McLAREN VALE
GRAPE, WINE
& TOURISM

Vineyard Measurement and Berry Sensory Analysis for Shiraz



FINAL REPORT to

GRAPE AND WINE RESEARCH & DEVELOPMENT CORPORATION

Project Number: RT ***03/27-4***

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Davidson
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McLaren Vale Project

Vineyard Measurement and Berry Sensory Analysis for Shiraz.

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Report prepared by

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EXECUTIVE SUMMARY

This Project, throughout the 2004/05 growing season, achieved its objective of using vineyard assessment, berry sensory and analytical assessment to differentiate between six Shiraz blocks in the McLaren Vale Region.

As a small-scale investigation, inferences were noted, rather than statistical relationships determined.

Some differences in canopy characteristics appeared to be associated with some fruit flavour characteristics, ie, in a canopy of moderate vigour leading to exposed fruit there was more intense flavoured and balanced fruit production.

Canopy vigour is a product of inherent site vigour and management practices; the latter needing more attention on higher vigour sites to achieve a favourable canopy.

The final step in the Project was to investigate if any characteristics could be related to final wine quality. This was not possible due to variability in the small wine batches, which made ranking of the wines difficult. This will be addressed in the following year of the Project.

Extension of the vineyard assessment procedure to growers, for use in their own vineyards, was started in the first seminar. It will be expanded upon in the July 2005 seminar, with these results being disseminated. More encouragement of the growers involved is needed in the 2005/06 season. Involvement of wine makers is critical and should be encouraged and acknowledged.

1.0 BACKGROUND TO PROJECT

Shiraz is the predominant variety grown in the McLaren Vale Region with many of the plantings around 10 years of age. In the current wine industry climate there is significant emphasis on being able to manage vines to achieve a desired end use to meet winery specifications.

This project investigated at Shiraz vineyards in McLaren Vale to see if any correlation could be drawn between canopy and fruit characteristics and the resulting wine quality in order to benchmark blocks within this region. Wine made from each block was kept separate, and then assessed by a sensory panel to see if a correlation could be made between vineyard and fruit characteristics, and the resultant wine quality.

The project involved a small working group of grower liaison officers and viticulture sub-committee members, the Winegrowers Development Group's Viticulture Officer, winemakers and some growers from the selected vineyards. The project was managed by Libby Tassie from Davidson Viticultural Consulting Services (DVCS) (also see Acknowledgements).

A workshop was held at the time of veraison to outline the aims of the project and protocols used for the vineyard assessment to interested growers. A second workshop will present the findings of the first year of the Project to growers.

2.0 PROJECT OBJECTIVES

The project was seen as primarily an extension exercise, with the following three aims.

1. To use canopy assessment, berry sensory and analytical assessments of Shiraz to benchmark blocks within the McLaren Vale Region.
2. To involve growers and winemakers in the vineyard assessment process in order to stimulate discussion and facilitate learning, whilst providing guidelines for fruit assessment in the vineyard.
3. To stimulate discussion and to generate ideas for improving management and evaluation of management based on the outcomes of the assessments.

3.0 PROJECT METHODOLOGY

3.1 Block Selection

Six vineyard blocks were selected by the grower liaison officers from the three companies involved - Wirra Wirra, Southcorp Wines and Hardy Wine Company. The vineyards were selected to represent a difference in end use, ie, each winery chose one vineyard with fruit typically producing high quality wine, and one that produced lower wine quality. All vines were approximately 10 years of age, with the exception of D which is 35 years old, representing the majority of Shiraz plantings in the district. The blocks selected were from around the Region on a number of differing soil types.

Block A - McLaren Vale
Block B - Willunga
Block C - McLaren Flat
Block D - McLaren Flat
Block E - McLaren Flat
Block F - Blewitt Springs

3.2 Project Workshop

A workshop was held in January (pre-veraison) to explain the Project and demonstrate the assessment process in the field. Forty growers attended this workshop. Two vineyards were selected to represent two different examples of canopies, one at Willunga on red brown duplex and Biscay alluvial soil and the other at Blewitt Springs on Blewitt Springs sands, and of greater vigour than the first vineyard.

The growers were taken through the assessment sheet at each vineyard at one of the sites selected, and were also told about the vineyard by the respective Grower Liaison Officer (GLO) or grower, or both.

3.3 Block details

Management practices were summarised, and soil types and data were collected as an additional part of the project; see Appendix 1 and 2.

3.3.1 Soil Assessment

Soil pits were dug for profile description (see Appendix 2) and soil samples taken from 30cm and 50cm for a chemical analysis (see Appendix 2). These were carried out at one site only in each vineyard. The chosen sites were considered to be most representative of the majority of the vineyard, or of the final wine batch to be assessed. The water holding capacities have been calculated using the Wetherby method (Soil Descriptions, K Wetherby, 2003), (see also Appendix 2).

Site A **–** This soil pit showed primarily red brown duplex soil, with roots at depth, down into the clay subsoil (~ 660mm). The soil pit analysis shows good soil structure in the effective root zone with numerous roots in the top 100cm. The soil is more compact and less penetrable at lower depths and is the main limitation to deep root penetration. The chemical analysis of this soil show low phosphorus levels and slightly low organic carbon levels at the 50cm depth. It is not common to have high levels of organic carbon below the topsoil, so in this case there is no detrimental effect on soil fertility, as shown by the Cation Exchange Capacity (CEC).

Site B **-** This site showed a duplex soil with slightly alkaline topsoil, clay loam underlying loam, with small roots distributed throughout. The soil pit analysis shows friable soils throughout the profile with limestone present at ~ 300mm and 700mm – 1m. The root distribution indicates that the major concentration is at 300mm of both small and large root size.

The chemical analysis of this soil shows low phosphorus and low exchangeable potassium, however this does not seem to be a limiting factor of fertility for this site.

Site C **-** The site was a relatively low fertility site with a deep dark grey, brown surface sand to yellow/brown sand overlying a clay subsoil of with fine roots distributed throughout the lower half of the profile. The soil pit analysis shows a profile of deep sands with soil structure restrictions at depth (1.5m). The mottling in the bottom layer in conjunction with the massive structure (480mm – 1.5m) indicates seasonal waterlogging, but may also explain the vines relatively high vigour. The chemical analysis of the soil shows some topsoil acidity and generally low nutrient status, however the main concern with this soil is the sodicity of the lower layer. This will limit further root development and should be noted as a management issue in the future.

Site D **-** This site shows a duplex brown clay loam with significant subsurface ironstone mottles overlying heavy clay. The soil pit analysis indicates dense subsurface clays with relatively even distribution of roots throughout the profile. Drainage and water holding capacity is aided by the high percentage of ironstone and gravel throughout the profile. The chemical analysis indicates significant soil acidity problems with both the topsoil and subsoil. The Ca:Mg is out of balance and causing structural problems in the lower half of the profile such as hard setting soils. Again phosphorus levels are low in addition to organic carbon. The organic carbon levels are not significantly low to require remediation at this stage.

Site E - This site displays well drained, friable soils above hard rock at 1.2m. There are many visible pores and roots distributed throughout the profile. The soil pit analysis indicates generally sandy loam surface over clayey subsoil with some subsurface mottling. The chemical analysis of the soils shows marginal to moderate soil acidity, but this is of no significance. Phosphorus, potassium and organic carbon levels are low, which is indicated in the low cation exchange capacities. The 30cm and 50cm samples have indicated sodicity problems especially at depth.

Site F - This site is generally typical of sandy sites with deep, low fertility sands over ironstone sheet rock. The soil pit analysis shows compacted soil @750mm below gradational sands and loamy sands. Roots are limited to the top 600mm of the profile and are relatively few in number compared with other sites. The chemical analysis describes strongly acidic upper sections of the profile with moderately acidic subsoils. Phosphorus is adequate in the topsoil, however is deficient in the subsoil. Potassium is very low throughout the profile. There are no structural problems with the soil however soil stability and erosion potential are concerning. Due to the sandy nature of the soil the fertility is low. The Relatively low RAW value calculated for this site may be due to the absence of clay at this particular site which is generally associated i.e. Blewett Springs Sands.

3.4 Canopy and Berry Sensory Assessment

Three sites were selected at each vineyard in consultation with the grape grower and the GLO, in an attempt to account for variability within the vineyard. Each site consisted of 2 groups of 20 vines in adjoining rows, marked with flagging tape. As only six vineyards were involved in this study, statistical analysis was not possible, but differences and tendencies were noted.

Vineyard assessment and berry sensory analyses were undertaken just prior to harvest (see Table 3.4.1) by the small team of viticulturists, growers and winemakers, with a consistent core of 2 viticulturalists and one or two wine makers who assessed all vineyards, plus wine makers from the vineyards being assessed. A modified version of the Southcorp vineyard assessment sheet was used (see Appendix 3). Assessments were made at each of the 3 assigned sites at each vineyard and took approximately 1½ hours for each vineyard.

When the fruit reached 11.5º Baumé the GLO's representing each vineyard maintained contact with the Viticultural Officer of the MVGWTA, in order to ensure the canopy and fruit was assessed as close to harvest as possible. All blocks were assessed between March 3rd, 2005, and March 29th, 2005, a day or so before harvest at each vineyard. Comments and suggestions on the assessment sheet were noted.

Table 3.4.1 Time of Vineyard Assessment for the six Shiraz Vineyards (immediately prior to harvest)

Vineyard	Date of Assessment
A	3/3/05
B	8/3/05
C	15/3/05
D	17/3/05
E	17/3/05
F	29/3/05

3.5 Berry Analytical Assessment

The fruit from each vineyard was sampled at two different times and analysed by the Australian Wine Research Institute (AWRI), for Brix, pH, Titratable Acidity, phenolics, and anthocyanins. The first time was at a similar, or "target baumé" for all sites, in this case 13.5º $\pm$ 0.5º, so that comparisons could be made between the different vineyards at a similar stage of ripeness, and the second at harvest. Samples were taken from each site at each vineyard, ie 3 samples per vineyard; 2 x 200 berries per site from 40 bunches per site.

An additional composite sample (2 x 200 berries) was taken as close as possible to harvest, to be as representative as possible to the resultant wine.

3.6 Winemaking

After much discussion within the group, the following course of wine making was utilised. Each winery vinified the blocks separately (a prerequisite for selection of the blocks). In

two cases (C and F), the vineyard was picked at two separate times, in which case at least two of the sites were still included in the wine followed through.

Once primary fermentation (to dryness) was complete, and before any wood treatment, 20 litres were racked off into an inert container. The wines were then delivered to Provisor, sulphured and maintained until bottling. This process relied upon a number of different people during a very busy time of the season and was therefore open to error.

The two major problems which occurred were partial malo fermentation, and the presence of some residual sugar from an incomplete primary fermentation.

3.7 Wine Evaluation

The wines were bottled and assessed early to try to pick up any fruit quality characteristics that could be attributed to vineyard influences.

The wines were evaluated and assessed by an experienced panel of the Region's winemakers, using a method following Patrick Iland's suggestion, and a final evaluation sheet compiled by Leigh Francis, AWRI and Jane Paull (see Appendix 7). It was specifically designed to pick up aroma and palate characteristics which could potentially correlate with those assessed in the vineyard fruit sensory assessment, and thus to see if there was any obvious relationship between the two. A linear scoring system was used for those characteristics.

A scoring system for assessing relative wine quality was also utilised.

4.0 FINDINGS

The full assessment sheets of the vineyards showed some variation between vineyards, plus within vineyard variability. This study was only of six vineyards with three sites within each vineyard, so basic observations and overall trends were observed rather than collating data for statistical analysis.

The winemaking batches similarly were non-replicated and merely kept separate in the winery until after fermentation, so again data was not collected for statistical analysis.

