Wine Grape Quality Measurement and Benchmarking

Vintage 2003 Report

SOUTHCORP WINES

LAKE MARMAL VINEYARDS

NATIONAL Wine&Grape Industry CENTRE

UniSA

Bendigo.
Gundagai.
North East Victoria.
Perricoota.
Swan Hill.

Assigning Sampling Locations in Vineyards.

Assessments of Vineyard Pre-Harvest.

Analysis of Berries for compounds influencing quality.

Making small lots of wine.

Assessment of Wine Quality.

Analysing data and extracting meaningful results.

Reporting: What makes good wine? What do these vineyards look like?

Predicting: Those grapes that will make good wine.

Key Findings:

Grape quality and data this season were detrimentally influenced by rain damage prior to harvest in many regions. In addition, data from North East Victoria was unusable due to smoke tainted wines caused by bushfires over summer.

Vineyard Assessment and Berry Analysis:
It proved difficult to assess quality in the vineyard in the 2003 vintage. Many vineyards displayed similar vine characteristics. There were weak relationships between objective vineyard measures and resulting wine quality.

Berry Analysis proved more reliable in predicting grape quality than vineyard measures. However to gain the full benefit of the data, detailed statistical analysis and modelling is required.

Predictive quality models identified different parameters over the past two seasons and as a result the models do not work well for different seasons, i.e. the model developed this season cannot be guaranteed to work next vintage.

It was also noted from analysis of results that variability in berry colour (anthocyanin) measures within a vineyard led to poor wine quality as did consistently low berry colour (anthocyanin) levels within a vineyard.

Most regions had a spread of vineyards producing high and lower quality wines. This is encouraging as it places the emphasis of quality back to the management of a vineyard.

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Introduction:

This report is not a full scientific report; it is compiled to simply communicate findings from a Shiraz quality measurement and benchmarking project.

For the sake of this research project, quality is defined as the potential end use and style of grape and wine that will be valued more highly in the marketplace. This season a score out of 20 was used to assess the quality of characteristics of the medium to full bodied red wines. In the previous system a winery assessment of fruit was used to measure end use quality.

This research was completed with scientific principles and statistical validity, in order to produce valid and meaningful results. The sampling techniques, analytical measures, small lot winemaking and statistical analysis have been methodical and reliable so as to eliminate experimental error.

This report simply gives brief results to participants in the project. The information in this report can and should be used for the following purposes:
Measurements that can be used in the vineyard to assess potential grape quality.
Measurements from Berry Analysis that can be used to assess potential wine quality.
How specific vineyards are performing against vineyards in their region, and other regions.
What are these measures saying about specific vineyards and management techniques?
Is high quality fruit worth striving for in a region and will there be a financial reward?

Project Goals:

This project was comprised of two main objectives: To research objective quality measurement of Shiraz grapes and allow Shiraz growers to benchmark their vineyard's performance against others in and outside their region.

The research component was designed to investigate:

1. What higher quality vineyards look like prior to harvest?
2. What the composition of higher quality berries was? and
3. What relationships vineyards and berry analysis have with resulting wine quality?

Additional benefits are also available to participants such as liaising with winemakers in vineyards, objective viticultural assessment of blocks, seeing vineyards across their region and how they have been managed and most importantly a chance taste wines, discuss results with Patrick Iland and other participants at the debrief session!

Project Details:

The short version:
There were a few people in the industry who thought it a good idea to research objective quality measurement and benchmark vineyard performance. Vineyards were willing to share information and participate in the research. There was a cost to growers of time to provide information, phone calls, travel, setting up trial sites, picking berries and sending them for analysis and picking 150kg of grapes at the worst time of year – grape harvest. Vignerons were found in Bendigo, Gundagai, North East Victoria, Perricoota, and Swan Hill; who thought that it would be a good idea to benchmark their property and participate in researching objective quality measurement. There were 42 vineplots of Shiraz grapes included in the trial from across these regions.

Each Shiraz vineyard block (vineplot) was assigned three sampling locations of 40 grapevines. These 120 grapevines were used for vineyard character assessments, berries for chemical analysis and also 150kg of fruit for small lot winemaking. The three sampling sites also allowed analysis of variation between these three sampling locations.

Each site, labelled A, B and C in a vineplot was assessed prior to harvest and the data recorded on a hand held PC.

The following vineyard attributes were measured objectively where possible:

Shoot Length - how long was the average shoot length?
Shoot Length variability - what variation was evident in shoot length?
Shoots Trimmed - had the shoots been trimmed?
Shoot Periderm - to what extent were the shoots lignified?
Leaf Condition 1 - what was the condition of the first 5 leaves?
Leaf Condition 2 - what was the condition of subsequent leaves?
Fruit Exposure - what proportion of fruit was exposed?
Leaf layer number - how many leaves were concealing the fruiting zone?
% light at fruit - how much light was getting to the fruit zone?
Spread of fruit - how well was the fruit spread out?
Fruit Zone height - what was the height of the fruit zone?
Fruit Zone width - what was the width of the fruit zone?
Berry size - how large were the berries?
Berry colour - what colour were the berries?
Berry shrivel - how much had the berries shrivelled?
Flavour intensity - how intense were the fruit flavours in the berries?
Sugar / acid - what was the sugar acid balance like?
Skin chewiness - how chewy were the skins?
Tannin intensity - how intense were the tannins?
Seed lignification - how lignified were the seeds?
Crop load - did the crop load appear balanced for the amount of canopy?

