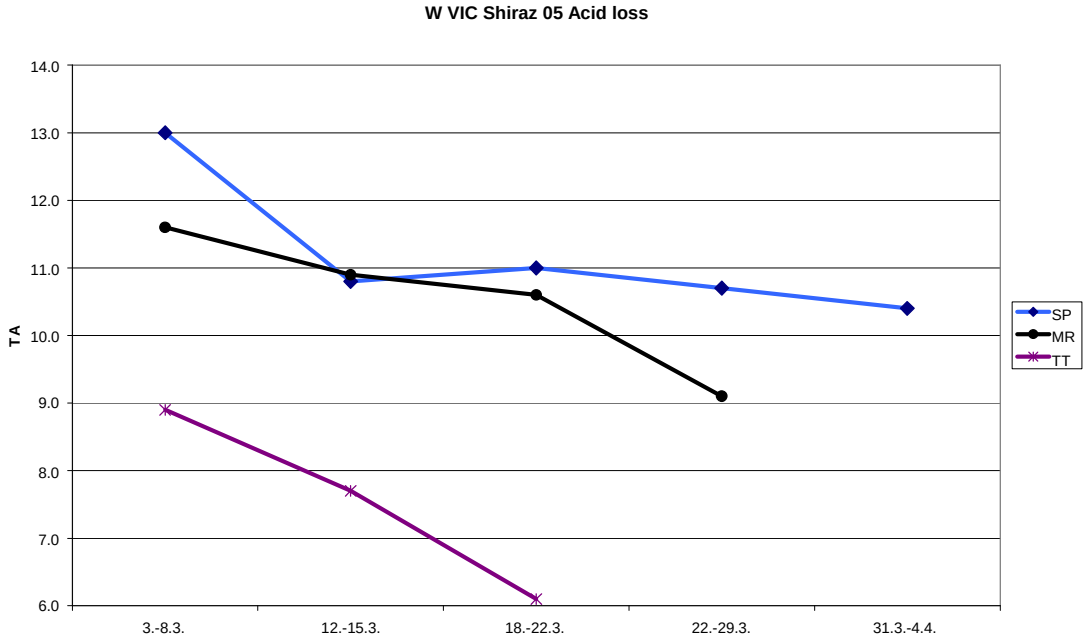


Fig. 15: All berries from the Grampians retained very high acid levels, acid loss in TT is about normal.

Brix / day vs vine balance

Comparing Baumé or Brix or TA between different vineyards makes little sense as the picking time is often decided by the winemaker for other reasons than Brix.
A good way to compare vineyards is to look at their speed of sugar evolution or acid loss.
As previously seen in the NE Victorian vineyards, vines with higher leaf area to fruit weight push sugar into the berries faster on a daily basis (see SP1 in Fig. 13) than vines with a lower vine balance value (MTL with partial leaf removal). The Brix is that measured by the viticulturists at harvest.

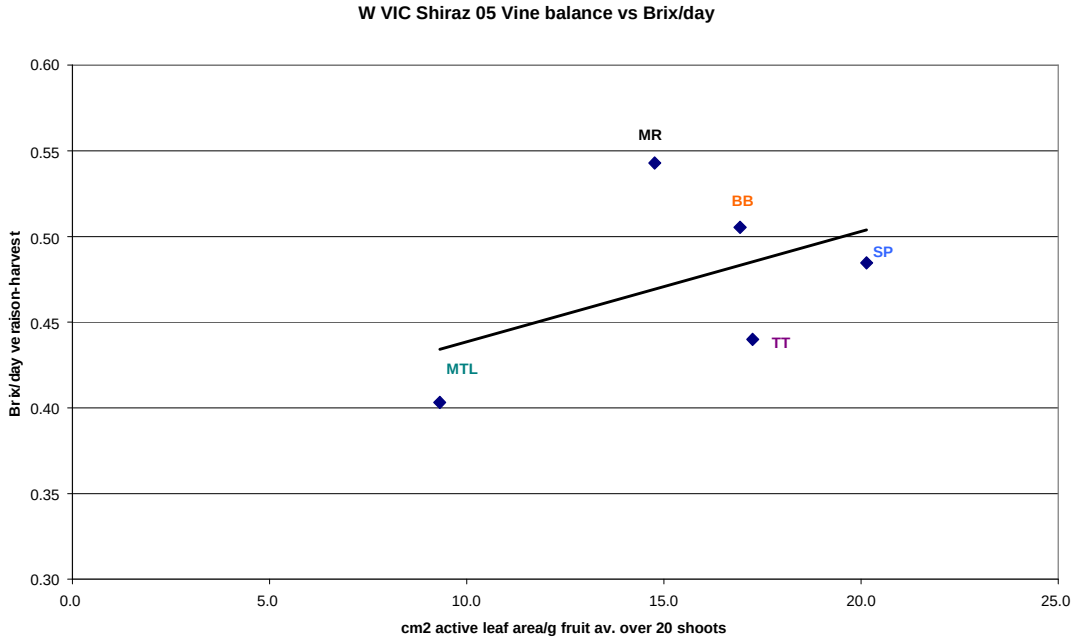


Fig. 16: Higher vine balance values generally lead to faster sugar loading. SP is frost damaged.

Cane lignification

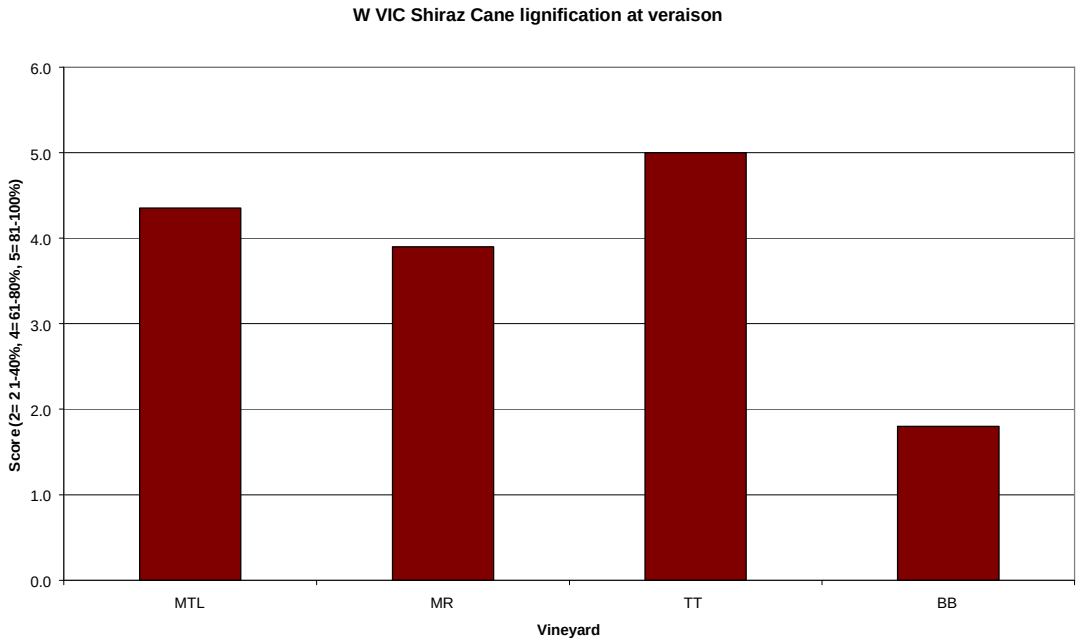


Fig. 17: Vineyards had well lignified canes except BB in the Pyrenees.