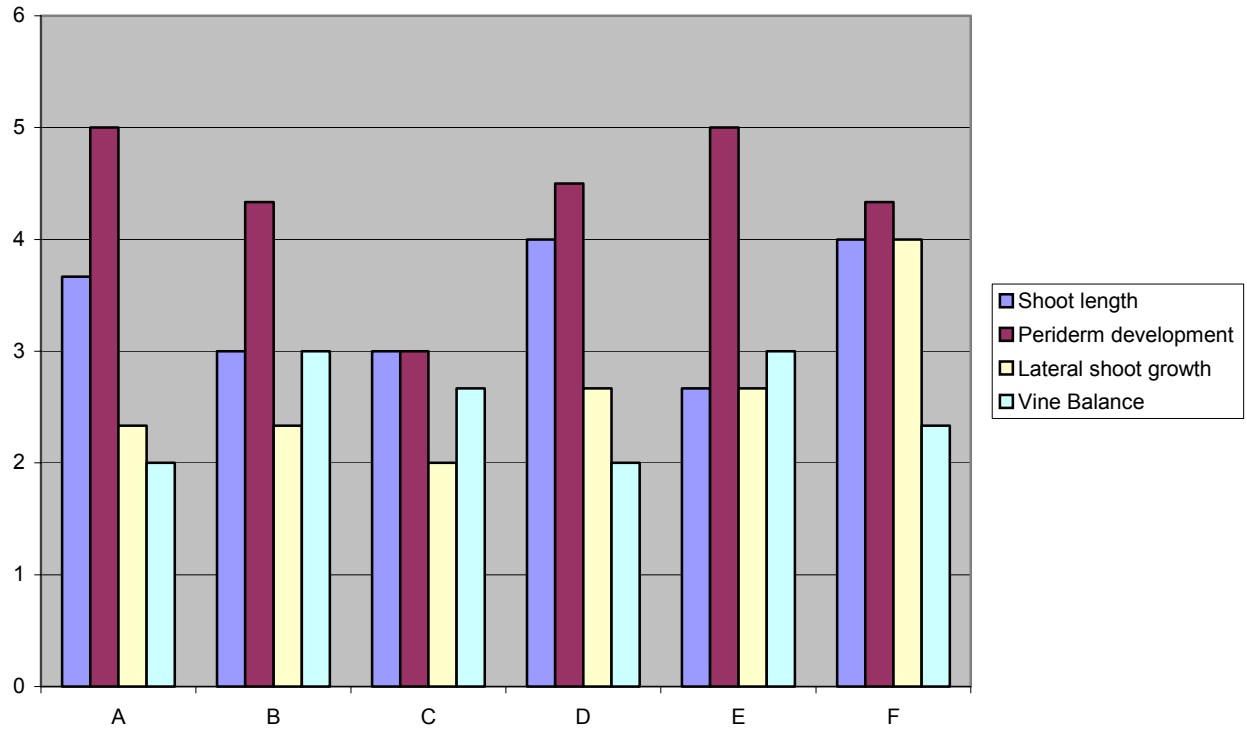
4.1 Canopy Characteristics

In looking at the canopy characteristics, it is useful to consider a number of groups as follows:

For a relative comparison, assessment scores have been graded in some characteristics – so the axes range from 0 to 6. Actual figures are in Appendix 4.

Shoot length, lateral growth and periderm development (lignification) give an indication of vine vigour and maturation stage.

Figure 4.1: Shoot length, periderm development, lateral shoot growth and vine balance assessed in the vineyard at harvest in the 2004/05 growing season



Shoot length in the range of 80 – 100cm would be considered of moderate vigour; >100cm indicated high vigour. There are some anomalies in these 6 vineyards – C which has relatively short average shoot length most likely due to the high shoot number from the machine pruning, and D which has relatively high shoot length as it has just been reworked.

F has a very high shoot length, but variable, and D and A had high shoot length (approximately 120 – 160).

Considering **lateral growth** in conjunction with shoot length gives a better idea of vine vigour. A and F both have high shoot lengths, but A has very few laterals, whereas F has moderate lateral growth. C with relatively short shoots also has low lateral growth (many shoots per vine noted, but not assessed in the formal assessment), and very low shoot lignification. Also noted, but not on a sheet, was high variability of shoot length and lignification at C.

Periderm development (shoot lignification) was lowest at C, with A and E the highest.

Vine balance, ie leaf area to crop load was visually assessed. Essentially the most balanced were B and E, with F assessed as balanced, but at higher absolute levels of leaf area and crop load.

4.1.1 Vine Leaf Condition

These characteristics aim to distinguish between healthy actively growing leaves or yellowing leaves due to stress (or senescence) or shading (raw results in Appendix 4).

C was the only vineyard that appeared to have yellow leaves due to shading (rather than stress) but leaf loss was relatively low at 10% on average. Of the other vineyards, D and B had the greatest leaf loss assumed to be from stress (average of 15 and 23%); B was more variable, possibly due to problems with the irrigation. D was unirrigated, so totally dependent on the rainfall. F had one site which was more stressed (20% leaf fall) and yellowing.

There were no growing tips evident, except on one site of D which is a reworked vineyard and therefore fewer buds were retained at pruning.

4.1.2 Fruit Environment within the Canopy

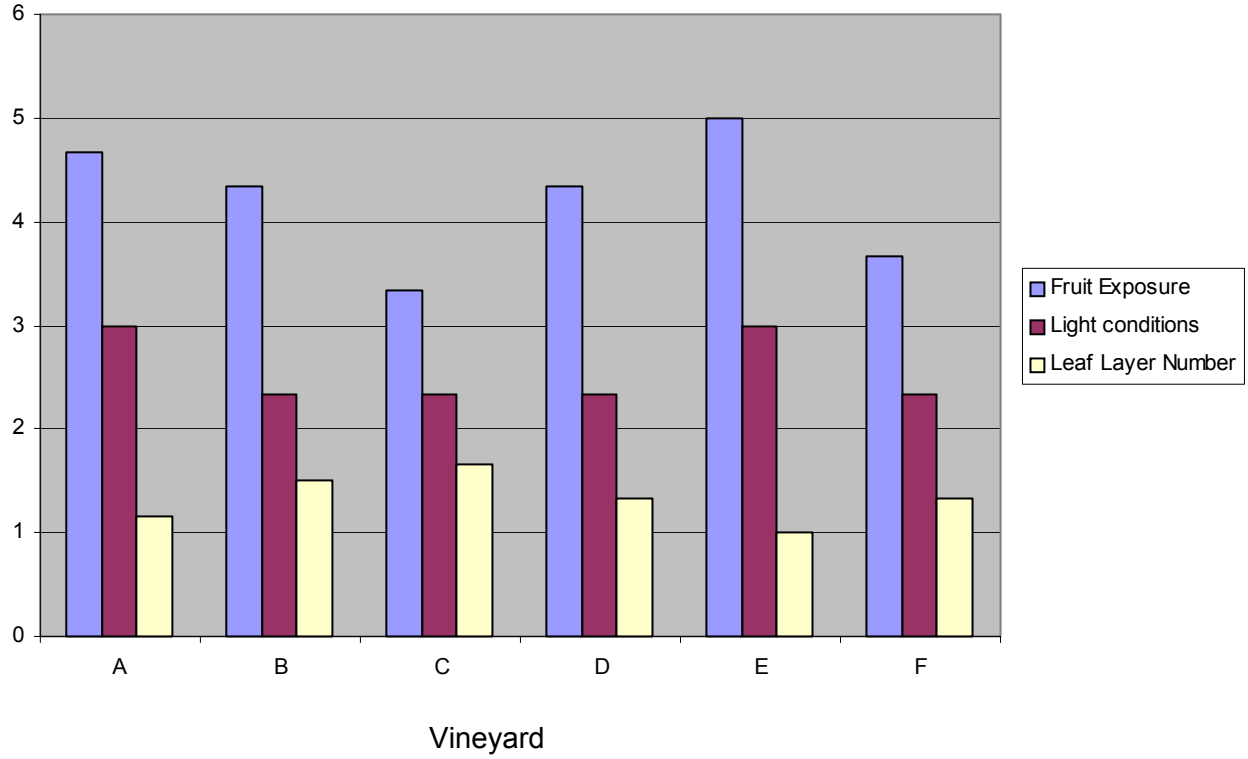
These characteristics gave an idea of the light environment created by the canopy experienced by the fruit at each vineyard.

Fruit exposure was highest at A (80 – 100%), E (80 – 100%), D and B (each 60 – 80%), and lowest at C and F (more like 50%, but one site 80 – 100%). F vineyard was leaf plucked, which obviously influences these characteristics.

Leaf layer numbers follow a similar trend with some variability showing between sites at C and F (some at B).

Figure 4.1.2: Fruit exposure, light conditions and leaf layer number within the canopy assessed at harvest in the 2004/05 growing season

The leaf layer number shows more consistency in vineyards A, D and E, with an average of 1 – 1.5 LLN; the other three vineyards have more variability and greater LLN evident. Light condition shows dappled light at A, and E, and more direct light at the other four vineyards.



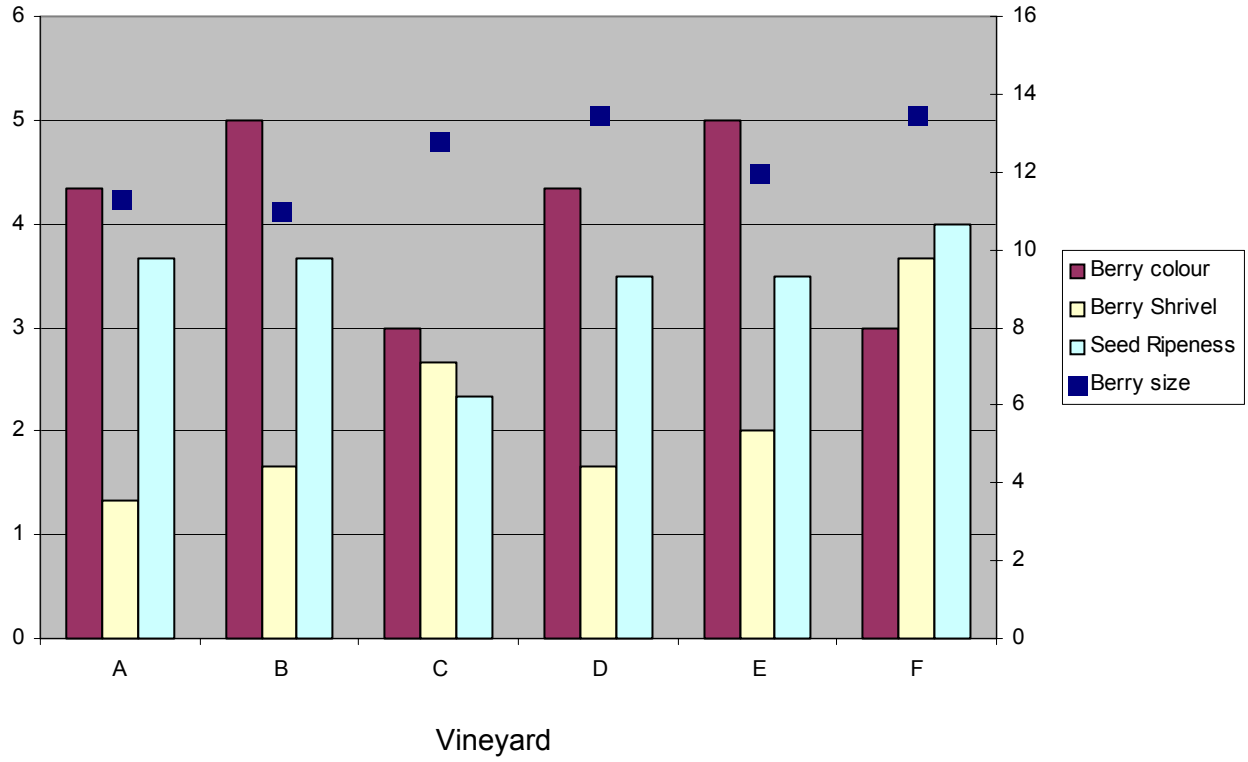
4.2 Fruit Characteristics (Vineyard Assessment)

The fruit was assessed randomly from the 40 vines at each site in the vineyards. Considering the characteristics in smaller groupings is again a useful way of looking at the results.