At harvest or approximately 13.5 Baumé a sample of berries was picked from each sampling site and sent to Myrrhee Consulting Services for determination of the following:

berry weight - what was the average berry weight?
skin weight - what was the average skin weight?
seed weight - what was the average seed weight?
% skin / berry - what proportion was the skin to the whole berry?
% seed / berry - what proportion was the seed to the whole berry?
Baumé - what was the Baumé level of the juice?
anthocyanins / g berry – what concentration of berry colour (anthocyanins) was in the skins?
phenolics / g berry – what concentration of phenolics were present in the skins?
flavonols /g berry – what concentration of flavonols were present in the skins?
Seed extract 280nm – what concentration of phenolics was present on the surface of the seeds?

Picture – Most of the benchmark growers would have met Dustin who was in charge of transporting the grapes to Wagga Wagga.



This was the day the bearing seized on the trailer and the wheel fell off. There were many challenging days involved in the collection and transport of grape samples to Wagga Wagga at the busiest time of the year for a grape grower.

At the same time as the berries were sampled and posted for chemical analysis, 150kg of fruit was picked from every vineplot for small lot winemaking at Charles Sturt University, Wagga Wagga. The transport of grapes to Wagga Wagga from these five grape growing regions was a massive task. These grapes were made into three wines of approximately 30 litres each.

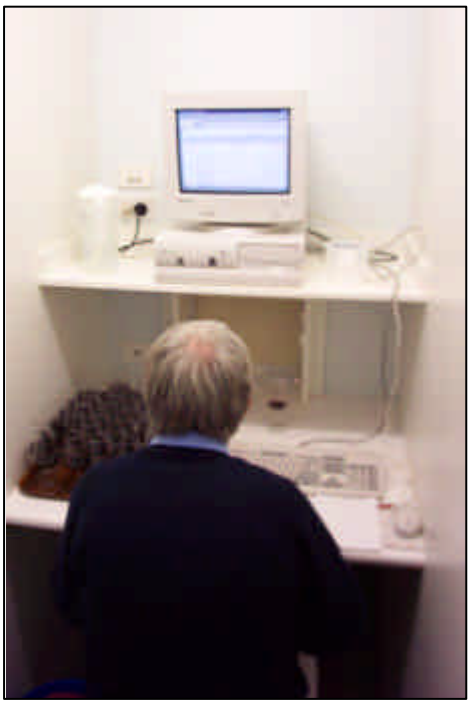


Picture - The Experimental Winery in Wagga Wagga. Patrick Iland, Ido Syrchin and Mark Bradshaw are assessing the wines for faults.

Ido was in charge of the small lot winemaking. The success of the wines is largely due to Ido's diligence and skill. Ido was studying at Charles Sturt University and landed the small lot winemaking for our research project as part of his industry placement.



The assessment of wines: Preparation of the samples for the tasting panel. Trays of 38 wines were poured and assessed by winemakers and industry personnel.



Wine assessment and data entry.

Following winemaking, the wines were assessed for the following:

Average Wine Quality
Colour
Flavour Concentration
Flavour Complexity
Confectionary Flavours
Raspberry Flavours
Plum Flavours
Spice Flavours
Tannin Description.

After these measures were completed the data was analysed for statistical correlations and relationships between vines, berries and the wine.

The data collected and results obtained are contained in the report as follows:

Data, Results and Charts:

This season there have been some issues that have affected the results we have achieved. These have included:

- ⇒ Rainfall events at harvest, lead to significant splitting and detrimental effects on quality in some Shiraz blocks in the project.
- ⇒ The wine scoring system only uses results between about 13.5 and 16.5. This makes it difficult to predict wine quality on such a finely incremented scale.
- ⇒ The effect of the drought allowed good control of growth with irrigation management. Many of the vineyards across the regions ended up with similar vineyard characters.
- ⇒ In the Victorian Alpine region smoke caused by bushfires caused severe smoke taint in all these wines. No data from this region was able to be used for analysis.

All results have been defined by a sensory wine tasting using winemakers or wine industry personnel skilled in the assessment of wine. All wines have been scored and results complied to give a final wine score out of 20. All wines were in the range of 13.5 to 16.5. This wine score has been used in all the results to determine which vineyard and berry measurements were related to quality.

Table 1 – Averages and Standard Deviations for Berry Analysis.
This table contains vineyard Identification, region, the wine quality score and all the berry analysis. In addition there are some columns next to measures that contain St D or Standard Deviations. This is a measure of the variability between the three sampling sites, high Standard Deviations mean high variability and in some assessments (eg Anthocyanin) relates to lower quality.

Table 2 – Vineyard Characteristics.
The table of Vineyard Characteristics contains the Vineyard Identification and all the measures that were taken in the vineyard. Higher values indicate more of the particular category was measured. Some data was not available to complete this table for every vineyard.