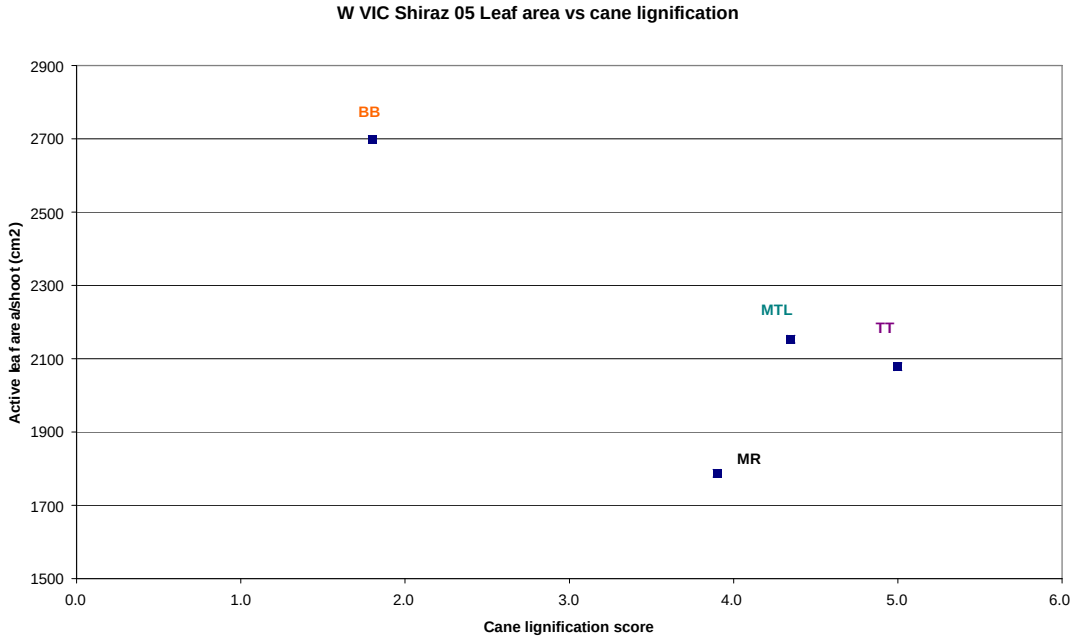


Fig. 18: The vineyard with the low cane lignification was much leafier than the other vineyards, SP1 had no data on cane lignification (frost damage).

Berry analysis

Unfortunately not very many samples finally reached the laboratory. The data are recorded in Tab. 11. Values are referred to as per g freshweight of berries as berries reach cellar door, not skins.

As can be seen from the BSA results (Tab. 10) seeds of the SP and TT vineyards were less ripe than those of the MTL vineyard. Accordingly, the extraction of the phenolics is higher in MTL. However the values are all higher than that generally found for NE Victoria. Attention may need to be paid to the effect of not fully ripe seeds in the ferment for SP1 and TT.

Tab. 13: Chemical analysis of berry samples

Region	Code	Av Berry Wt (gms)	Av Skin Wt (gms)	% Skin / Berry	Baume	pH	TA	Skin Extract Abs. Units / 1g Berry		
								Anthocyanins 520nm	Phenolics 280nm	Flavonols 360nm
Grampians	SP1	1.3	0.21	15.99	14.0	3.34	7.40	72.8	63.9	14.5
	MTL	1.1	0.15	13.58	14.8	3.89	5.40	80.1	69.7	18.9
Pyrenees	TT	1.2	0.18	14.79	14.4	3.62	6.40	76.5	66.8	16.7

Region	Code	Av Seed Wt (gms)	% Seed / Berry	Seed Extract Seed Phenolics 280nm
Grampians	SP1	0.083	6.45	32.29
	MTL	0.11	9.77	51.44
Pyrenees	TT	0.10	8.11	41.87

Due to the scarcity of data points the vineyards of W Vic were compared to those of the high lying valleys of NE VIC namely Beechworth and Alpine Valleys.
This will give the vineyards of the Grampians and the Pyrenees a feeling for where they are – data have been produced by the same laboratory.

Total phenolics in berries

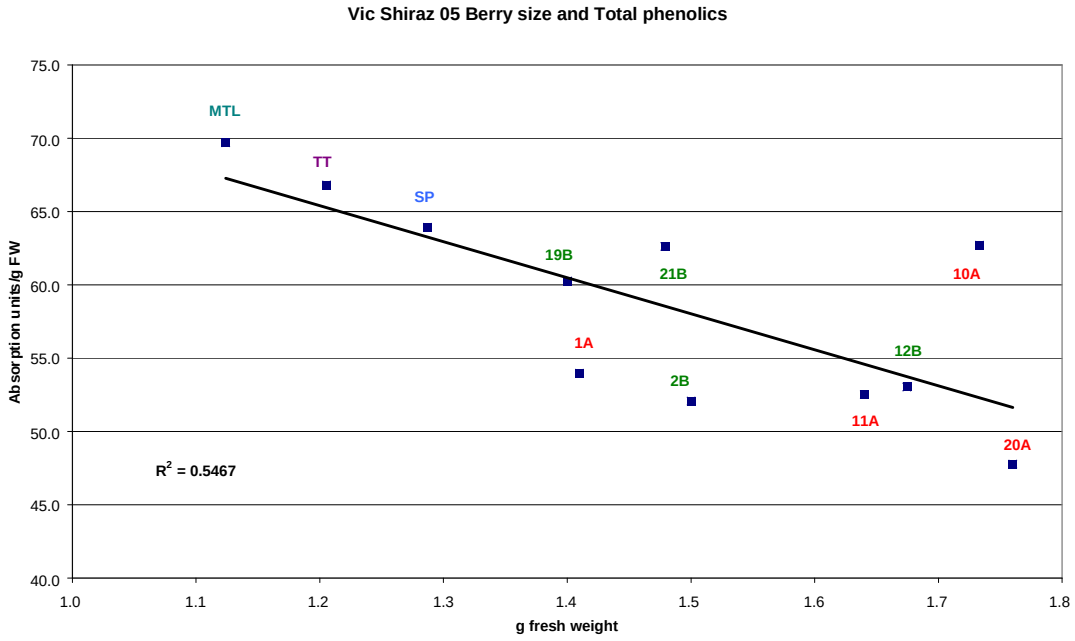
The values discussed below are phenolics in skins only. If berries are ground up and seed and skin phenolics are measured together, berry quality cannot be assessed as the origin of the phenolics is unclear. Unripe seeds emit a large amount of phenolics (unwanted) and emit less when ripe, unripe skins emit less phenolics and more when ripe.

Phenolics in berries were found to often correlate with phenolics in wine (*Somers 1998*) but not always. This warranted investigation.
Also sunlight is said to have a positive effect for berries destined for full bodied wines (*Smart and Robinson, 1992*) – but this did not always work for warmer regions.

Does size matter?

In the case of the 3 measurements of berry size we have we can see in comparison to the berries from Beechworth and the Alpine valley that the berries in W Vic are really small. Small berries were hard to obtain in NE Vic this year due to abundant rainfall (see climate comparison). Smaller berries had higher phenolics/g FW.

Fig. 19: Smaller berries had higher phenolics/g FW.



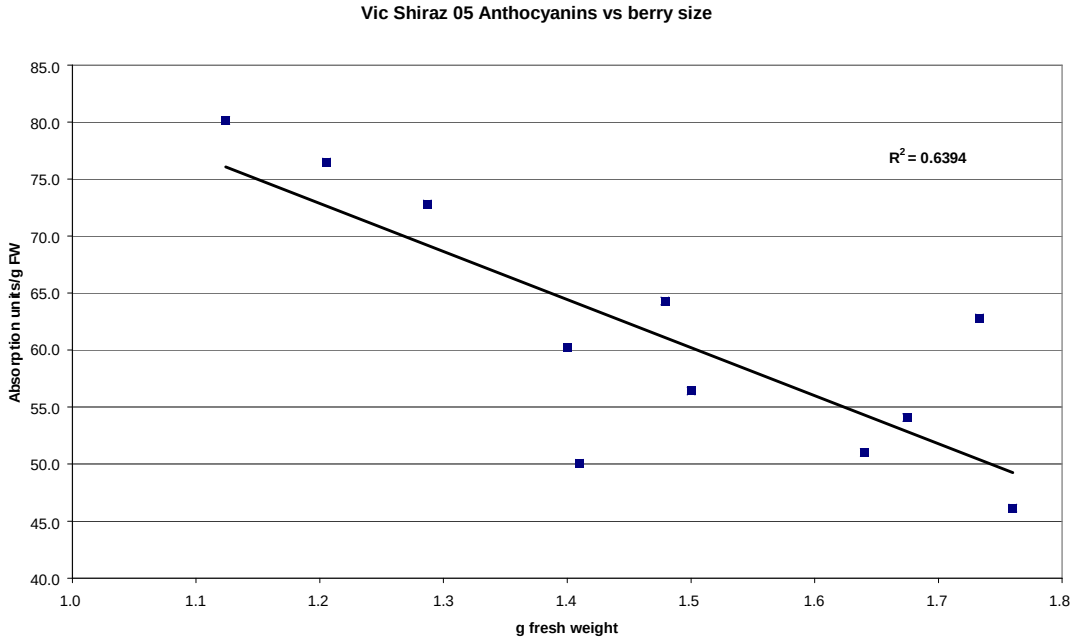


Fig. 20: Similar trend with even higher significance existed for colour.