4.2.1 Berry size, colour and seed ripeness and berry shrivel

- ***Shrivel*** **-** The greatest amount of shrivel (>50%) was at F, followed by C (20 – 50%). The other 4 vineyards had some shrivelling, with A, B and D the least.
- ***Berry Size*** **-** There is a slight difference in the visual assessment of berry size; slightly smaller in A and B (about 1mm), and larger in the other four vineyards (see later measured berry size).
- ***Berry Colour*** **-** Berry colour was not assessed as low in any vineyard, but F and C (medium colour) were both less than the other four vineyards (high colour). These correspond to the analysed colour samples at harvest (see 4.3.1).
- ***Seed Ripeness*** **-** Seed ripeness was advanced at F, low at C and moderate to advanced in the other four vineyards.

Figure 4.2.1 Berry colour, berry shrivel, seed ripeness and berry size assessed in the vineyard at harvest in the 2004/05 growing season



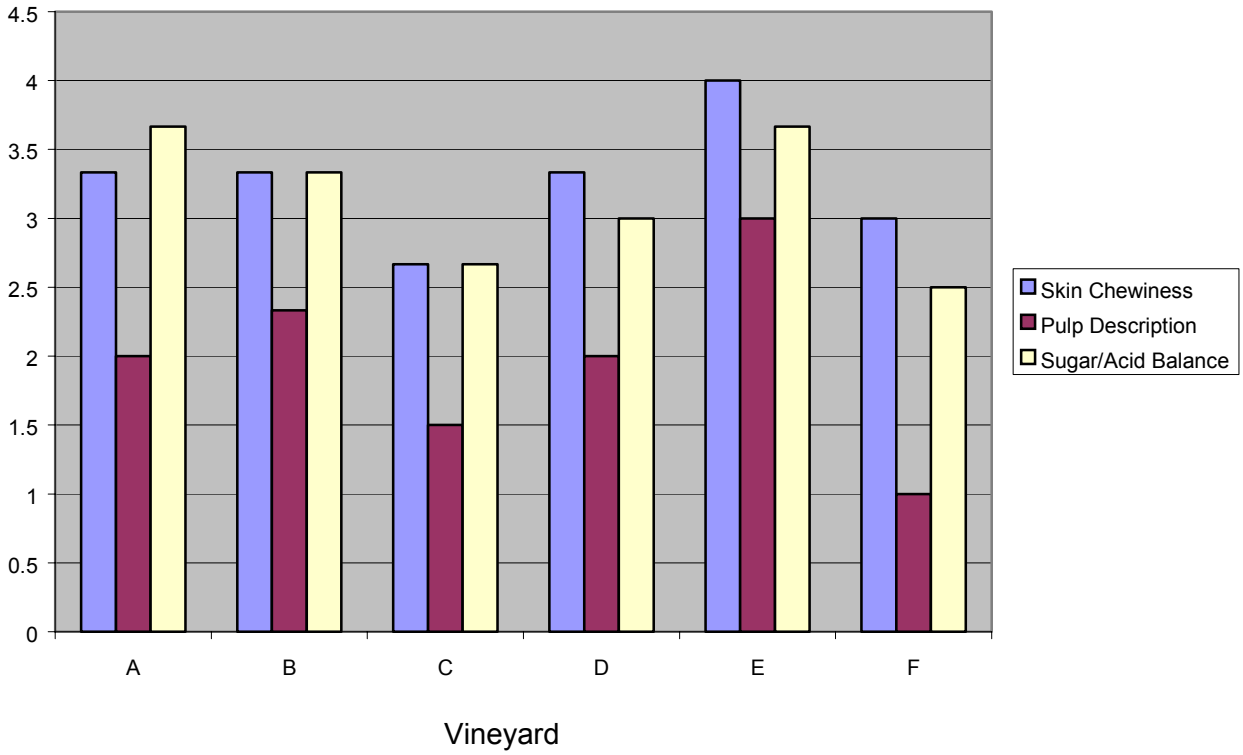
4.2.2 Pulp description and sugar / acid balance

Most vineyards had fruit with medium skin chewiness and of these E was the chewiest.

In pulp description, E was firm, A and D were moderately firm, B moderate to firm, C moderate to juicy and F juicy or watery.

With the sugar acid balance, four vineyards, A, B, D and E were all assessed as balanced to moderately balanced, and C and F less balanced, with moderately balanced to unbalanced fruit.

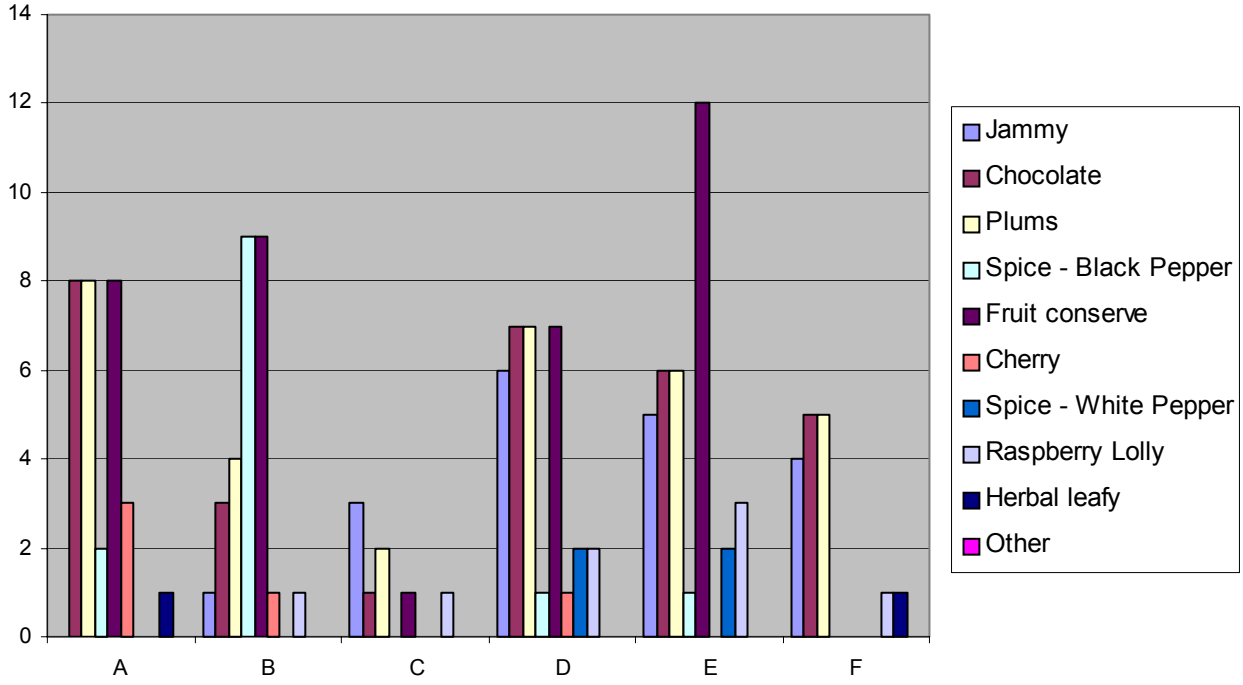
Figure 4.2.2 Skin chewiness, pulp description and sugar / acid balance assessed in the vineyard at harvest in the 2004/05 growing season



4.2.3 Flavour Intensity & Description

The flavour intensity was assessed in the field; five possible levels were given a numerical equivalent, ie very intense level of 5 down to intense, medium, low and very low. These were then graphed to give a comparison.

Figure 4.2.3 Fruit flavour characteristics assessed in the vineyard at harvest in the 2004/05 growing season



E, B and A had the greatest assessed flavour intensity, with D next, and then F and C vineyard lowest.

With the particular flavour descriptors, four vineyards A, B, D and E had a greater number of descriptors present than the other two vineyards.

A had chocolate, plums, fruit conserve with some cherry and black pepper. Slight herbal/leafy character was evident in the most vigorous site of this vineyard.
B had mainly black pepper, fruit conserve, plums and chocolate.
C had low levels of jammy/port/raisin, plums, some chocolate and raspberry, but short flavour.
D had fruit conserve, plums, jammy/port/raisin and chocolate characters.
E had fruit conserve, plums, chocolate, and jammy characters. Both these last blocks had some raspberry lolly characters.
F had more jammy, plum characters.

4.2.4 Tannin Intensity and Description in the Field

Tannin intensity was assessed as high to medium, low or none. E was high to medium, B medium to high, A moderate, D, C and F moderate to low. The types of tannin were assessed. A had grainy, chalky to powdery, as did B which also had soft rich supple tannins.

E had powdery, fine talc tannins. C and D had grainy chalky tannins as did F, which also had some chewy tannins.

4.3 Fruit Characteristics (Analytical Assessment)

In this Region at the 2005 harvest, colour levels were high on all samples (1.89 – 2.49mg/g), with some variation between vineyards.

Berry samples were taken at a set 'target' baumé of 13.5º ± .5º. However the target baumé was not always achieved, due to logistics and seasonal vagaries.

In the set baumé analysis the baumé range was 13.2º to 14.7º with the colour higher in A (14.7º baumé), B (13.8º baumé) and F (13.8º baumé), and lower colour at E (14.1º baumé), D (14.3º baumé) and C (13.2º baumé).

Both A and B had smaller berries which could be a contributing factor to colour, and F the greatest degree of shrivel – which could also have contributed to the high colour measurement. Phenolic levels tend to follow colour levels.

Figure 4.3.1: Berry analysis at 'set' baumé (13.5º ± .5º) showing baumé, pH, TA, anthocyanins, phenolics and berry weight.