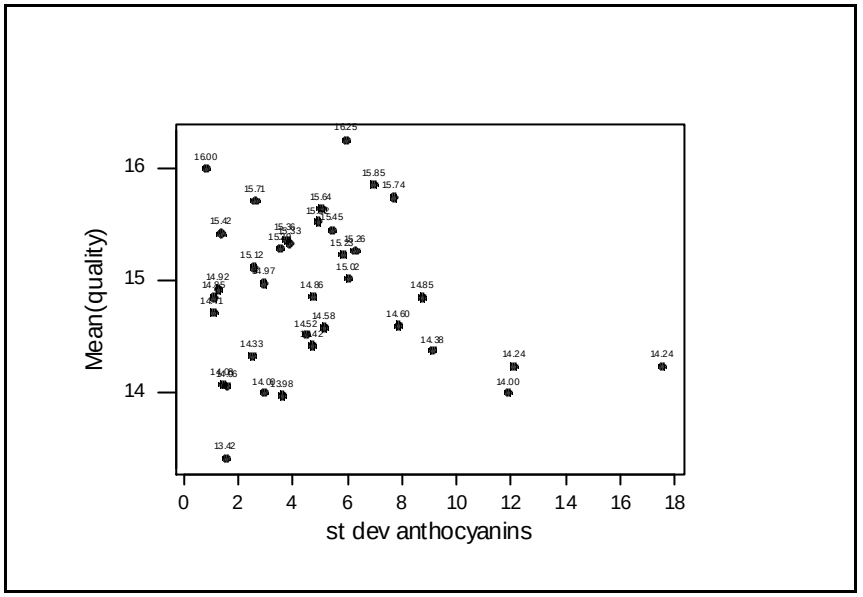
Table 3 – Wine Scores and Wine Characteristics.
Wine Scores and Wine Characteristics contain all the data from the wine assessment. Higher values indicate higher concentrations of the attribute being measured. It is also noted that high quality wines tend to have more plum flavours and less confectionary flavours.

Chart – Average Wine Score.
This chart simply depicts the range of wine scores and specific vineyard values. Regions are shown in colours. There appears to be a good spread of regions across wine scores.

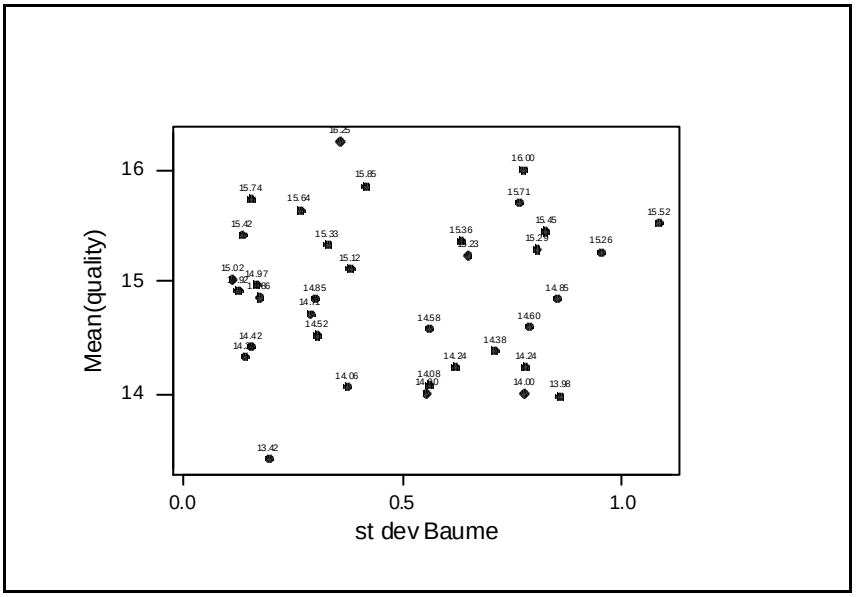
It is important for growers participating in the project to closely examine this chart and see how their vineyard is performing. This can be explained by looking to the key parameters influencing quality such as Vineyard: Leaf Layer, Colour and Periderm Development of Shoots. Then at the berry analysis categories such as Baumé, Berry colour (anthocyanin) and Berry Size. It may also be a good check to look at vineyard uniformity and whether this has detrimentally affected quality – this is found as a Standard Deviation in Table 1.

Chart – Wine Score v's Crop Level.
This chart shows each individual vineyard with a wine score and a crop load. Higher performing vineyards tended to be cropping at less than 9 tonnes per hectare, however lower performing vineyards were cropping at high and low levels.

Variability Charts.



This Chart shows how much variation was present in Berry colour (anthocyanin) between the three vineyard Sampling Sites. Vineyards with a Standard Deviation greater than about 8 have not made wine with a score of 15 or greater. Variability in colour across a block appears to be detrimental to wine quality. It is also possible to have consistently low colour across a block and achieve a low wine score.



This chart shows that Baumé has a large range of Standard Deviations (variability) across vineyards. There appears to be no relationship between the variation in Baumé within a block and the resulting wine quality.

What makes Good Wine – What do these vineyards look like?

Vineyard Assessment – Can we predict Wine Quality in the Vineyard?