Does Sugar matter?

In the 25 NE Victorian vineyards there is no relationship between Be and colour or phenolics. Looking at the higher altitude NE Vic vineyards there could be an inverse trend with 11 A and 20A with rather long hangtime, very leafy and shaded fruit in both cases high Be did not lead to excellent wine scores.

In the W-VIC vineyards there seems to be a higher colour with higher sugar ripeness as there is very little heat loads on grapes but MTL had a higher hangtime which might have contributed to its high colour value.

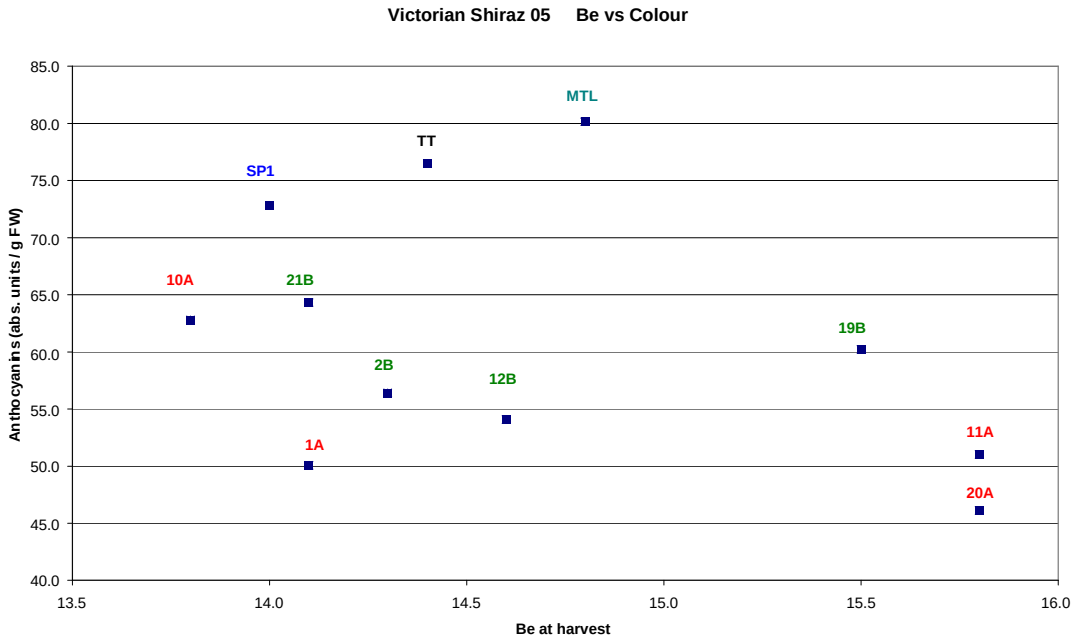


Fig. 21: Comparative analysis of the relationship of Baumé and anthocyanins in Victorian high altitude vineyards.

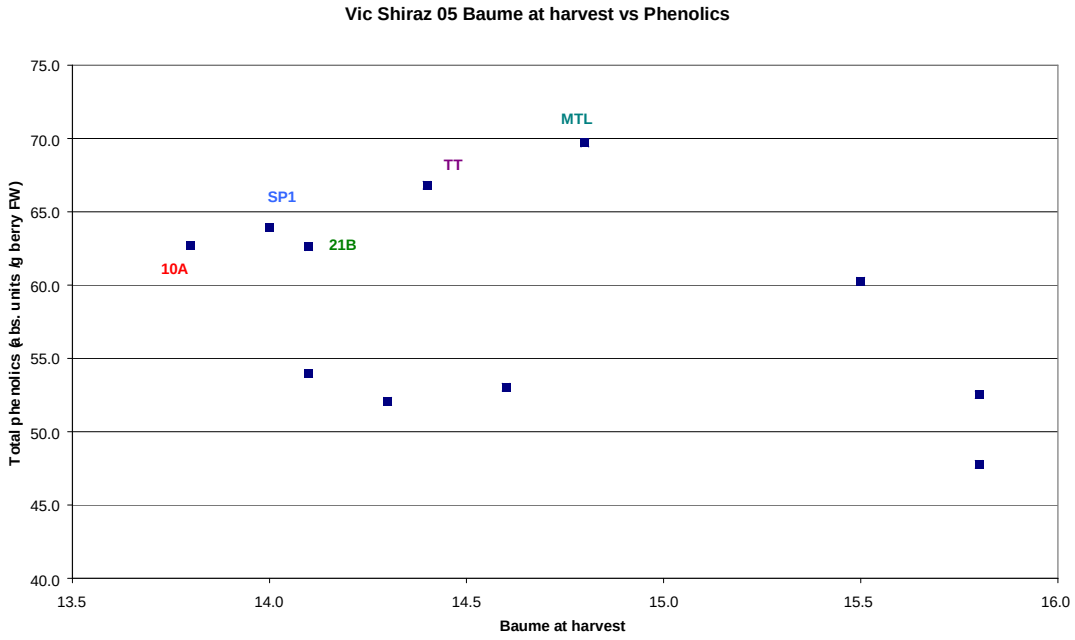
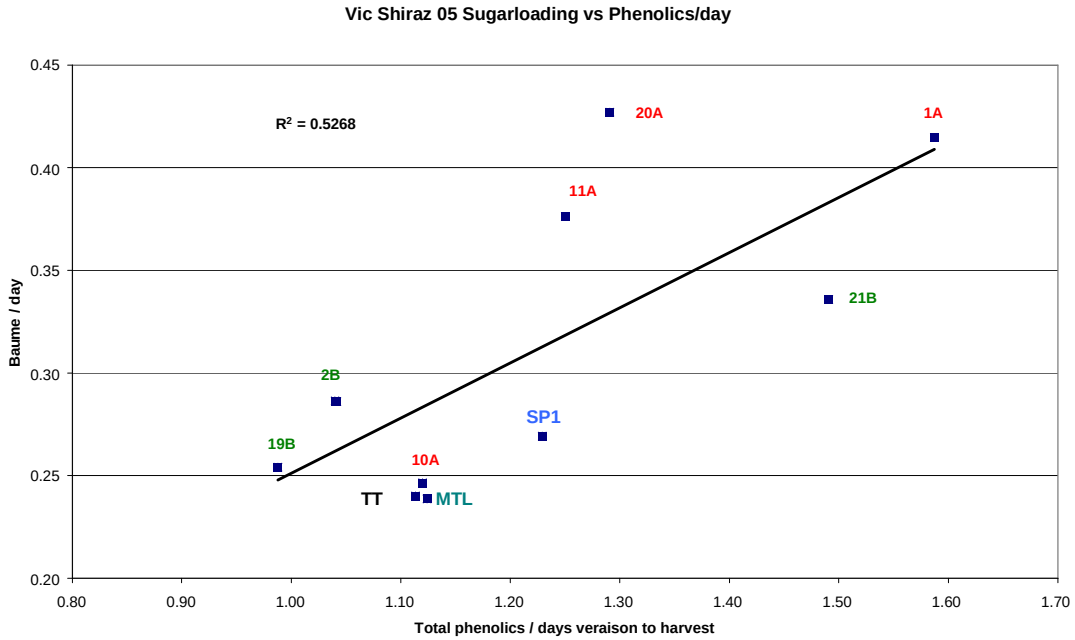


Fig. 22: Relationship between Be and total phenolics at harvest in grapes.