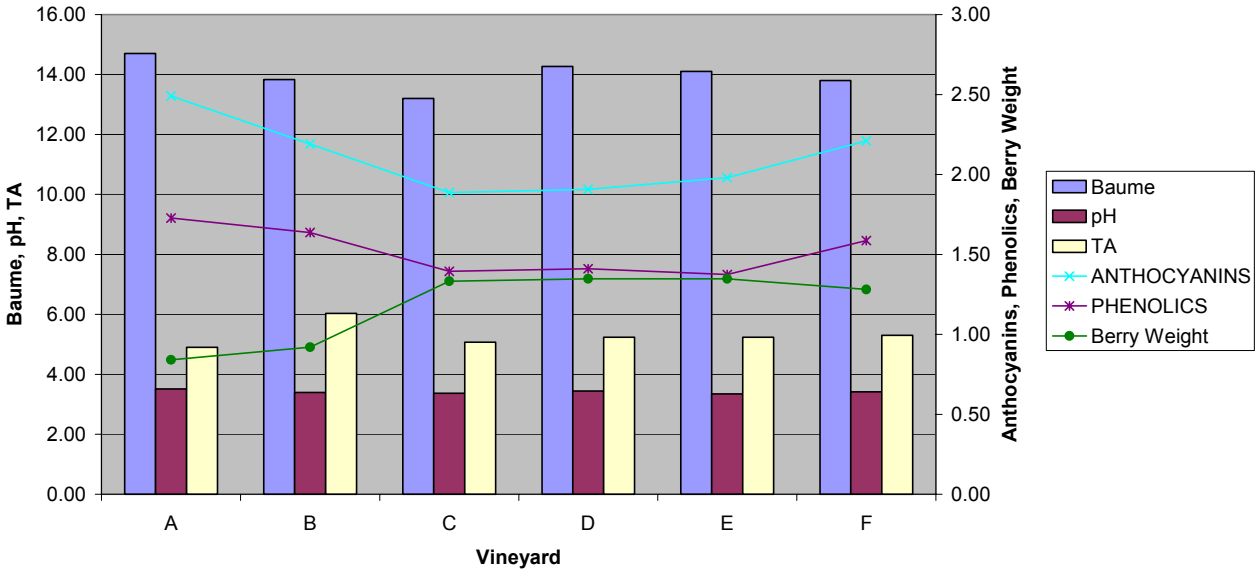
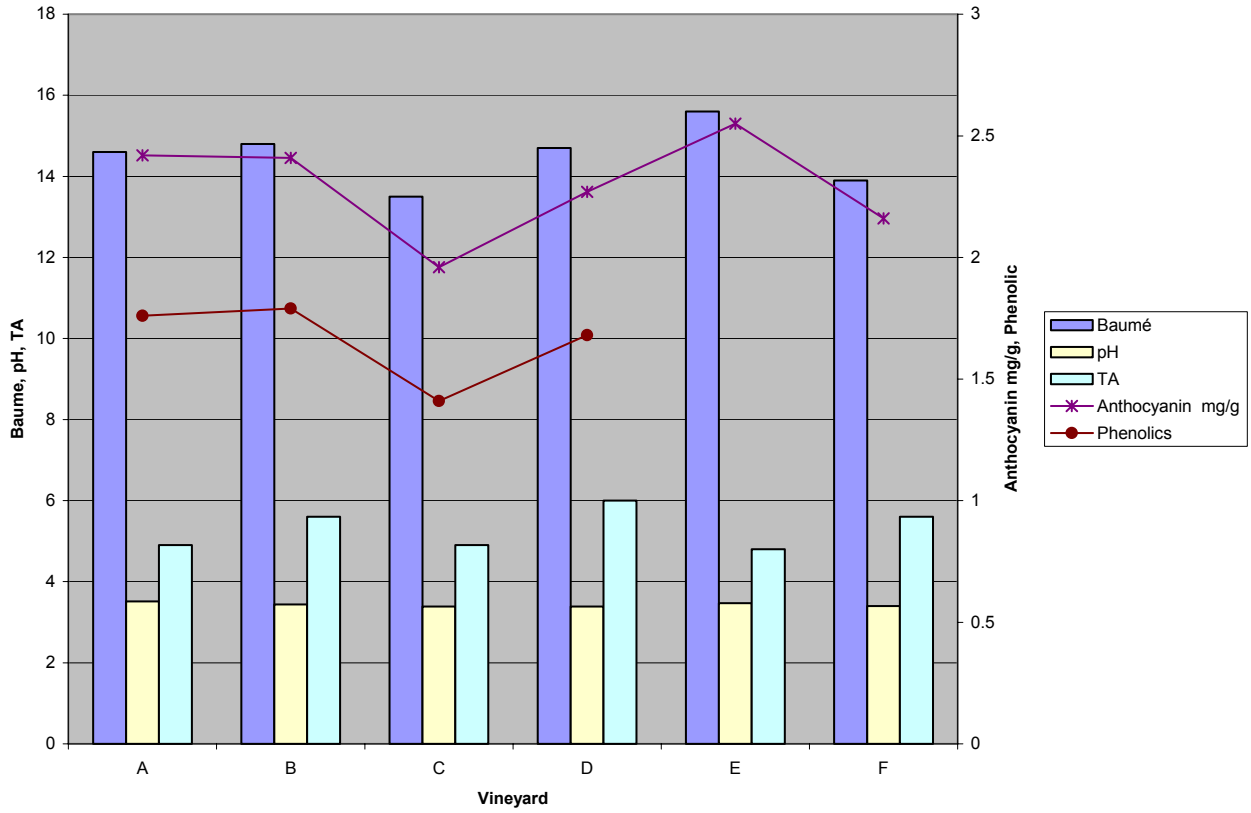


Figure 4.3.2: Berry analysis taken at "harvest" showing baumé, pH, TA, anthocyanins, phenolics and berry weight.



In the composite harvest sample, E had the highest baumé of 15.6º, and the highest colour levels of 2.55mg/g. A, B and D were all picked at about equal baumé levels (14.6º – 14.8º), with the latter having slightly lower colour levels.

F and C vineyards were picked at a lower baumé (13.9º and 13.5º respectively) and also had the lowest colour.

Thus a trend of riper fruit corresponding to greater colour is evident.

Titratable acidity (TA) varied between vineyards and it is difficult to see any relationships between fruit exposure and pH or TA, given that E and A had the greatest fruit exposure.

4.4 Wine Assessment

The wine assessment of the six non-replicated wines was a well set up and randomised tasting, with assessment conducted in duplicate. Tasters were firstly taken through the aroma and palate characteristics to be assessed (see Appendix 7), and the scoresheet was discussed. A preliminary 'practice' assessment with three wines which were not part of the study was conducted initially, to familiarise the tasters with the scale used and the attributes. In preparing this report, Dr Leigh Francis from the AWRI who prepared and carried out the tasting, was consulted and offered the following comments

The results showed that the tasting data in itself was good, but due to differences in the wines from non-treatment effects it is difficult to conclude any treatment effects, ie it is not possible to conclude that sensory differences are due to the differences between the vineyards rather than due to winemaking variations.

The basic chemical analysis of the final wines in Table 7.1 (Appendix 7) shows a high variation in residual sugar, malic acid and Titratable acidity (TA), indicating that some wines had not completed primary fermentation, and that there was variability in completion of malolactic fermentation. The measurements of colour and glucose/fructose are also difficult to compare as different methods were used. From Table 7.2 the faults picked up by the tasters showed H_2S in all but one wine, B. This was after copper additions had been made following a preliminary tasting of the wines by several experienced tasters two weeks earlier. In addition to having high residual sugar, C's wine was mousy, which would have significantly influenced the aroma and palate characteristics detectable. Unfortunately the wine making protocol involved transfer from one winery to another through a number of links, and was difficult to control. The faults were not attributable directly to winemaking but more to the degree of control over the process.

Figure 4.4.1 Wine aroma characteristics as judged by the sensory panel post vintage for the 2005 vintage

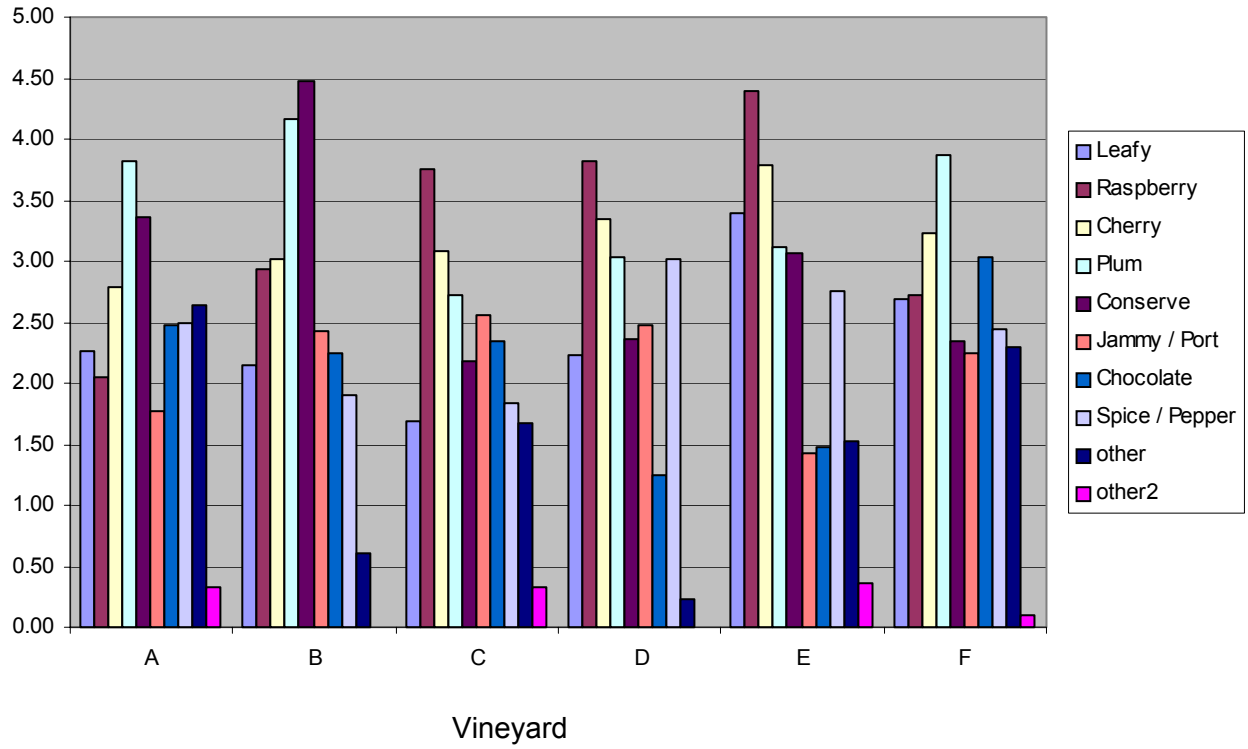
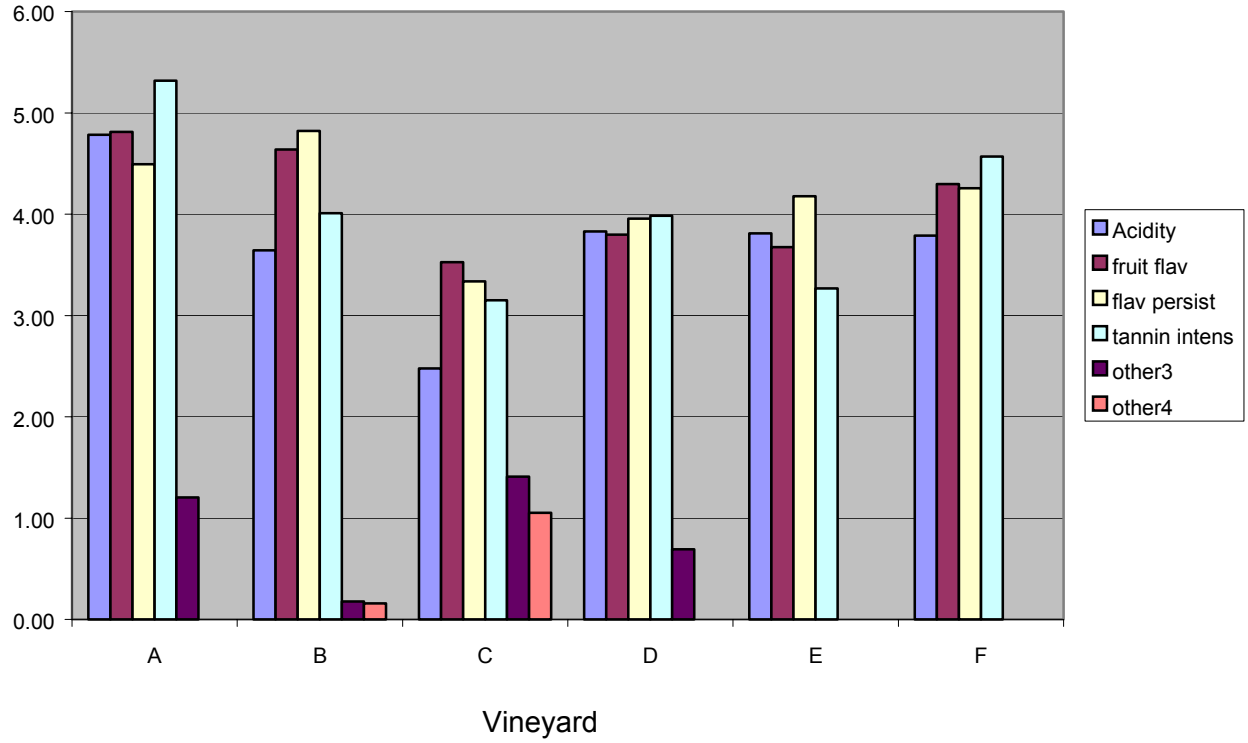


Figure 4.4.2 Wine palate characteristics as judged by the sensory panel post vintage for the 2005 vintage



The results can be briefly discussed with this caveat; that the winemaking variations and faults were difficult to look past, and could have reduced and altered the responses to the detectable fruit characters. It was thus very difficult for the winemaker panel to rate their quality and therefore, unfortunately, problematic to draw any correlation between the sensory properties of the wines and the vineyard characteristics. C in particular should be ignored due to the difficulty of assessment with the presence of the mousiness taint.