Vine parameter	Correlation with final wine quality
Shoot Length	-0.20
Shoot Length variability	0.07
Shoots Trimmed	-0.22
Shoot Periderm	0.37
Leaf Condition 1	-0.03
Leaf Condition 2	0.38
Fruit Exposure	0.38
Leaf layer number	-0.47
% light at fruit	0.10
Spread of fruit	-0.37
Fruit Zone height	0.01
Fruit Zone width	0.03
Berry size	-0.34
Berry colour	0.43
Berry shrivel	0.01
Flavour intensity	0.26
Sugar / acid	-0.14
Skin chewiness	0.28
Tannin intensity	0.11
Seed lignification	-0.15
Crop load	-0.17

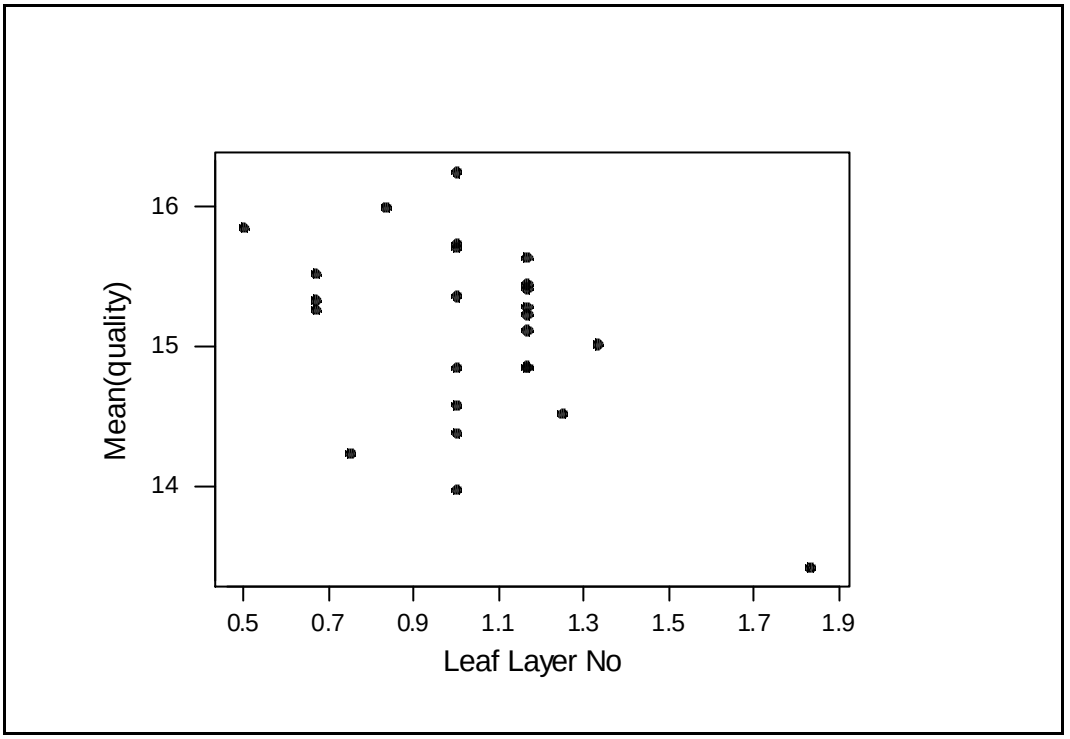
Table: Vine Parameter and Correlation with final wine quality.

The higher the number, the more this vineyard character is related to quality. For example high values such as Leaf Layer Number and Berry Colour have the largest influence on quality. Leaf Layer Number is also negative – this means that as leaf Layer Number decreases, i.e. less leaves between the fruit zone and sunlight; then quality increases. Berry colour is positive; therefore as berry colour increases so does the quality of the fruit.