Does speed matter?

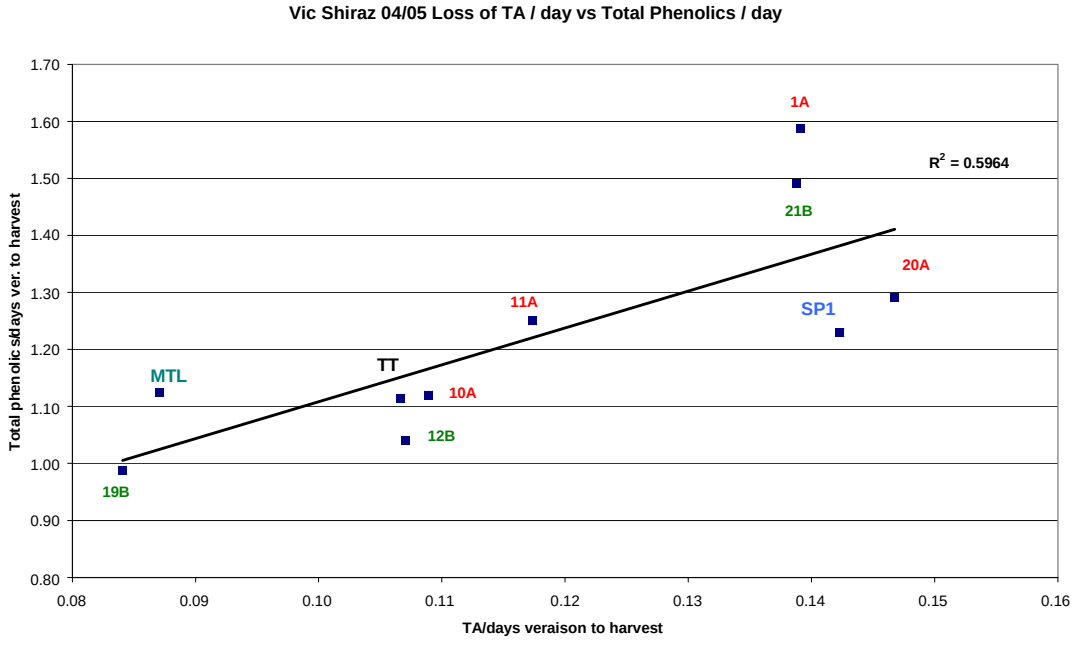
The fast sugar loaders do not have the highest phenolics at harvest and slow sugar loaders have low amounts of extractable phenolics per day of hangtime.

Fig. 23: Slow sugar loaders also produce less phenolics per unit time but have more left at the end /g FW.



Slow loss of acid was typical for the Grampians (MTL and SP1) vineyard but due to an initial fast loss SP1 was faster than TT when the whole ripening period was considered. In the comparison 19 B, 10A and 12B have all low afternoon heat loads from cool breezes and mountains hiding the afternoon sun.

Fig. 24: Slow acid losers were slow phenolic producers. 19 B was a bronze medal wine.



Is BSA of skins a good indicator of skin phenolic potential?

Ripe skins emitted many phenolics.

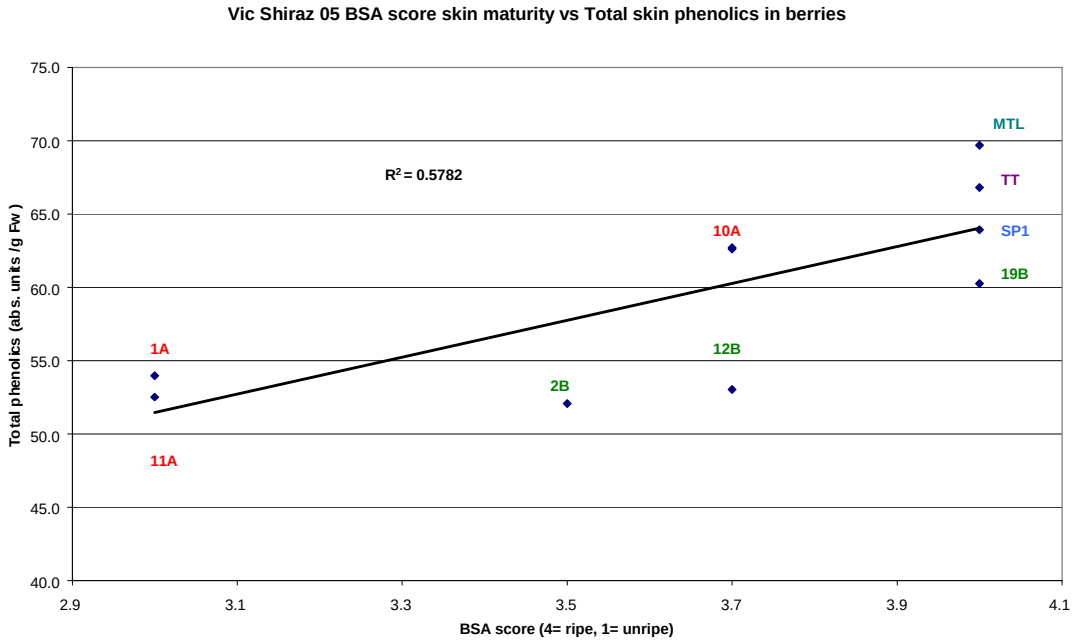


Fig. 25: Skin BSA is a good indicator of phenolic potential.

The relationship between colour and total phenolics

As observed previously this relationship is not linear (it was if all dots were on the red line) in particular in cooler climates. Berries with high colour usually are less exposed to heat and therefore have lower than expected phenolics (SP1, TT, MTL, 21B) whereas hot bunches (1A, 11A) have more phenolics and less colour than expected.

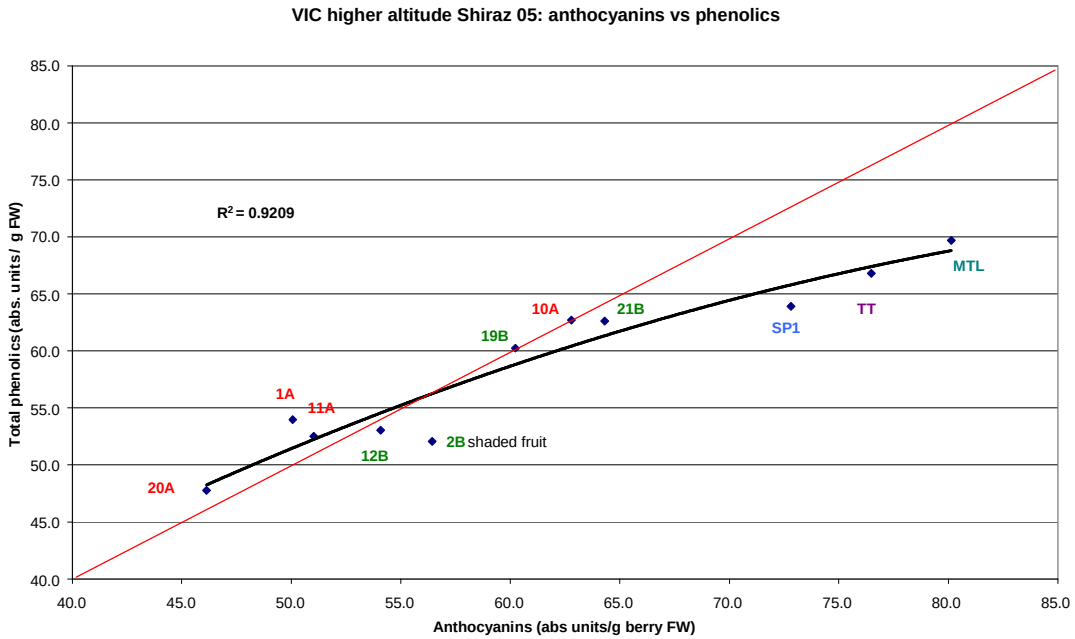


Fig. 26:The relationship between colour and phenolics in cooler Victorian vineyards.