The graphs of quality, wine aroma and palate characteristics (Figures 4.4.1 and 4.4.2) show some differences,

The wine which had no H_2S, but did have relatively high residual sugar, B, was rated highest in overall quality rating; however high residual sugar can have the effect of increasing the perception of fruit flavours: it was also ranked as top for conserve and plum and overall top for fruit flavour.

Because of the variation in TA and malic acid, it is difficult to conclude if the tannin perceptions are really different, because of interaction of these components and their effect on the tasting.

The wine results generally indicate that a different process is necessary for the wine making in the next year or two of this trial.

5.0 CONCLUSIONS

Results from the vineyard assessment section of this Project indicate differences between the Shiraz vineyards. The canopy assessment indicates variability in vigour characteristics providing a picture of each vineyards' canopy and fruit exposure. There were some differences in fruit characteristics and, it appeared, an indication of potential quality from this assessment.

However, the wines batched from these blocks unfortunately were variable due to wine making differences not vineyard differences. The differences in the vineyards therefore could not be significantly correlated with the quality of the resultant wine batches.

However the vineyard differences noted can give an idea of canopies and of possible potential fruit value or end use.

The canopy growth differences noted in the vineyard assessment are that the three vineyards of F, A and D have longer shoots than the others, lateral growth is greatest at F least at C, and periderm development is lowest at F and most consistently high at A and E. Vine balance was an extra characteristic with B, E and C as 'most' balanced, with C being so through high crop and high leaf area.

The fruit environment shows more fruit exposure at A and E (80 – 100%), and lower LLN (1 at E and 1 – 1.5 at A). Similarly, there is consistently dappled light at those two vineyards, and more direct light/shade at the other four.

For the fruit characteristics, berry size was assessed as smallest at A and B. Colour was high overall, but lowest at F and C, berry shrivel greatest at F and C (>20%), with a degree of shrivel in all vineyards. Seed ripeness was lowest in C.

For fruit mouth feel analysis, E was most chewy, with also the firmest texture, with C and F least chewy and of juicy / watery texture. The sugar / acid balance was most even in A and E, and least in C and F.

A greater flavour intensity and more fruit conserve flavour in the four vineyards of E, A, B and D may be linked with greater fruit exposure. There may also be a relationship with greater periderm development that was an indicator in the previous study (Luke Rolley: 2003) of shoot maturity and ability therefore to fully ripen and develop desirable fruit flavours.

The Rolley study suggested that leaf layer number and berry colour influenced quality in 2003 and that periderm and berry size influenced quality in 2002. Information from these studies suggested that a moderately open canopy with healthy leaves was more desirable for quality production than a densely shaded canopy. In this current study, one vineyard with high potential vigour (F) utilised canopy management (leaf plucking, shoot positioning) to alleviate the potential shading problems. The other vineyard which had more assessed vigour (C) in fact had a very spread out canopy, but still resulted in relatively low fruit exposure and also lower fruit flavour intensity. Both of these vineyards showed low assessments for berry chewiness, watery textures and sugar / acid balance.

Both vineyards were situated on deep light textured soils, overlying heavier soils, with roots exploring throughout, ie, high potential sites. C has a lower input for canopy management and possibly had more nutrient inputs than the other vineyards. It had a significantly higher crop at 15t/ha compared with 10t/ha or less, but did appear to have more canopy area to ripen that crop (although very variable shoot lignification and shoot length).

In considering berry colour or size as possible indicators or potential quality, the measured colour values are all quite high. It seems that waiting to pick on flavour, influenced colour accumulation;

in the harvest measurement the higher colours corresponded with greater sugar levels. At more equal baumés, ie the 'set baumé' sample, F was quite high in colour. A relatively high shrivel was visually assessed for F, berry weight was measured as about the same as other vineyards with lower colour values, so the shrivel may have contributed to the greater colour value.

Berry size was visually assessed and also measured as lower in A and B, which also had high colour in both sample sets analysed.

It appears that the duplex soils produce a more moderate vigour vine, ie have moderate vigour potential soils. These may be easier to manage and to obtain a balanced moderately open canopy, which potentially may produce fruit with greater flavour intensity, complexity and colour.

Although the wines could not be satisfactorily used as quality benchmarks, some inference can be drawn from the fruit assessment in the field. Translation to quality of wine assumes a certain consistency within the vineyard (or very good selection of selected sites within the vineyard). This season may have exacerbated variability in the case of problems with irrigation (greater in a dry year), which did occur with F and B to some extent. To translate fruit quality to wine quality also relies very heavily on experienced fruit and wine tasters; the role of the wine makers in this assessment is critical. It would thus be useful for the grower if other more easily measurable or objective characteristics could be used.

Vineyard canopy measurement should thus be ideal if any of them could be good 'potential quality' indicators. From this initial study, possibly periderm development, fruit exposure / leaf layer number, and even light conditions could be useful.

Berry assessment of size and colour could also be objectively carried out by non-winemakers. The added berry characteristics of skin chewiness, fruit conserve and chocolate flavours also appeared distinctive in this initial study.

Figure 5.1 – Web diagram indicating possible quality parameters

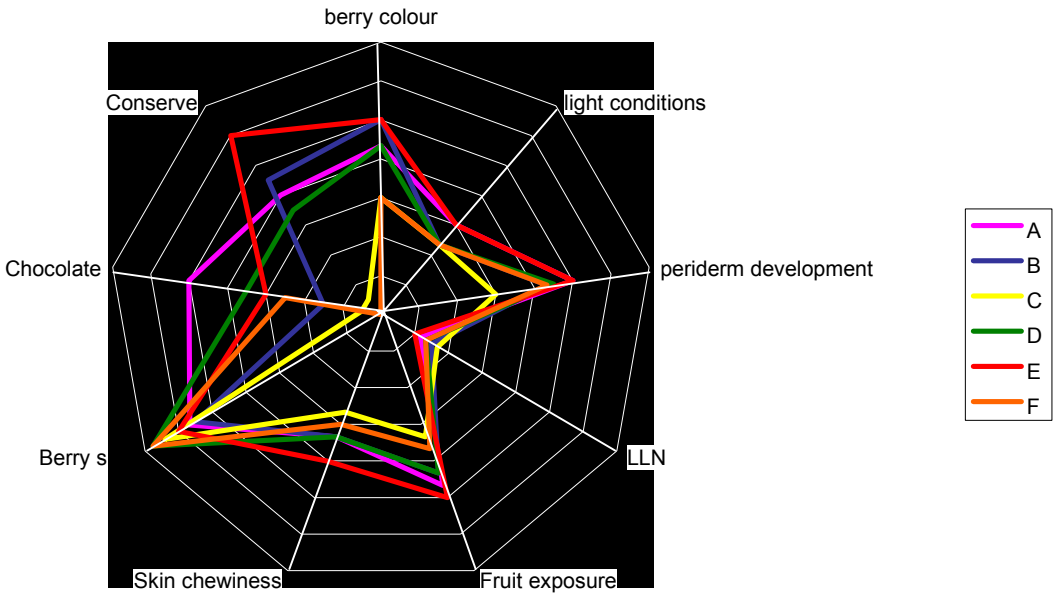


Figure 5.1 has to put together some characteristics which were different in the six vineyards, and may be considered useful when assessing wine quality.

The problem with the wine variability and thus potential for comparison and correlations with vineyard characteristics has highlighted the need for a different wine making process for next year. However the vineyard assessments and berry analysis have shown up some interesting differences which could be useful indicators. This needs to be confirmed over a number of years, given the differences in seasons and fruit and canopy developments each season.

As far as achievement of objectives, this Project successfully used the vineyard assessment and berry sensory and analytical assessment to differentiate between the six Shiraz blocks selected in the McLaren Vale Region. Involvement of growers and wine makers in the assessment process occurred to a certain degree, but if this is to remain an objective, growers need to be encouraged more actively to participate. Stimulation of discussion and generation of ideas for improving management options will be addressed in the seminar to be held at the end of July, and could be expanded upon in the next Project.

APPENDIX 1

BLOCK DETAILS – MANAGEMENT PRACTICES

AND VINEYARD PHOTOGRAPHS

(as at December 2004)

SUMMARY OF SOME MANAGEMENT PRACTICES IN THE SIX SHIRAZ VINEYARDS

	A	B	C	D	E	F
Yield – 2005 average	6.2t/ha	10.2t/ha 8.6t/ha	15t/ha	8.3t/ha	8.4t/ha	8.6t/ha
Trellis	Single fruiting wire	Scott Henry – one vine up, one down	2 wire vertical	Single wire	2 wire split canopy	Single wire
Foliage Wires	Single fixed, lazy VSP	1 fixed, anti-roll	Fixed	-	-	Pair of movable wires
Pruning	2 bud spur to vigour	-	Machine 50 buds/vine	Reworked 2004/05	2 bud spur	
Canopy management	Shoot thin if necessary	Shoot thin – November/December Bunch thin – veraison Shoot trim – mid December	Shoot trimming	No trimming 2005	Trim if needed	Shoot thin Shoot trim Leaf pluck
Nutrition	Respond to petiole testing Banded MAP undervine (2005)	Not really	1 – 2g/vine N twice until flowering. Zn, Mn foliar Soil and petiole analysis			
Irrigation	Irrigate to requirement to produce balanced vine. Post veraison on winery request	6hour/Week December – April 165ml total 2005	40 – 50 litres/vine/week Gypsum blocks diviner	No	2 shifts 626 litres west end 86 litres east end	Variable shifts, taps, valves for variable blocks. Started in February
Age	7yo	7yo	15yo	35yo	10yo	7yo



Vineyard A



Vineyard B



Vineyard C



Vineyard D



Vineyard E



Vineyard F

APPENDIX 2

SOIL ANALYSIS

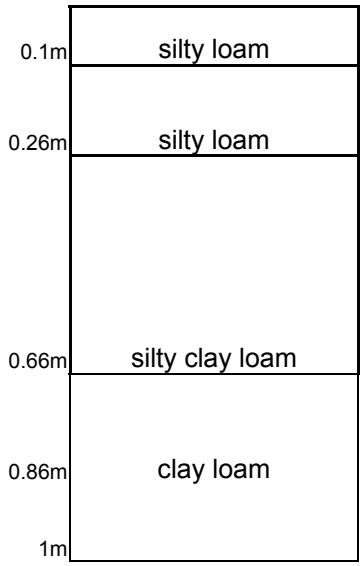
Table 2.1.1 – Site A soil pit descriptions