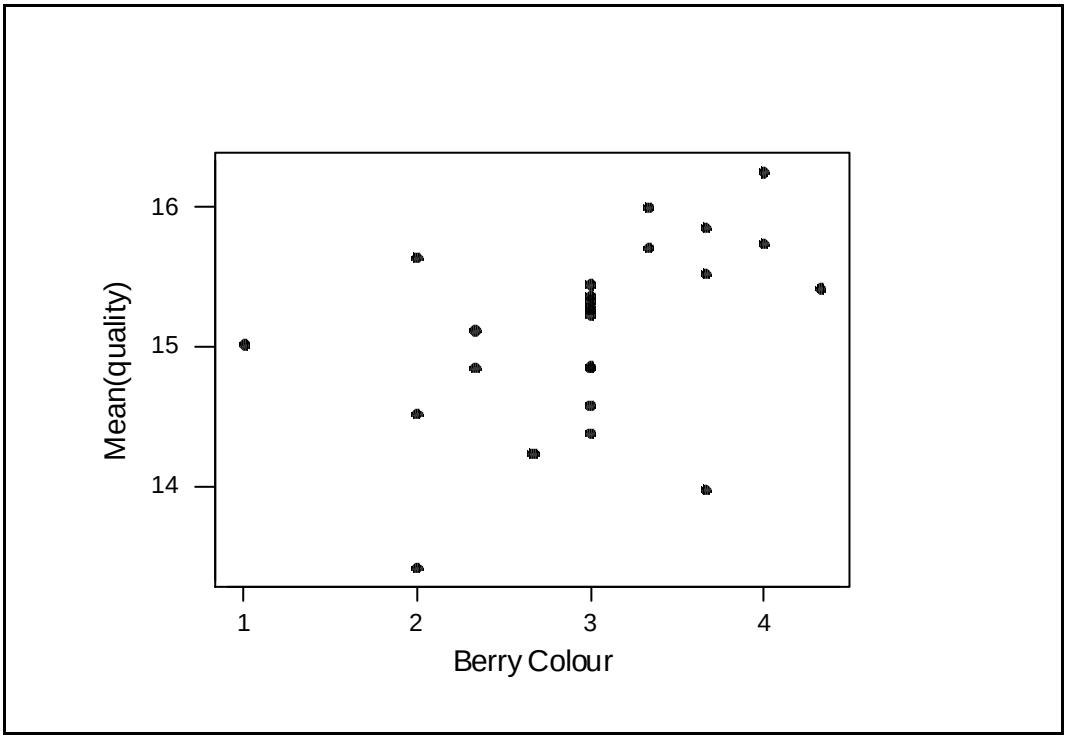
Generally the correlations in this table are not high enough to be significant indicators of quality, with -.47 coming in as the highest value for Leaf Layer Number. In the 2002 Vintage we had correlations of -.72 for periderm development and -.66 for berry size. The 2003 vintage resulted in a smaller degree of variation between vineyards which is likely to have lead to this compression of results and poorer correlation with vineyard characteristics.

Some of the indicators such as fruit exposure (0.38), spread of fruit (-0.37) and leaf condition 2 (0.38) all tend to suggest a moderately open canopy with healthy leaves rather than a dense shaded canopy will result in better quality fruit.

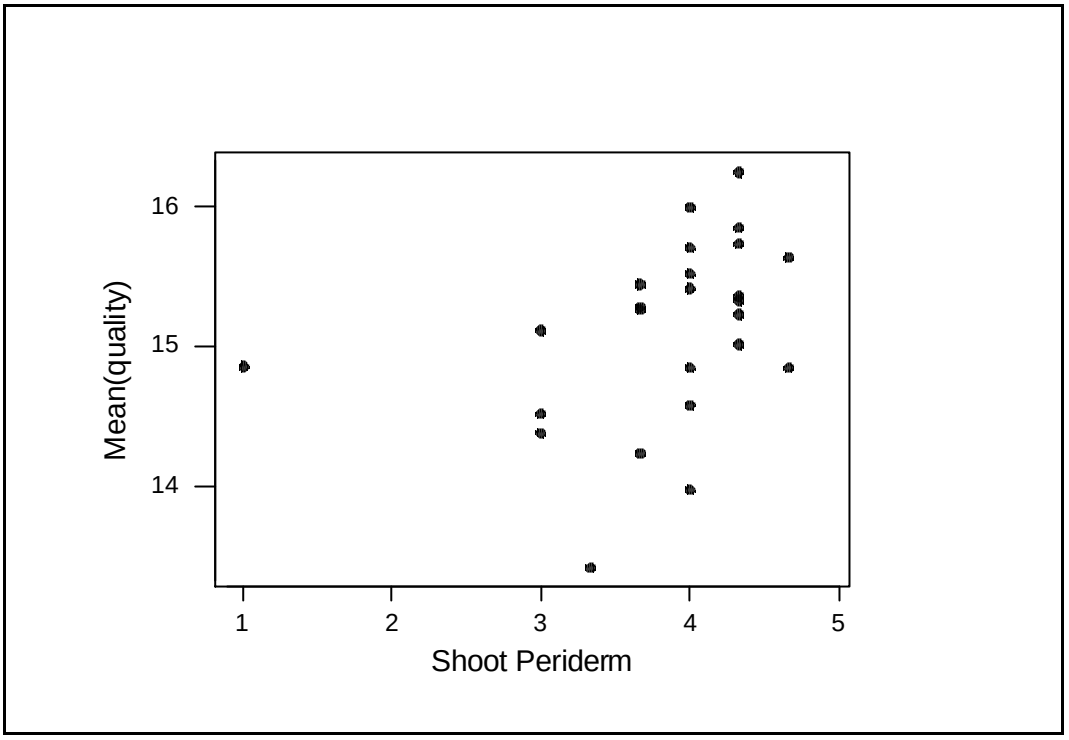
Shiraz grape growers should not disregard these results as they simply reflect what happened in the 2003 (drought) vintage. It is important to aim for full lignification of shoots, controlled berry size and appropriate canopy exposure as these aspects still had the best correlation with wine quality.



Leaf Layer Number: Shows the trend that as Leaf Layer Number decreases, there is an increase in Quality. In the project this year, vineyards that generally had more fruit exposure ended up with higher wine scores.



Berry Colour: As berry colour increases so does the quality of the resulting wine. This measure of berry colour is simply assessed in the vineyard as low, medium, high or vibrant.