Does exposure matter?

Flavonols are the sunscreens of grapes. High flavonols mean high exposure - as could be seen from the correlation of leaf cover over bunches vs flavonols in NE VIC. Leaf layer numbers over bunches were not recorded for all W VIC vineyards and cannot be correlated to flavonol values. In the cooler climate of W VIC high exposure can be afforded which subsequently also correlated highly with high total phenolics. Maybe the small size of the berries or hangtime also contributed to high amount of skin phenolics.

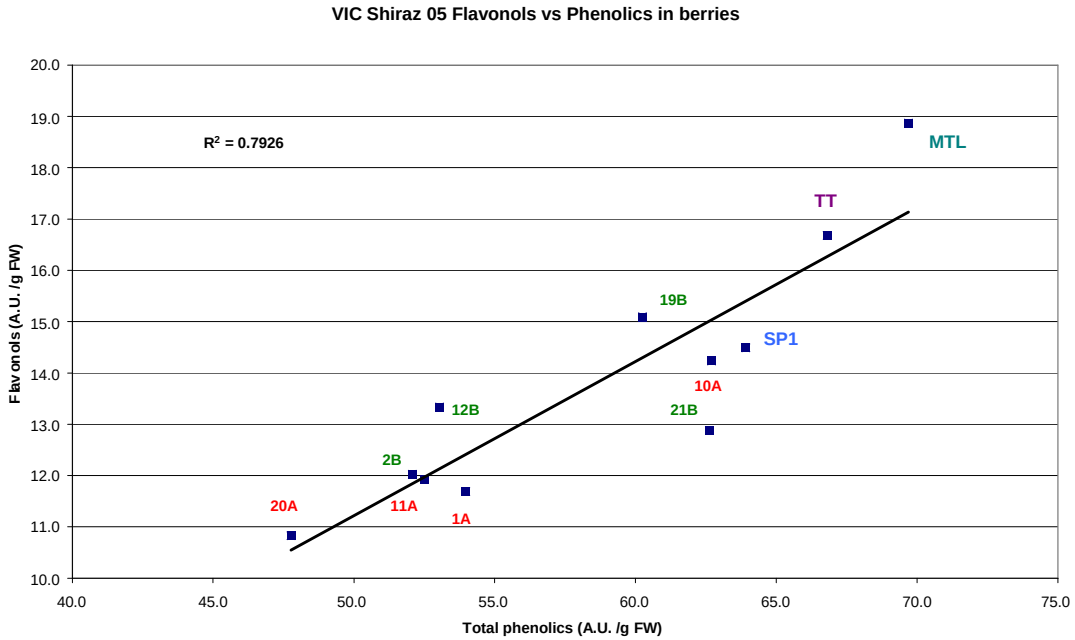


Fig. 27: High flavonols correlated with high phenolics particularly in cooler sites.

Does hangtime matter?

Only 3 values but highly correlated.

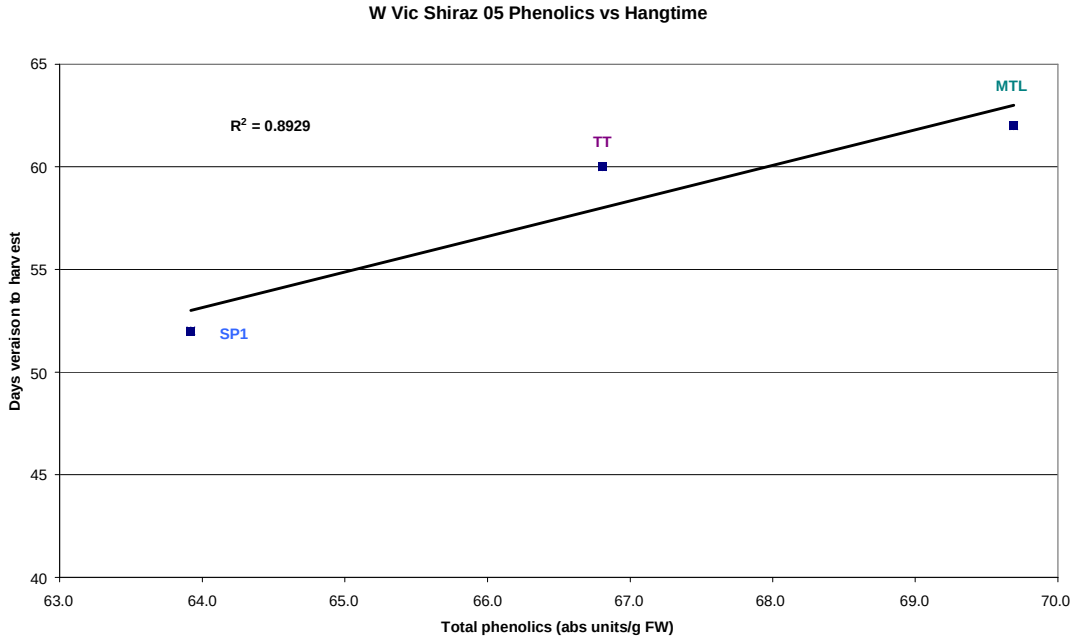


Fig. 28: Longer hangtime may have resulted in higher phenolics at harvest.
Not only hangtime but also hang-condition may play a role.

Bunch zone temperature curves

Data loggers were inserted into the vineyards. Not all data loggers yielded useable data – some were slashed by machinery, some did not perform well (Fig. 29).