Vineyard **A**			Units = mm	Soil Pit No	Date: 14/4/05
Block					
Aspect	Minimal slope				
Soil type			Geology		
CRITICAL DEPTHS					
Effective root depth	Drain barrier /	Hard Rock /	Watertable /	Pale colours 660 →	Mottles 660
HORIZON DESCRIPTIONS					
Horizon Type					
Lower Depth of horizon	**100**	**260**	**660**	**660 →**	
Colour (moist)	Very dusky red	Very dusky red	Dark reddish brown	Red	
Texture	Silty loam	Silty loam	Silty clay loam	Clay loam → loam clay	
Structure (type, grade, size)	Sub angular blocky, single grain, loose incoherent, 1-2 mm	Sub angular blocky, single grain, loose incoherent, 1-2mm	Sub angular blocky, massive, no pedality, very hard, >2mm	Granular, weak pedality, 1-2mm	
Consistence – Dry	Weak – small but significant force required to crush	Weak – small but significant force required to crush	Strong – Beyond power of thumb and forefinger. Crushes underfoot on hard flat surface with small force	Firm – Moderate or firm force	
Mottles (col, %, mm, contrast)	/	/	5% Red	50% Red	
Visible Pores/ Cracks (#/10x10)	10 - 20	10 - 20	Very few	Very few	
Gravel (type, %)	/	/	/	/	
Roots (type, <2mm)	Nil	Few	Many	Few	
Roots (type, >2mm)	Nil	Nil	Few	Few	
Reaction to acid	Nil	Nil	Nil	Thick effervescence	

Table 2.1.2 – Site A soil sample analysis

	Depth (cm)	30 cm	50 cm
	Texture	**3.5**	**3.5**
Measurement	**Unit**	**Result**	**Result**
pH_{water} **pH_{CaCl}**	pH pH Comment	**7.3** **6.8** Marginally acidic	**7.4** **6.5** Marginally acidic
Phosphorus	mg/kg Comment	**108** Adequate	**4** Low
Potassium	mg/kg Comment	**458** Adequate	**439** Adequate
Sulphur	mg/kg Comment	**9.3** Marg. to low	**20.7** Adequate
Organic Carbon	% Comment	**1.49** Acceptable	**0.81** Low
Iron	mg/kg Comment	**641**	**804**
Salinity (EC) **Estimated ECe**	dS/m dS/m Comment	**0.159** **1.034** Low salinity	**0.083** **0.540** Low salinity
Nitrogen: Nitrate **Ammonium**	mg/kg Comment mg/kg	**27** may be acceptable **2**	**1** could be low **1**
CEC	meq/100g Comment	**13.62** Acceptable	**33.36** Acceptable
Calcium	% Comment	**79** High	**69** Acceptable
Magnesium	% Comment	**12** Acceptable	**25** High
Sodium ESP	% Comment	**1** Non sodic	**3** Non sodic
Potassium	% Comment	**9** High	**4** Acceptable
Calcium:Magnesium	 Comment	**6.8** Acceptable	**2.7** Acceptable
Aluminium	mg/kg Comment	**0** Acceptable	**0** Acceptable
Boron	mg/kg	**0.6**	**0.9**
Chloride	mg/kg Comment	**37** Below critical	**17** Below critical

Table 2.1.3 – Site A Water Holding Capacity



zl = 0.1m X 65mm/m = 6.5mm

zl = 0.16m X 65mm/m = 10.4mm

zcl = 0.4m X 70mm/m = 28mm

cl = 0.2m X 65mm/m = 13mm

Total RAW @ 60 kpa = 57.9mm

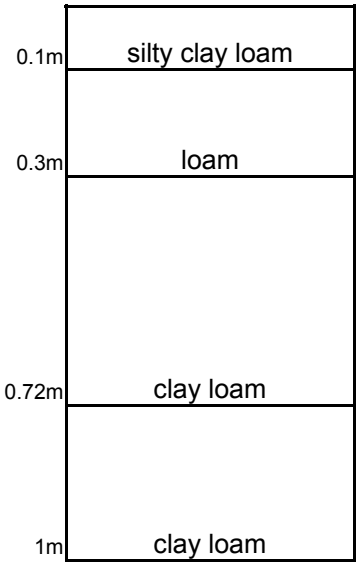
Table 2.2.1 - Site B soil pit descriptions

Vineyard **B**			Units = mm	Soil Pit No	Date: 14/4/05
Block					
Aspect	Minimal slope				
Soil type			Geology		
CRITICAL DEPTHS					
Effective root depth 1m small 690m – 700 large	Drain barrier /	Hard Rock /	Watertable /	Pale colours ~ 300mm Limestone fragments	Mottles Some CaCo3 from 700 – 1m
HORIZON DESCRIPTIONS					
Horizon Type					
Lower Depth of horizon	110	300	720	720 →	
Colour (moist)	Very dusky red	Very dark grey	Dark reddish brown	Strong brown	
Texture	Silty clay loam	Loam	Clay loam	Clay loam	
Structure (type, grade, size) Consistence (M moist/ D dry)	Prismatic, single grain, loose incoherent 2-5mm Very weak	Sub angular blocky, moderate pedality, variable 10-15mm Firm	Columnar, moderate pedality, 10 – 50 mm Very weak	Sub angular blocky, weak pedality, 10 – 20 mm Weak	
Mottles (col, %, mm contrast)					
Visible Pores/ Cracks (#/10x10)	Nil	10 - 20	1- 10	10 – 20	
Gravel (type, %)	/	/	/	/	
Roots (type, <2mm)	Few	Few	Few	Few	
Roots (type, >2mm)	No roots	Few roots	No roots	No roots	
Reaction to acid	Strong effervescence	No effervescence	No effervescence	Thick effervescence	

Table 2.2.2 – Site B soil sample analysis

	Depth (cm)	30 cm	50 cm
	Texture	**3.5**	**3.5**
Measurement	**Unit**	**Result**	**Result**
pH_{water} **pH_{CaCl}**	pH pH Comment	**7.8** **7.1** Marginally Alkaline	**8.1** **7.3** Marginally alkaline
Phosphorus	mg/kg Comment	**87** Adequate	**12** Low
Potassium	mg/kg Comment	**530** Adequate	**333** Adequate
Sulphur	mg/kg Comment	**8.2** Marginal to low	**12.3** Adequate
Organic Carbon	% Comment	**2.11** High	**1.23** Acceptable
Iron	mg/kg Comment	**586** Adequate	**1026** Adequate
Salinity (EC) **Estimated ECe**	dS/m dS/m Comment	**0.098** **0.637** Low Salinity	**0.084** **0.546** Low salinity
Nitrogen: Nitrate **Ammonium**	mg/kg Comment mg/kg	**11** May be acceptable **1**	**4** May be low **1**
CEC	meq/100g Comment	**29.34** Acceptable	**36.03** Acceptable
Calcium	% Comment	**77** High	**79** High
Magnesium	% Comment	**18** High	**16** High
Sodium ESP	% Comment	**1** Non sodic	**2** Non sodic
Potassium	% Comment	**5** Acceptable	**3** Low
Calcium:Magnesium	 Comment	**4.4** Acceptable	**4.8** Acceptable
Aluminium	mg/kg Comment	**0** Acceptable	**0** Acceptable
Boron	mg/kg	**1**	**0.7**
Chloride	mg/kg Comment	**18** Below critical	**13** Below critical

Table 2.2.3 – Site B Water Holding Capacity



zcl = 0.1m1 X 70mm/m = 7.7mm

l =0.2m X 84mm/m = 16.8 mm

cl = 0.42m X 65mm/m = 27.3 mm

cl = 0.28m X 65mm/m = 18.2 mm

Total RAW @ 60 kpa = 70 mm

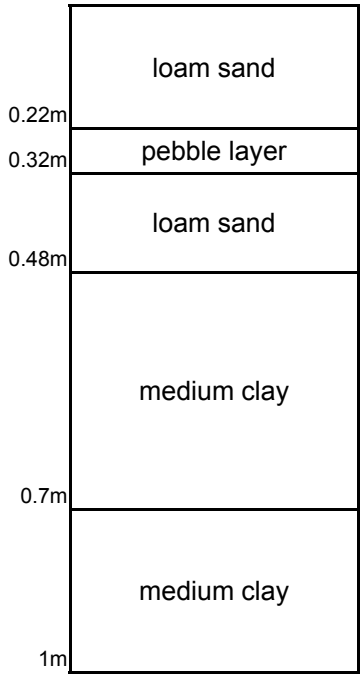
Table 2.3.1 – Site C soil pit descriptions

Vineyard **C**			Units = mm	Soil Pit No	Date:
Block					
Aspect					
Soil type			Geology		
CRITICAL DEPTHS					
Effective root depth 480mm	Drain barrier /	Hard Rock /	Watertable /	Pale colours sand	Mottles 480
HORIZON DESCRIPTIONS					
Horizon Type					
Lower Depth of horizon	210	300	480	1500	
Colour (moist)	Very dark greyish brown		Light yellowish brown	Dark yellowish brown	
Texture	Loam sand	Pebble layer	Loam sand	Medium clay	
Structure (type, grade, size)	Granular, single grain, loose incoherent, 2 – 5 mm		Granular, single grain, loose incoherent, 2 – 5 mm	Sub angular blocky, massive, no pedality and very hard. 10 – 20mm	
Consistence (M moist/ D dry)	Weak, small but significant force		Weak, small but significant force	Very strong, crushes underfoot on hard flat surface with full body weight applied slowly	
Mottles (col, %, mm contrast)	/	/	/	Orange, green purple, 50%	
Visible Pores/ Cracks (#/10x10)	/	/	/	/	
Gravel (type, %)		Round 50%			
Roots (type, <2mm)	Few	None	Few	Few	
Roots (type, >2mm)	None	None	Few	Many	
Reaction to acid	Nil	Nil	Nil	Nil	

Table 2.3.2 – Site C soil sample analysis

	Depth (cm)	30 cm	50 cm
	Texture	**3.5**	**3.5**
Measurement	**Unit**	**Result**	**Result**
pH_{water} **pH_{CaCl}**	pH pH Comment	**6.8** **5.9** Moderately acidic	**7.5** **6.8** Marginally acidic
Phosphorus	mg/kg Comment	**48** Adequate	**8** Low
Potassium	mg/kg Comment	**103** Marginal	**68** Low
Sulphur	mg/kg Comment	**12.3** Adequate	**11** Adequate
Organic Carbon	% Comment	**1.15** Low	**0.37** Low
Iron	mg/kg Comment	**596**	**714**
Salinity (EC) **Estimated ECe**	dS/m dS/m Comment	**0.064** **0.416** Low salinity	**0.071** **0.462** Low salinity
Nitrogen: Nitrate **Ammonium**	mg/kg Comment mg/kg	**2** could be low **1**	**2** could be low **1**
CEC	meq/100g Comment	**3.12** Low fertility	**1.85** Low fertility
Calcium	% Comment	**74** Acceptable	**63** Low
Magnesium	% Comment	**15** High	**26** High
Sodium ESP	% Comment	**5** Non sodic	**6** Sodic
Potassium	% Comment	**6** Acceptable	**5** Acceptable
Calcium:Magnesium	 Comment	**4.9** Acceptable	**2.5** Acceptable
Aluminium	mg/kg Comment	**0** **Acceptable**	**0** **Acceptable**
Boron	mg/kg	**0.3**	**0.2**
Chloride	mg/kg Comment	**23** below critical	**18** below critical

Table 2.3.3 – Site C Water Holding Capacity



ls = 0.22m X 55mm/m = 12.1 mm

ls = 0.16m X 55mm/m = 8.8 mm

mc = 1.02m X 57mm/m = 58.14 mm

Total RAW @ 60 kpa = 79.04 mm

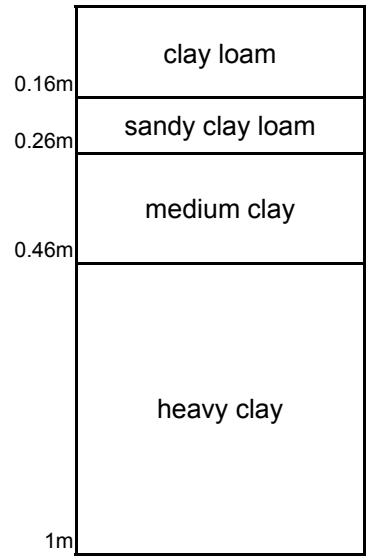
Table 2.4.1 – Site D soil pit descriptions