Shoot Periderm or Lignification: Higher levels of Lignification of Shoots are giving Higher Wine Scores. The reason for this is that when grapevines undertake all their programmed functions at the right time; for example laying down lignin on canes. There is reserve in the plant that is able to be used in the berries to form colour and flavour compounds. If a vine has not completely lignified canes, then this process will compete with the assimilation of colour and flavour compounds in the berries.

Can we predict wine quality in the vineyard?
From the data we have collected over the past two years it would seem very hard and unreliable to be assessing the quality of fruit by looking at the vineyard characteristics. One measure which is likely to assist in this determination, having the fruit tasted by an experienced winemaker for flavour intensity prior to harvest. It was difficult to get an accurate assessment of grape quality by assessing the vineyard in the 2003 season.

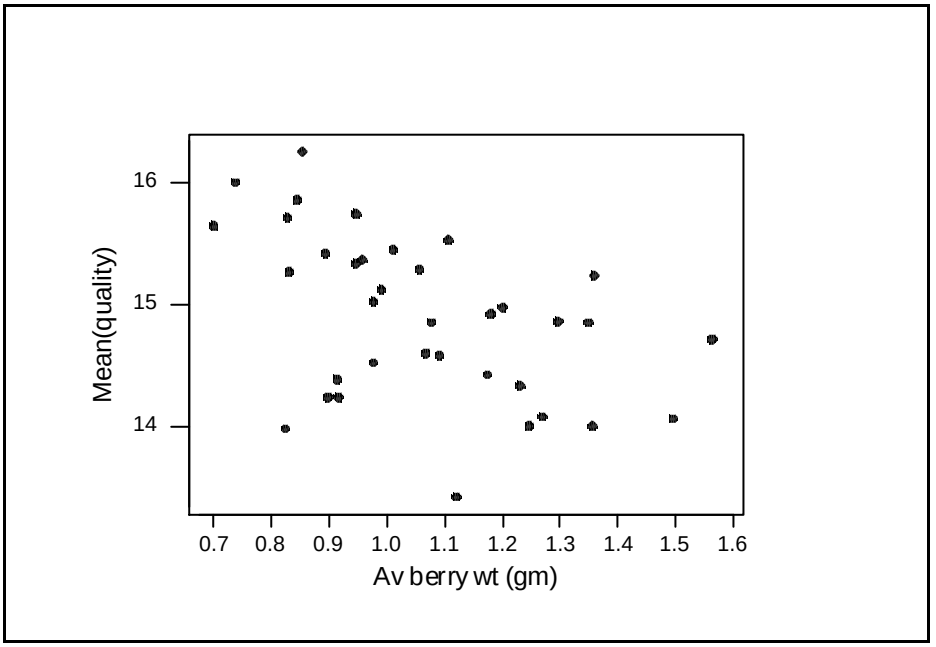
For a vineyard to achieve high quality fruit it typically requires; good lignification of shoots, smaller berry size and appropriate levels of exposure.

Berry Analysis – Can we predict Wine Quality from Analysis of Berries?

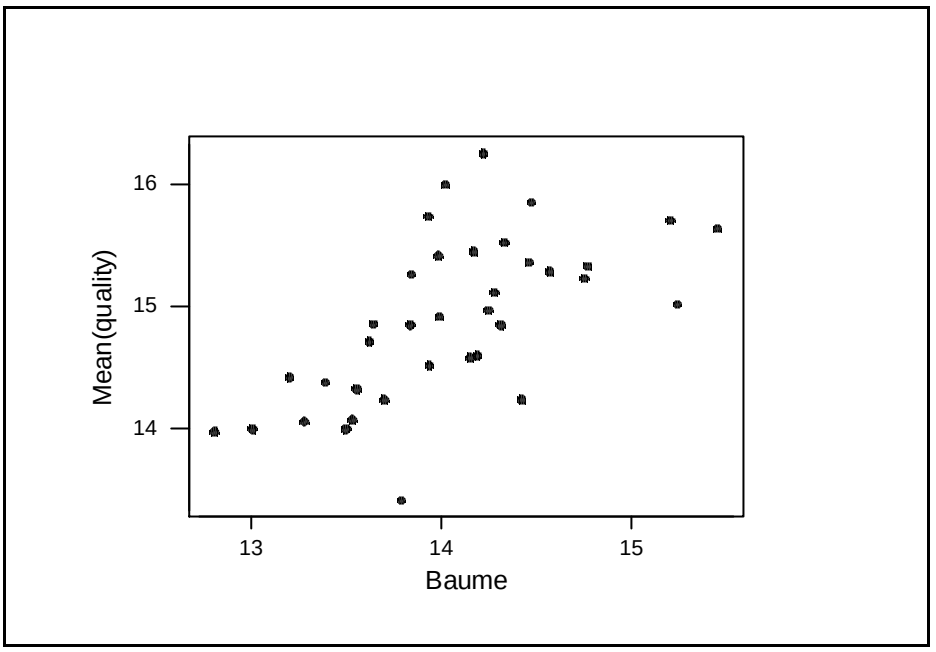
Berry parameter	Correlation with final wine grade
berry weight	-0.48
skin weight	-0.36
seed weight	-0.29
%skin/berry	0.37
%seed / berry	0.25
baume	0.63
anthocyanins / g berry	0.68
phenolics / g berry	0.54
flavonols /g berry	0.51
Seed extract 280nm	0.16

Table: Berry Parameter and Correlation with final wine grade.
Similar to the Vineyard Parameters and wine quality, as the correlation figure increases, so does the relationship with the listed measure. With a negative measure, for example berry weight; this is a negative correlation which means that as berry size decreases there is a correlation with an increase in the wine grade.