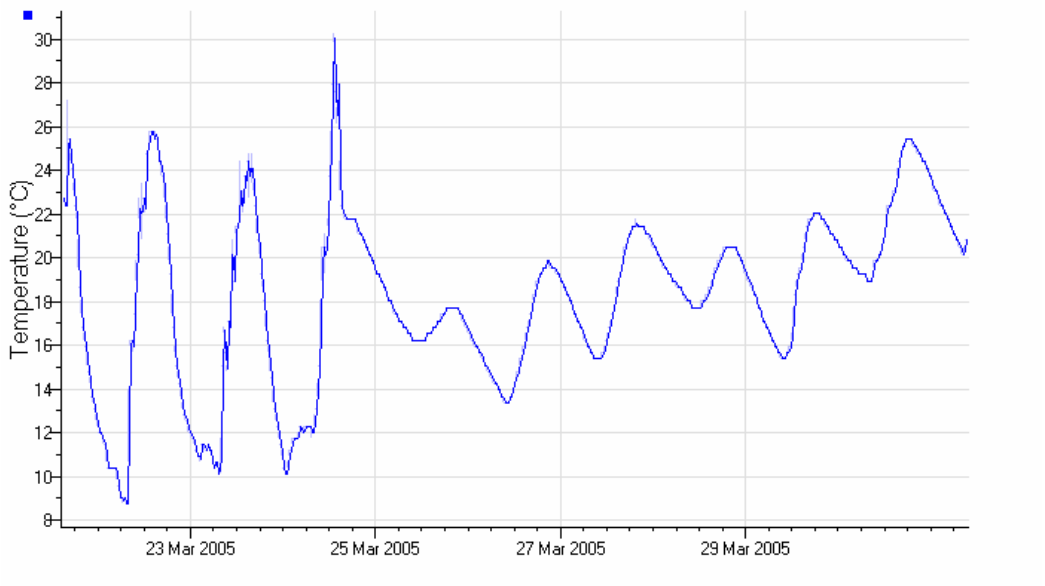
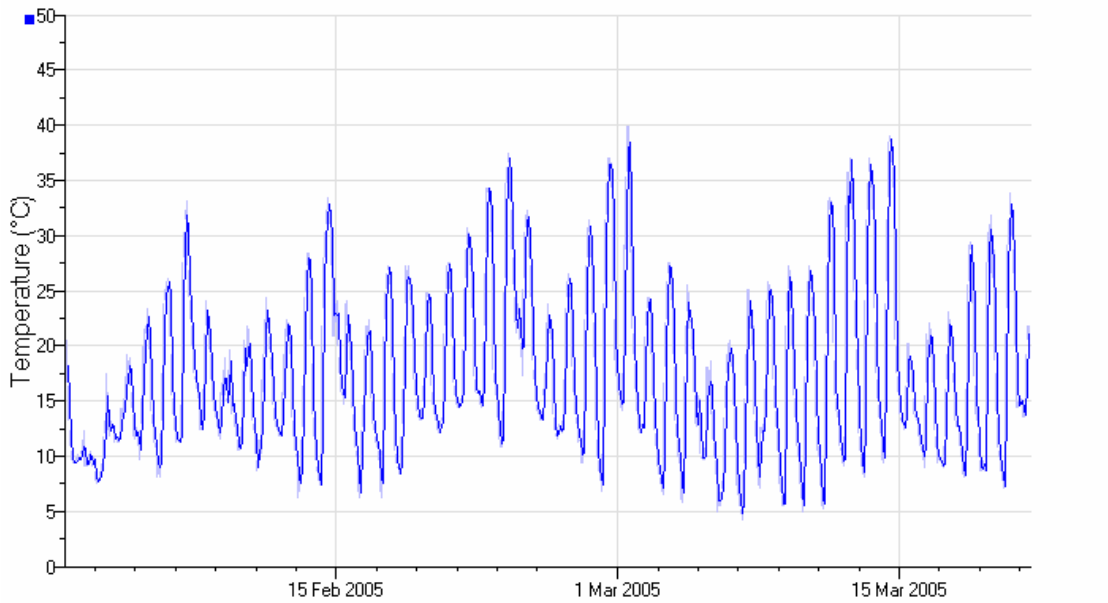


Fig. 29: Data logger with some injury after 24. March.

A good example of the ripening period was only obtained from the SP1 vineyard in the Grampians region.

Fig. 30: SP1 - daily bunch zone temperature movement veraison to harvest, EW rows on a N facing slope.



From the diurnal movements in the ripening period it can be observed that daily maxima very rarely exceeded the 35 degree threshold recommended to avoid heat loads in red grapes (*Spayd et al 2002*). Also the absence of 20 degree nights (except one) is striking (when compared with the cooler vineyards of NE Victoria (*Winter and Lowe 2005*).

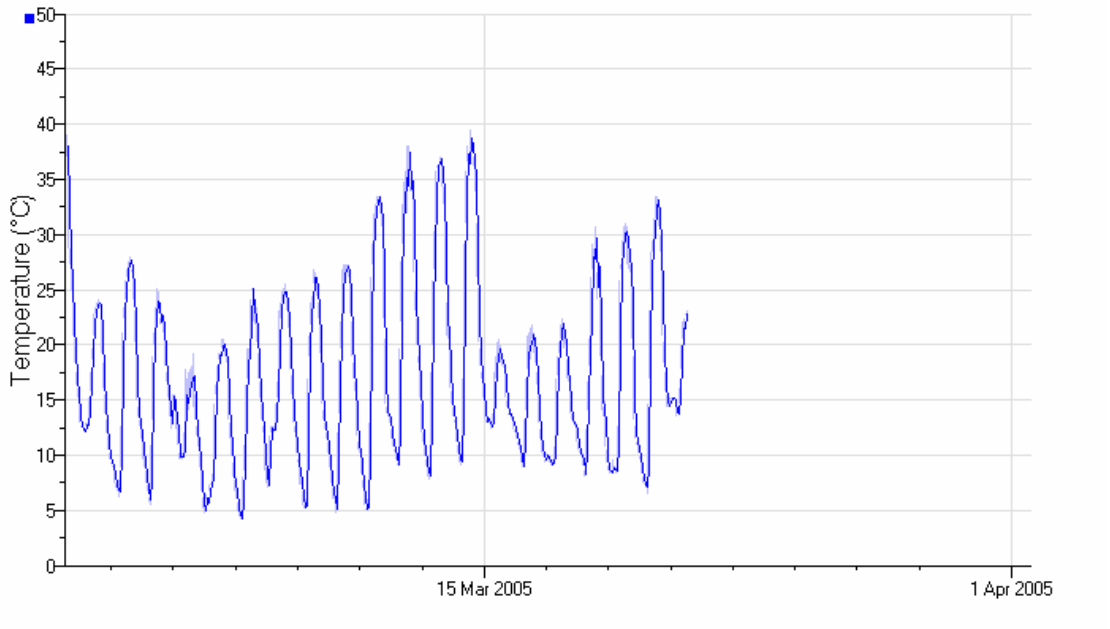
This vineyard has a summative degree hour value of 19,273 accumulated over 47 days.

As there are 5 days not accounted for the temperature summations cannot be compared to those of the NE Victorian Vineyards except maybe for 12B (24,199 degree h in 51 days).

Unfortunately the wines were not assessed so tannin softness and flavour intensity cannot be related to the temperature summations as in the NE VIC study.

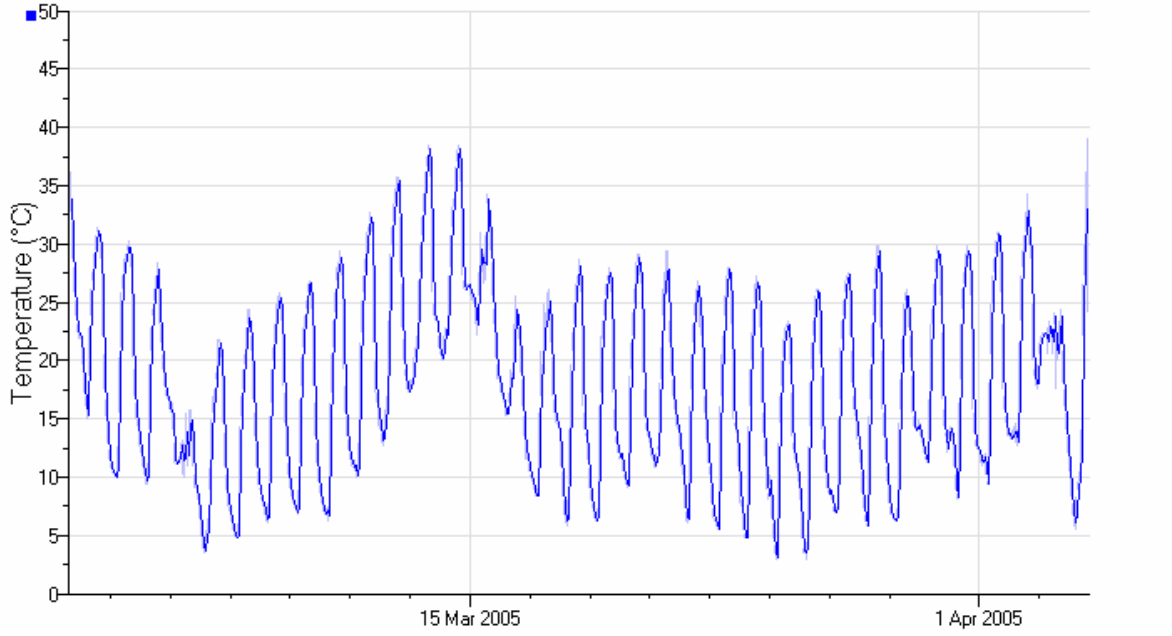
In a close-up we can see that the diurnal curves in SP1 are similar every day only at different heights according to some hotter or cooler weather.