Vineyard **D** **Block**			Units = mm	Soil Pit No	Date: 14/4/05
Aspect					
Soil type			Geology		
CRITICAL DEPTHS					
Effective root depth >1000mm	Drain barrier /	Hard Rock /	Watertable /	Pale colours /	Mottles 200mm
HORIZON DESCRIPTIONS					
Horizon Type					
Lower Depth of horizon	160 mm	260 mm	480 mm	1000 →	
Colour (moist)	Dark yellowish brown	Dark Brown	Dark reddish brown	Red	
Texture	Clay loam	Sandy clay loam	Medium clay	Heavy clay	
Structure (type, grade, size)	Granular, single grain, loose incoherent 2-5mm	Platy, single grain, loose incoherent, 5-10mm	Sub angular blocky, single loose incoherent, 2-5mm	Polyhedral – sub angular blocky, massive, no pedality very hard	
Consistence (M moist/ D dry)	Strong, beyond the power of thumb and forefinger. Crushes underfoot on hard flat surfaces with small force	Strong, beyond the power of thumb and forefinger. Crushes underfoot on hard flat surfaces with small force	Very strong, crushes underfoot on hard flat surface with full body weight applied slowly	Very strong, crushes underfoot on hard flat surface with full body weight applied slowly	
Mottles (col, %, mm contrast)	/	Orange, yellow, red, white, grey, varying sizes	/	/	
Visible Pores/ Cracks (#/10x10)	None	Few	Few	Few	
Gravel (type, %)	1-2mm, 50%	2-3mm, 90%	2-3mm, 80%	2-4mm, 80%	
Roots (type, <2mm)	Few	Few	Few	Few	
Roots (type, >2mm)	Few	Few	Few	Few	
Reaction to acid	Nil	Nil	Nil	Nil	

Table 2.4.2 – Site D soil sample analysis

	Depth (cm)	30 cm	50 cm
	Texture	**3.5**	**3.5**
Measurement	**Unit**	**Result**	**Result**
pH_{water} **pH_{CaCl}**	pH pH Comment	**5.8** **5.3** Strongly acidic	**5.8** **5.1** Strongly acidic
Phosphorus	mg/kg Comment	**8** Low	**5** Low
Potassium	mg/kg Comment	**248** Adequate	**286** Adequate
Sulphur	mg/kg Comment	**54.8** Adequate	**73.8** Adequate
Organic Carbon	% Comment	**0.92** Low	**1.16** Low
Iron	mg/kg Comment	**913**	**996**
Salinity (EC) **Estimated ECe**	dS/m dS/m Comment	**0.099** **0.644** Low salinity	**0.118** **0.767** Low salinity
Nitrogen: Nitrate **Ammonium**	mg/kg Comment mg/kg	**1** Could be low **1**	**2** Could be low **1**
CEC	meq/100g Comment	**11.56** Acceptable	**14.53** Acceptable
Calcium	% Comment	**72** Acceptable	**54** Low
Magnesium	% Comment	**23** High	**42** High
Sodium ESP	% Comment	**1** Non sodic	**1** Non sodic
Potassium	% Comment	**5** Acceptable	**4** Acceptable
Calcium:Magnesium	 Comment	**3.2** Acceptable	**1.3** Structural problems
Aluminium	mg/kg Comment	**1.5** **Acceptable**	**0.2** **Acceptable**
Boron	mg/kg	**0.4**	**0.4**
Chloride	mg/kg Comment	**9** below critical	**9** below critical

Table 2.4.3 – Site D Water Holding Capacity



cl = 0.16m X 65mm/m = 10.4mm

scl = 0.1m X 70mm/m = 7mm

mc = 0.2m X 57mm/m = 11.4mm

hc = 0.54 X .41mm/m = 22.14mm

Total RAW @ 60 kpa = 50.94mm

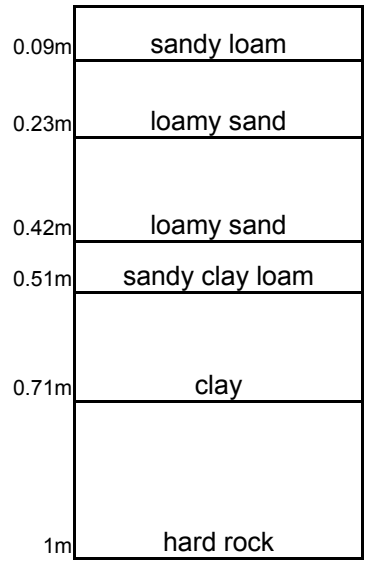
Table 2.5.1 – Site E soil pit descriptions

Vineyard **E**			Units = mm	Soil Pit No	Date: 14/4/05
Block					
Aspect					
Soil type			Geology		
CRITICAL DEPTHS					
Effective root depth <510mmm	Drain barrier /	Hard Rock 1.2	Watertable /	Pale colours 510	Mottles 510
HORIZON DESCRIPTIONS					
Horizon Type					
Lower Depth of horizon	90mm	230mm	420mm	510mm	1120mm
Colour (moist)	Dusky red	Dusky red	Yellowish red	Strong brown	Red
Texture	Sandy loam	Loamy sand	Loamy sand	Sandy clay loam	Grey clay and rock
Structure (type, grade, size)	Granular, single grain, loose incoherent 2-5mm	Granular, single grain, loose incoherent 2-5mm	Granular, single grain, loose incoherent 2-5mm	Granular, single grain, loose incoherent 2-5mm	Massive solid rock
Consistence (M moist/ D dry)	Weak, small but significant force	Weak, small but significant force	Weak, small but significant force	Very strong, crushes underfoot on hard flat surface with full body weight applied slowly	
Mottles (col, %, mm contrast)	/	/	/	Few	
Visible Pores/ Cracks (#/10x10)	Many 2-5mm	Many 2-5mm	None	None	
Gravel (type, %)	2 – 20mm, 20%	0	20-40mm, 80%	0	
Roots (type, <2mm)	Many	Few	Few	Few	
Roots (type, >2mm)	Few	Few	Many	Few	
Reaction to acid	Slight, effervescence audible and or just visible	Nil	Nil	Nil	

Table 2.5.2 – Site E soil sample analysis

	Depth (cm)	30 cm	50 cm
	Texture	**3.5**	**3.5**
Measurement	**Unit**	**Result**	**Result**
pH_{water} **pH_{CaCl}**	pH pH Comment	**6.9** **6.4** Moderately acidic	**7.1** **6.6** Marginally acidic
Phosphorus	mg/kg Comment	**27** Low	**8** Low
Potassium	mg/kg Comment	**20** Very low	**15** Very low
Sulphur	mg/kg Comment	**8.2** Marginal to low	**4.5** Marginal to low
Organic Carbon	% Comment	**0.42** Low	**0.26** Low
Iron	mg/kg Comment	**511**	**398**
Salinity (EC) **Estimated ECe**	dS/m dS/m Comment	**0.112** **0.728** Low salinity	**0.079** **0.514** Low salinity
Nitrogen: Nitrate **Ammonium**	mg/kg Comment mg/kg	**1** could be low **1**	**1** could be low **1**
CEC	meq/100g Comment	**2.79** Low fertility	**1.41** Low fertility
Calcium	% Comment	**78** High	**60** Low
Magnesium	% Comment	**11** Acceptable	**21** High
Sodium ESP	% Comment	**9** Sodic	**16** Strongly sodic
Potassium	% Comment	**2** Low	**3** Low
Calcium:Magnesium	Comment	**7.3** Acceptable	**2.8** Acceptable
Aluminium	mg/kg Comment	**0** Acceptable	**0** Acceptable
Boron	mg/kg	**0.2**	**0.1**
Chloride	mg/kg Comment	**102** below critical	**65** below critical

Table 2.5.3 – Site E Water Holding Capacity



sl = 0.09m X 65mm/m = 5.85mm

ls = 0.14 X 55mm/m = 7.7mm

ls = 0.19 X 55mm/m = 10.45mm

scl = 0.09 X 70mm/m = 6.3mm

C = 0.2m X 55mm/m = 11mm

Total RAW @ 60 kpa = 41.3mm

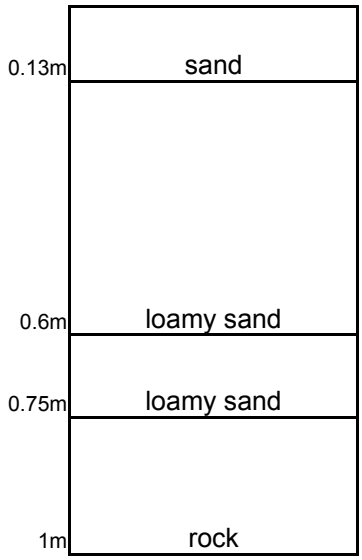
Table 2.6.1 – Site F soil pit descriptions

Vineyard **Coker's**			Units = mm	Soil Pit No	Date: 14/4/05
Block					
Aspect					
Soil type			Geology		
CRITICAL DEPTHS					
Effective root depth	Drain barrier	Hard Rock	Watertable	Pale colours	Mottles
500mm	/	750mm	/	/	750mm
HORIZON DESCRIPTIONS					
Horizon Type					
Lower Depth of horizon	130	600	750	Ironstone hard sheet rock	
Colour (moist)	Dark reddish brown	Strong brown	Light yellowish brown	Light red	
Texture	Sand	Loamy sand	Loamy sand		
Structure (type, grade, size)	Granular, single grain, loose incoherent, 2-5mm	Granular, single grain, loose incoherent, 2-2.5mm	Sub angular blocky, massive, no pedality and very hard		
Consistence (M moist/ D dry)	Loose, no force required	Loose, no force required	Firm, moderate or firm force		
Mottles (col, %, mm contrast)	/	/	/		
Visible Pores/ Cracks (#/10x10)	/	/	/		
Gravel (type, %)	/	/	/		
Roots (type, <2mm)	Few	Few	Nil		
Roots (type, >2mm)	Few	Few	Nil		
Reaction to acid	Nil	Nil	Nil		

Table 2.6.2 – Site F soil sample analysis

	Depth (cm)	30 cm	50 cm
	Texture	**3.5**	**3.5**
Measurement	**Unit**	**Result**	**Result**
pH_{water} **pH_{CaCl}**	pH pH Comment	**6.1** **5.1** Strongly acidic	**6.8** **6.1** Marginally acidic
Phosphorus	mg/kg Comment	**48** Adequate	**9** Low
Potassium	mg/kg Comment	**32** Very low	**21** Very low
Sulphur	mg/kg Comment	**3.7** Marginal to low	**1.5** Marginal to low
Organic Carbon	% Comment	**0.5** Low	**0.12** Low
Iron	mg/kg Comment	**418**	**356**
Salinity (EC) **Estimated ECe**	dS/m dS/m Comment	**0.033** **0.215** Low salinity	**0.017** **0.111** Low salinity
Nitrogen: Nitrate **Ammonium**	mg/kg Comment mg/kg	**5** may be acceptable **1**	**1** could be low **1**
CEC	meq/100g Comment	**1.82** Low fertility	**1.09** Low fertility
Calcium	% Comment	**72** Acceptable	**63** low
Magnesium	% Comment	**20** High	**27** High
Sodium ESP	% Comment	**3** Non sodic	**5** Non sodic
Potassium	% Comment	**5** Acceptable	**6** Acceptable
Calcium:Magnesium	 Comment	**3.5** Acceptable	**2.4** Acceptable
Aluminium	mg/kg Comment	**0.5** Acceptable	**0** Acceptable
Boron	mg/kg	**0.2**	**0.2**
Chloride	mg/kg Comment	8 below critical	5 below critical