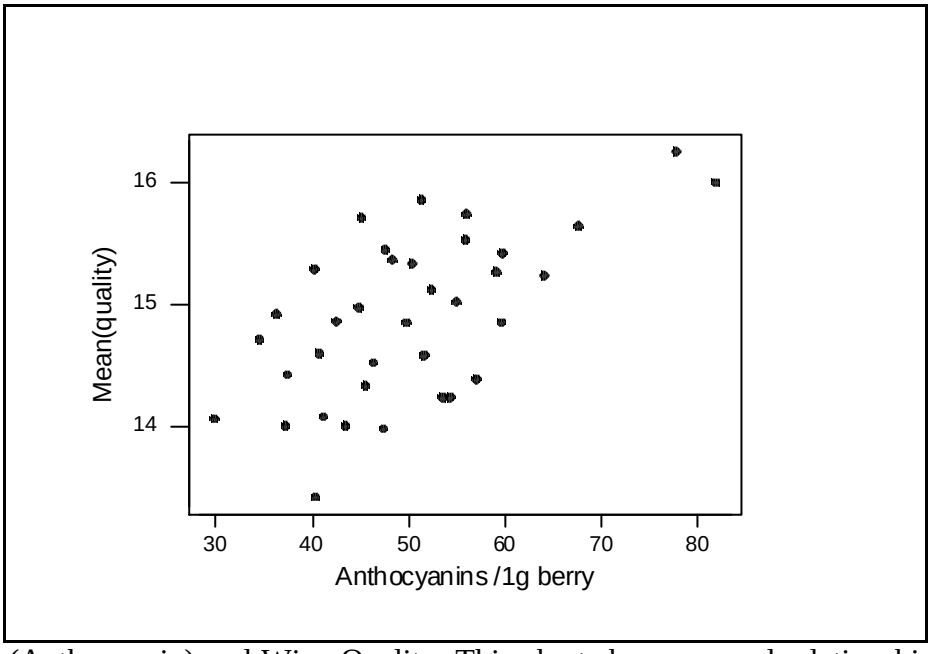
The two most significant measures this season are Baumé and berry colour (anthocyanin). Although not perfect the higher these two measures were the higher the resulting wine grade is likely to be. Please refer to the charts below for details.



Berry Weight and Wine Quality: This chart illustrates a general trend that as berries become smaller it is likely that they will achieve a higher wine grade.



Baumé and Wine Quality: This chart shows a general trend that as Baumé increases so does the resulting wine quality; however the best four wines are in the range of 14 – 14.5 Baumé.



Berry Colour (Anthocyanin) and Wine Quality: This chart shows a good relationship with Colour and the resulting wine quality, although there is some scatter in the chart. It is also easy to note that the two best wines contained much more colour than the others.

Can we predict wine quality from analysis of berries?
It is difficult to predict wine quality from the berry analysis. The analysis of berries gives a much better indication than the vineyard assessment, as the correlations with wine quality are much higher. It is encouraging to see smaller berries, high anthocyanin and Baumé levels, as in the 2003 vintage they were more likely to lead to higher quality fruit.

Consistently high berry colour (anthocyanin) levels across the three sampling sites in a vineyard also appear to be a key criterion to achieving high quality. This is shown on Table 1 by looking at the Standard Deviations of Anthocyanin and Quality Score. Visually this can be seen on the first chart in the results section looking at Standard Deviation of Anthocyanin against Wine Score.

In the 2003 season berry analysis gave better indications of quality than vineyard assessments. However to achieve better powers of predicting grape quality we need to utilise some predictive modelling techniques.

How do we predict the better wines?

By using a combination of berry measures we can start to more accurately predict the wine quality.

The model below utilises seed weight, baumé, berry colour (anthocyanin) and the Standard Deviation of Anthocyanins (variability in colour) to give a predictive model with confidence level of 71.3%

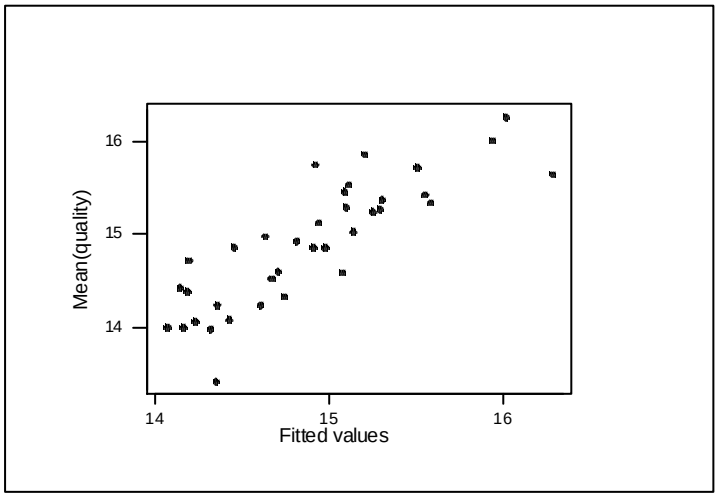
This basically means that in 2003 good wines had low seed weight, high baumé, high berry colour (anthocyanin) and low variability in colour.