Fig. 31: Diurnal curves in summer SP1 vineyard



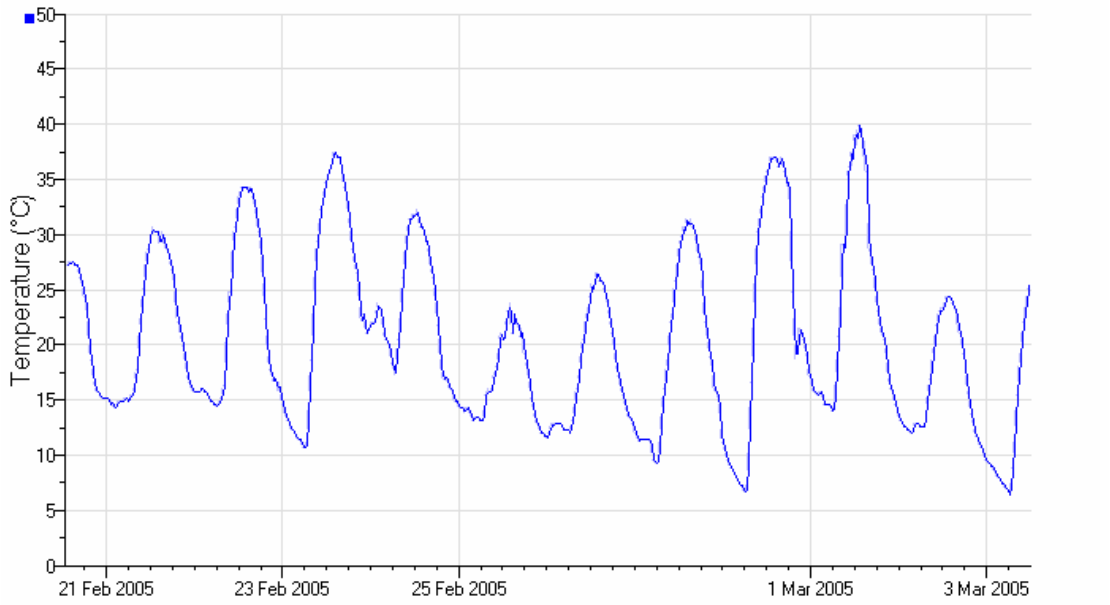
Comparing the **19B** vineyard at the same scale it becomes obvious that there is a large weather event over Victoria around 16. March affecting both areas but in Beechworth the nights are warmer.

Fig. 32: Same scale curves in B19 vineyard.



The most interesting view is to observe a close-up of a few summer days.
SP1 *Phenolic value* ***63.9.*** **E/W row at 240 m altitude, 2% slope in a cool climate (Grampians).** Takes long to reach bunch warmth in unplucked vines – 15 degrees at 7am but good rise in temperature – 30 degrees at 10 am. Some small plateau between 1 and 4pm which may be rather too warm – sometimes in summer above 35 degrees. Sharp decline after 3.30 pm. Similar (albeit a bit warmer) to the 19B below.

Fig. 33: Close up of diurnal temperature movements in the bunch zone of SP1



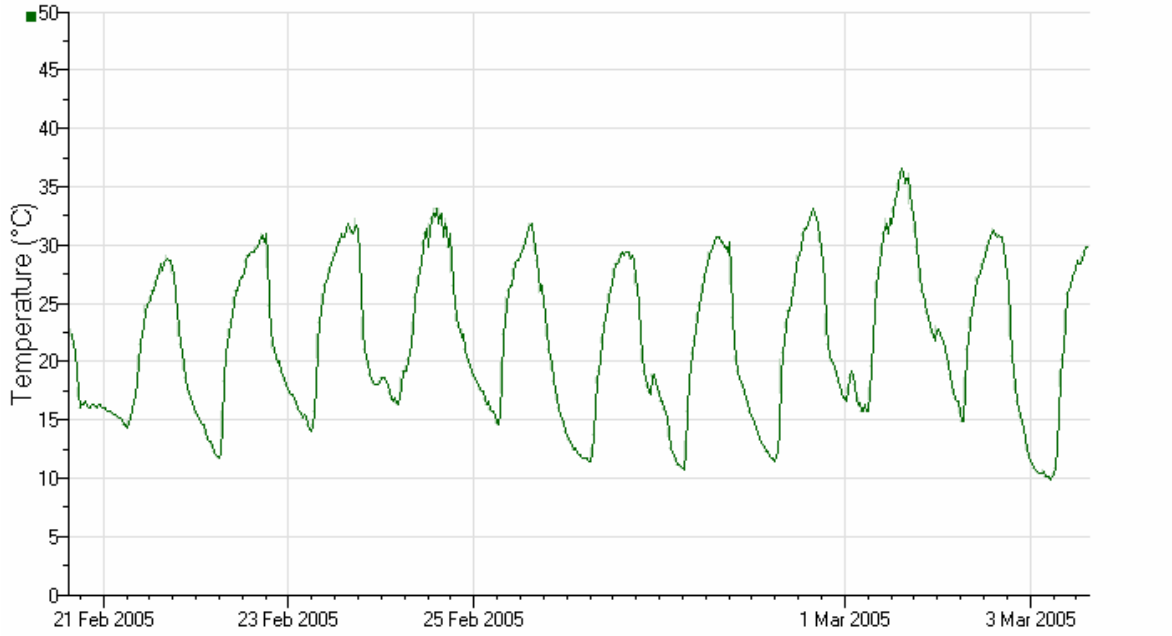
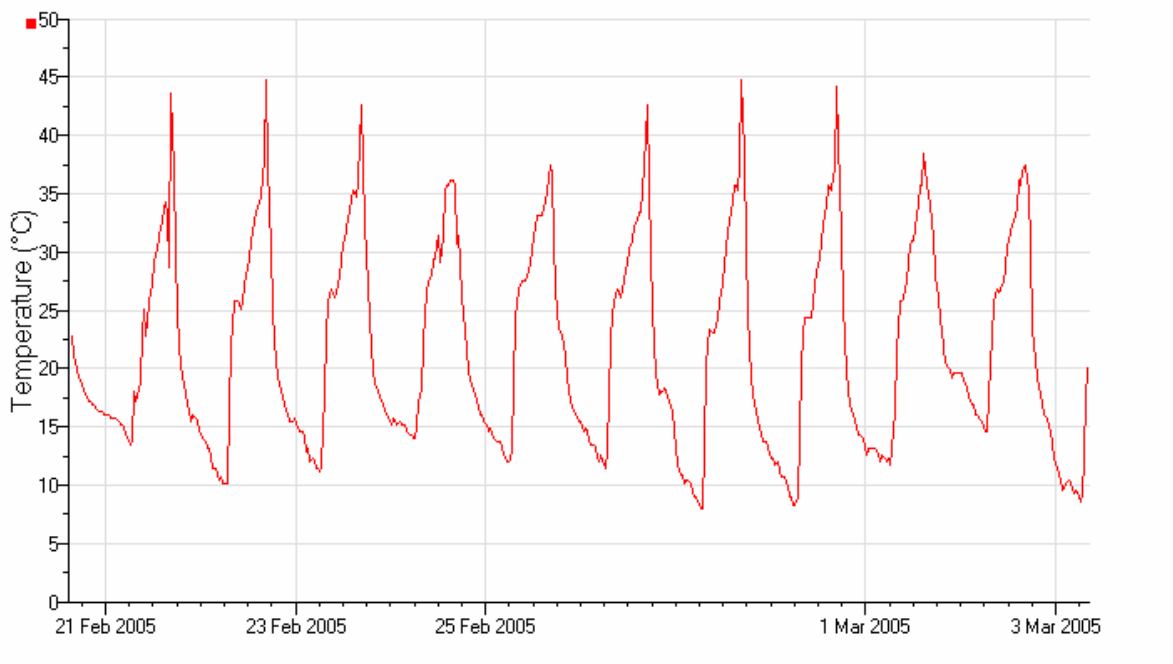


Fig. 34: Comparative diurnal curves in vineyard 19B *(phenolic value* ***60.3****)* **N/S rows with 10% slope, on a plateau in a cool climate (Beechworth)**. Unplucked with dead lower leaves and *very exposed fruit late season*. Takes long to warm up (17.5 degrees at 7am on a summer day) but *good increase of temperatures in the morning sun* with midday plateau at 33 degrees between 1.30 pm and 5pm. *No heat loads in the afternoon*. Long hangtime.