For those statistically inclined here is how it works ….

```
The regression equation is
Quality= 7.46 - 19.1seedwt + 0.548Baume + 0.0266Anthocyanins - 0.0596st dev anthocyanins

Predictor        Coef     SE Coef          T        P
Constant        7.460       1.570       4.75    0.000
seed wt       -19.074       6.084      -3.13    0.004
Baume          0.5480      0.1172       4.68    0.000
Anthocya     0.026644    0.006376       4.18    0.000
st d ant     -0.05959     0.01857      -3.21    0.003

S = 0.3818      R-Sq = 71.3%     R-Sq(adj) = 67.6%
```



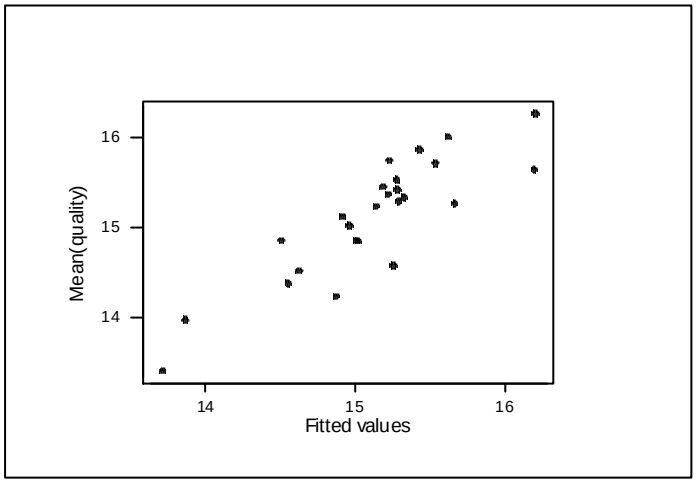
This plot has the fitted or predicted values of this model against the actual final wine grade. It is evident that there is still some variation of results.

It is possible to make the model more accurate by combining both the berry analysis data (specifically anthocyanins, baumé and seed weight) and the shoot length variability from the vineyard assessment. This gives a prediction model with confidence of 76.4%, this means that the model generally works but there is some scatter of results.

```
The regression equation is
quality= 4.72 + 0.0276Anthocyanins + 0.686Baume - 22.3seed wt + 0.352Shoot Length Varia


Predictor        Coef     SE Coef          T        P
Constant        4.723       2.059       2.29    0.033
Anthocya     0.027566    0.007182       3.84    0.001
Baume          0.6855      0.1317       5.20    0.000
Seed wt       -22.290       6.354      -3.51    0.002
Shoot Le       0.3524      0.1351       2.61    0.017

S = 0.3520      R-Sq = 76.4%     R-Sq(adj) = 71.7%
```



This plot shows the fitted or predicted values against the actually wine score. Generally the model is good with low predictions actually having a low wine score and vice versa. However there is still a certain amount of uncertainty in the results.

Can we use this model every year to predict grape quality?

The short answer is no. When comparing these models with those that were generated from last years data there is a discrepancy and the models do not work across years. This simply means that the model worked well for the 2003 vintage but there will be a different model depending on the seasonal variation and climatic influence.

We are confident that the small lot winemaking was a good indication of grape quality from the block it was taken from, this is likely to be the best measure of assessing quality that we have for the vintage.

It is likely that a much larger data set would be required to accurately use a predictive model, where climatic parameters are used to determine the important vine and berry parameters to measure in a given season. It is obvious that as the seasons are vary so are the desired berry and vine structures which are leading to high quality.

Future Directions for Research.

Variability and Management effects on wine quality.
After pondering over the data and results we have obtained over the past few season there are some questions that we still no not seem to have answers for, such as: What effect does variability within a vineyard have on resulting wines and what management practices alter wine quality. These are the two questions that we will be endeavouring to find answers to in the future.

This will involve the use of large trial sections in large vineyards with a number of management practices being employed to try and differentiate wine styles. These results will be more focused at the management of vineyards and will be more useful to the general viticultural community. This data will also be used to try and refine our predictive grape quality techniques.

As it exists at the moment the benchmarking project across regions will not be continuing, however procedures and funding are available to regions who are interested in pursuing it in the future.

Acknowledgements:

Special thanks to the following, without them the project would not have happened:

Shiraz Vignerons …..
For this type of research and benchmarking to occur it involves a large and costly effort. The vineyards involved in this season were excellent, accurately sampling vineyards at the busiest time of the year, without their assistance it would not have happened.

Patrick Iland for his tireless work in ensuring that the project was designed and executed correctly.

Southcorp Wines P/L.
Mark Smith for his advice and expertise and the inception of the program.
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Thanks to Ross Polglase who travels the countryside coming up with good ideas and promoting the project.