This is in contrast to the sharp peaks of heat experienced in **10A** of NE Vic. (*phenolic value **62.7***) ***plucked on east side*, NE/SW rows at 300m on a 10% NW slope in a cool climate.**
There is a *sudden increase of temperature* between 6am and 8am (with the temperature of the bunches at 24.4 degrees at 7am on the 25.2.) and a second rise between 10am midday where temperatures are at 30 degrees. From there they again rise for 4h in the afternoon of most days to 45 degrees *with cool bunches after 4pm* with the sun on the unplucked side.

Fig. 35: Comparative diurnal curves in vineyard 10A



4. Discussion

The vineyards under observation al belong to a true cool climate zone (*Gladstones, 1992*).
Their phenology was, as many times described in the literature (*Coombe and McCarthy, 2000*) dependent on the water availability and crop load. The vineyards were all in balance when not frost damaged (*Howell, 2001*) and had rather more than less leaves to ripen the crop.

Fruit development was fast for the Pyrenees and more slow and steady for the Grampians and fruit was only harvested when fully physiologically ripe (some lack of seed ripeness noted in SP! And TT, both vineyards harvested at lower Brix than their neighbours from a similar region). The vineyards with the steepest curve of sugar loading were those with the highest leaf area/fruit weight. The leafiest vineyard had the lowest cane lignification.

Unfortunately only 3 vineyards had their grapes analysed for chemical characteristics.
Therefore the data were compared to the NE VIC fruit of higher altitudes (*Winter and Lowe 2005*). The W-VIC grapes were much smaller (less rain) and had higher colour and total phenolics than their NE Vic counterparts. They had very high values compared to all other data from Victoria (*Rolley 2003*) independent of training system (*Wolf et al 2003*) In all chemical measurements W VIC fits well into the general trends of high performance with low speed of acid loss, high exposure and longer hangtime in cooler conditions.

Data logger curves showed the cooler bunch zone of SP1 compared to most of the NE VIC curves. Unfortunately there is only one good curve for the area. The interesting conclusions drawn for NE VIC relating bunch zone summations to wine flavour and aromas may only be drawn in a larger study where the wine is also assessed.

It can be hoped that these humble measurements will encourage more participants next time.

5. Conclusions and recommendations

The RITA Benchmarking project was rather a pilot study than a full survey.

☞ Not enough vineyards participated to produce valid statements and statistical correlations.

☞ Grower and winemaker involvement was moderate with some measurements missing.

☞ The scarce data was compared to other higher altitude vineyards in NE Victoria to allow some interpretations. More data for the W-Victorian vineyards are needed.

☞ New insights were largely based on inexpensive, grower suitable temperature measurements in the bunch zone which will possibly become standard practice in many other viticultural regions growing for full bodied red wines.

☞ The study should be done with more participants and higher involvement of the field coordinator to chase data and samples.

☞ There is a potential that from now on more enthusiasm could result in a high degree of involvement which will lead to

– a higher motivation of the participants to aim high in difficult times
– some financial benefits after changed practice
– sustainable growing practices
– an even better cohesion of the regional grapegrowers and winemakers
– attraction of researchers to perform replicated trials in well known sites
– an enhanced image of the grapegrowing and winemaking skills of W Victoria.

☞ Some observed phenomena seemed to correlate to site conditions and growing practice. Proper testing of those relationships in replicated trials must follow to understand these observations.

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7. References

Coombe, B.G. and McCarthy, M.G. Dynamics of grape berry growth and physiology of ripening. Aust. J. Grape and Wine Res., 6, 131-135, 2000.

Downey, M.O., Harvey, J. S. and Robinson, S.P. Analysis of tannins in seeds and skins of Shiraz grapes throughout berry development. Aust. J. Grape and Wine Res., 9, 15-27, 2003.

Downey, M.O., Harvey, J. S. and Robinson, S.P. The effect of bunch shading on berry development and flavonoid accumulation in Shiraz grapes. Aust. J. Grape and Wine Res., 10, 55-73, 2004.

Gladstones, J. Viticulture and Environment. Winetitles, 1992.

Habertson, J.F, Kennedy, J.A. and Adams, D.O. Tannin in skins and seeds of Cabernet Sauvignon, Syrah and Pinot noir berries during ripening. Am. J. Enol. Vitic. 53 (1) 2002.

Haselgrove, L., Botting, D., vanHeeswijk, R., Hoj, P.B., Dry, P.R., Ford, C. and Iland, P.G., Canopy microclimate and berry composition: the effect of bunch exposure on the phenolic composition of *Vitis vinifera* L. cv. Shiraz grape berries, Aust. J. Grape and Wine Res., 6, 141-149, 2000.

Howell, S. Sustainable grape productivity and the growth-yield relationship. Am. J. Enol. Vitic. 52(3) pp 165-174, 2001.

Kliewer, W.M and Dokoozlian, N.K. Leaf area/crop weight ratios of grapevines: Influence on fruit composition and quality. Proc. ASEV Ann. Meeting, Seattle, pp 285-295, 2000.

Lowe, S. North East Victoria Wine Grape Quality Measurement and Benchmarking. Vintage 2004 Report to GWRDC.

Petrie, P.R., Cooley, N.M. and Clingeleffer, P.R. The effect of post-veraison water deficit on yield components and maturation of irrigated Shiraz in the current and following season. Aust. J. Grape and Wine Res., 610, 203-215, 2004.

Price, S.F., Breen, P.J., Vallaladao, M. and Watson, B.T. Cluster sun exposure and quercetin in grapes and wine, Am. J. Enol. Vitic., 46, 187-194, 1995.

Rolley, L. Wine Grape Quality Measurement and Benchmarking. Central Victoria, Vintage 2002 and 2003 Reports to GWRDC.

Smart, R. and Robinson, M. Sunlight into Wine. A handbook for wine grape canopy management. Winetitles, 1992.

Smart, R. Dick, J., Garvett, I. and Fisher, B. Canopy management to improve grape yield and wine quality – principles and practices. S Afr J Enol Vitic Vol 11 No 1, 3-25, 1990.

Somers, C. The Wine Spectrum. Winetitles1998.

Spayd, S.E., Tarara, J.M., Mee, D.L. and Ferguson, J.C. Separation of sunlight and temperature effects on the composition of *Vitis vinifera* cv. Merlot berries. Am. J. Enol. Vitic. 53 (3), 2002.

Walker, R.R., Blackmore, D.H,., Clingeleffer, P.R., Kerridge, G.H. and Ruehl, E. Shiraz berry size in relation to seed numbers and implications for juice and wine composition. **.** Aust. J. Grape and Wine Res., 11, 2-8, 2005

Winter, E. Growing good Shiraz. Three years of Shiraz benchmarking studies in Victorian Vineyards. Australian Viticulture Jan/Feb. pp 61-64, 2005.

Winter, E. and Lowe, S. Benchmarking NE Victorian Shiraz, Season 04/05. GWRDC Report RT04/08a, 2005.

Winter, E. and Whiting, J. Using leaf area to crop weight to determine vine balance. Australian Viticulture Jan/Feb pp 70-73, 2004.

Winter, E. Whiting, J. and Rousseau, J. Winegrape Berry Sensory Assessment in Australia. Winetitles, 2004.

Wolf, T.K., Dry, P.R., Iland, P.G., Botting, D., Dick, J., Kennedy, U. and Ristic, R. Response of Shiraz grapevines to five different training systems in the Barossa Valley, Australia. Aust. J. Grape and Wine Res., 9, 82-95, 2003.