Table 2.6.3 – Site F Water Holding Capacity



s = 0.13m X 35mm/m = 4.55 mm

ls = 0.47m X 55mm/m = 25.85 mm

ls = 0.15m X 55mm/m = 8.25 mm

Total RAW @ 60 kpa = 38.65 mm

APPENDIX 3

VINEYARD ASSESSMENT SHEET

APPENDIX 4

RESULTS: CANOPY CHARACTERISTICS: VINEYARD ASSESSMENT

Figure 4.1. Canopy Characteristics

	Shoot Length (cm)		Lateral Growth			Periderm Development			Vine balance		
	Range	**Average**	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**
A	80 – 170	120 – 160	LL	LL	LM	5	5	5	2	2	2
B	80 – 110	80 – 110	LL	LL	ML	4.5	4.5	4	3	3	3
C	50 – 160	50 – 110	LL	LL	LL	3	3	3	3	3	2
D	120 – 160	120 – 160	LL	ML	ML	4.5	4	5	2	2	2
E	50 – 110	80 – 110	LL	ML	ML	5	5	5	3	3	3
F	50 – 170+	120 – 160	MM	HM	ML	4	4	5	3	2	2

1. Shoot length: range of 3 sites and average (cm)
2. Lateral growth: first and final laterals, Low, Medium or High
3. Periderm Development: score – 5 fully lignified – 1 low (0 – 20%) lignification.
4. Vine Balance: Scale 1 - low or high leaf area:crop, ie unbalanced
   3 – balanced leaf area:crop

Table 4.2: Vine Leaf Condition

	A			B			C			D			E			F		
	A	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**
Leaf condition – Est % leaves remaining	90	90	90	70	90	95	90	90	90	70	75	85	80	95	95	80	90	85
Physical Leaf condition																		
Green/healthy growing tips present										√								
Green/healthy tips stopped growing	√	√	√		√	√			√		√	√	√	√	√		√	√
Green/healthy leaves lose turgor, backs visible		√									√	√	√					
Green/healthy basal leaf yellow from stress	√	√								√	√	√				√		
Green/healthy basal leaf yellow from shading			√				√	√	√	√								
Pale green leaves wilting				√														
Yellowing (autumnal senescence)											√					√		
Yellowing browning due to stress/dying off				√	√					√		√				√		
Other leaf symptoms																		

Table 4.3: Fruit Environment within the Canopy

	Fruit Exposure			Light Condition			Leaf Layer Number		
	A	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**
A	5	5	4	3	3	3	1	1	1.5
B	5	4	4	2	3	2	.5	1.5	>2
C	4	4	2	3	2	2	1.5	1	>2
D	4	4	5	2	3	2	1.5	1.5	1
E	5	5	5	3	3	3	1	1	1
F	5	3	3	2	2	3	.5	2	1.5

Scales for descriptors:

1. Fruit exposure: 5 –; 80 – 100%; → 1; <20%
2. Light Condition: Scale: 1 - Full sun or shade; 3 - Dappled
3. Leaf layer number: 0 to greater than 2

APPENDIX 5

RESULTS: FRUIT CHARACTERISTICS: VINEYARD ASSESSMENT

Table 5.1 Berry size, colour and seed ripeness

	Berry Size (mm)			Berry Colour			Seed Ripeness		
	A	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**
A	11	11	12	H	H	M	4	4	3
B	10	11	12	H	H	H	4	4	3
C	>13	12/13	12/13	M	M	M	2	3	2
D	>13	>13	>13	M	H	M	3 – 4	3 - 4	3 – 4
E	12	12	12	H	H	H	3 – 4	4	3
F	>13	>13	>13	M	M	M	4	4	4

1. Berry size – visual estimation in mm.
2. Berry colour – visual assessment range Very High – Low (H-high, M - moderate)
3. Seed ripeness – visual assessment of seed colour and flavour ;5 - very ripe,1 - not ripe

Table 5.2 Berry Shrivel, Chewiness

	Degree of Berry Shrivel 0 – 4,			Skin Chewiness 5 – 1		
	A	**B**	**C**	**A**	**B**	**C**
A	1	2	1	3	3	4
B	3	1	1	3	3	4
C	2	3	3	3	3	2
D	2	2	1	4	3	3
E	2	2	2	4	4	4
F	4	3	4	3	3	3

1. Degree of Berry Shrivel – 0 – firm (no shrivel)
   4 – extensive shrivel (>50%)
2. Skin Chewiness 5 – very thick / chewy
   1 – very thin (splits easily)

Table 5.3 Pulp description and Balance

	Pulp description	**Sugar Acid Balance**
A	Moderately firm	Balanced to moderately balanced
B	Firm to moderately firm	Moderately balanced to balanced
C	Moderate to juicy	Moderate to unbalanced/acidic
D	Moderate	Moderately balanced
E	Firm	Moderately balanced to balanced
F	Juicy/watery	Moderate to unbalanced/acidic

Table 5.4 Flavour Intensity & Description

	A			B			C			D			E			F		
	A	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**
Flavour intensity	3	4	3	3	4	4	2	2	1	2.5	3	3	3.5	4	4	3	2	3
Description:																		
Jammy/port/raisin	-	-	-	1	-	-	1	2	-	3	2	1	2	1	2	2	-	2
Chocolate	3	4	1	-	2	1	-	1	-	2	2	1	2	2	2	-	-	-
Plums	3	2	3	3	1	-	1	1	-	1	3	3	3	2	1	2	2	1
Spice – black pepper	1	1	-	2	3	4	-	-	-	1	-	-	1	-	0	-	-	-
Fruit conserve	3	4	1	3	3	3	-	-	1	3	2	2	4	4	4	-	-	-
Cherry	2	1	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-
Spice – white pepper	-	-	-	-	-	-	-	-	-	2	-	-	-	2	-	-	-	-
Raspberry/lolly						1	1	-	-	-	1	1	1	1	1	-	-	1
Herbal/leafy	-	-	1	-	-	-	-	-	-	-	-	-		-	-	-	1	-
Other – spice										*	**	***	#*			##		

* spice
** fruit cake
*** Christmas pudding
# prune
confectionary

Table 5.5 Fruit flavour characteristics assessed in the vineyard at harvest in the 2004/05 growing season

	A	**B**	**C**	**D**	**E**	**F**
Jammy	0	1	3	6	5	4
Chocolate	8	3	1	7	6	5
Plums	8	4	2	7	6	5
Spice - Black Pepper	2	9	0	1	1	0
Fruit conserve	8	9	1	7	12	0
Cherry	3	1	0	1	0	0
Spice - White Pepper	0	0	0	2	2	0
Raspberry Lolly	0	1	1	2	3	1
Herbal leafy	1	0	0	0	0	1
Other						

Table 5.6 Main Flavours in the six vineyards

	Main Flavours and Intensity (point score)
A	Chocolate (8), plums (8), fruit conserve (8)
B	Spice – black pepper (9), fruit conserve (9), plums (4)
C	Jammy (3), plums (2)
D	Chocolate (7), plums (7), fruit conserve (7)
E	Chocolate (6), plums (6), fruit conserve (12)
F	Chocolate (5), plums (5), jammy (4)

Table 5.7 Tannin Intensity and Description in the Field

	Tannin intensity (point score)	Description
A	Medium (6)	Grainy, chalky to powdery, talc
B	Medium – High (7)	Grainy, chalky, powdery and soft
C	Medium – Low (5)	Grainy, chalky
D	Medium – low (5.5)	Grainy, chalky and chewy
E	High – medium (7)	Powdery, talc fine
F	Low – Medium (4)	Grainy, chalky and chewy

APPENDIX 6

RESULTS: FRUIT CHARACTERISTICS: ANALYTICAL ASSESSMENTS

Table 6.1 Berry analysis at 'set' baumé

Block		Baumé	Brix	pH	TA	Anthocyanin	Phenolics	Berry Weight	Bunch Weight
A	A	15.00	27.00	3.50	4.70	2.48	1.74	0.88	68.35
	B	14.80	26.80	3.51	4.90	2.56	1.75	0.76	74.40
	C	14.30	25.80	3.51	5.10	2.43	1.69	0.88	93.95
	Ave	14.70	26.53	3.51	4.90	2.49	1.73	0.84	78.90
	stdev	0.29	0.52	0.00	0.16	0.05	0.03	0.06	10.92
	st error	0.17	0.30	0.00	0.09	0.03	0.02	0.03	6.31
B	A	14.10	25.40	3.47	5.90	2.37	1.76	0.72	66.60
	B	14.70	26.60	3.36	5.30	2.63	1.95	0.80	67.45
	C	12.70	23.40	3.36	6.90	1.57	1.20	1.24	122.27
	Ave	13.83	25.13	3.40	6.03	2.19	1.64	0.92	85.44
	stdev	0.84	1.32	0.05	0.66	0.45	0.32	0.23	26.05
	st error	0.48	0.76	0.03	0.38	0.26	0.18	0.13	15.04
C	A	12.70	23.00	3.36	5.30	1.96	1.46	1.36	98.57
	B	14.00	25.20	3.34	5.10	1.77	1.32	1.28	82.61
	C	12.90	23.30	3.40	4.80	1.93	1.40	1.36	93.14
	Ave	13.20	23.83	3.37	5.07	1.89	1.39	1.33	91.44
	stdev	0.57	0.97	0.02	0.21	0.08	0.06	0.04	6.63
	st error	0.33	0.56	0.01	0.12	0.05	0.03	0.02	3.83
D	A	14.20	25.60	3.36	6.10	1.71	1.30	1.40	122.40
	B	14.30	25.70	3.60	4.70	1.89	1.39	1.24	148.89
	C	14.30	25.70	3.37	5.50	2.12	1.54	1.40	141.69
	Ave	14.27	25.67	3.44	5.23	1.91	1.41	1.35	137.66
	stdev	0.05	0.05	0.11	0.58	0.17	0.10	0.08	11.18
	st error	0.03	0.03	0.06	0.34	0.10	0.06	0.04	6.46
E	A	14.50	26.10	3.31	5.40	2.04	1.40	1.36	92.60
	B	14.00	25.20	3.28	5.50	1.92	1.36	1.20	108.40
	C	13.80	25.00	3.46	4.80	1.98	1.36	1.48	90.00
	Ave	14.10	25.43	3.35	5.23	1.98	1.37	1.35	97.00
	stdev	0.29	0.48	0.08	0.31	0.05	0.02	0.11	8.13
	st error	0.17	0.28	0.05	0.18	0.03	0.01	0.07	4.69
F	A	13.40	24.10	3.44	5.10	2.12	1.62	1.20	91.30
	B	13.90	25.10	3.43	5.10	1.94	1.42	1.26	106.10
	C	14.10	25.40	3.37	5.70	2.57	1.72	1.38	104.80
	Ave	13.80	24.87	3.41	5.30	2.21	1.59	1.28	100.73
	stdev	0.29	0.56	0.03	0.28	0.26	0.12	0.07	6.69
	st error	0.17	0.32	0.02	0.16	0.15	0.07	0.04	3.86

Table 6.2 Berry analysis at "harvest"

	Baumé	Brix	pH	TA	Anthocyanin	Phenolics
A	14.6	26.3	3.51	4.9	2.42	1.76
B	14.8	26.7	3.44	5.6	2.41	1.79.
C	13.5	24.3	3.39	4.9	1.96	1.41
D	14.7	26.5	3.39	6	2.27	1.68
E	15.6	28.1	3.47	4.8	2.55	
F	13.9	25.1	3.4	5.6	2.16	

APPENDIX 7

RESULTS: WINE ASSESSMENTS

Figure 7.1 Tasting Sheet used in Wine Assessment

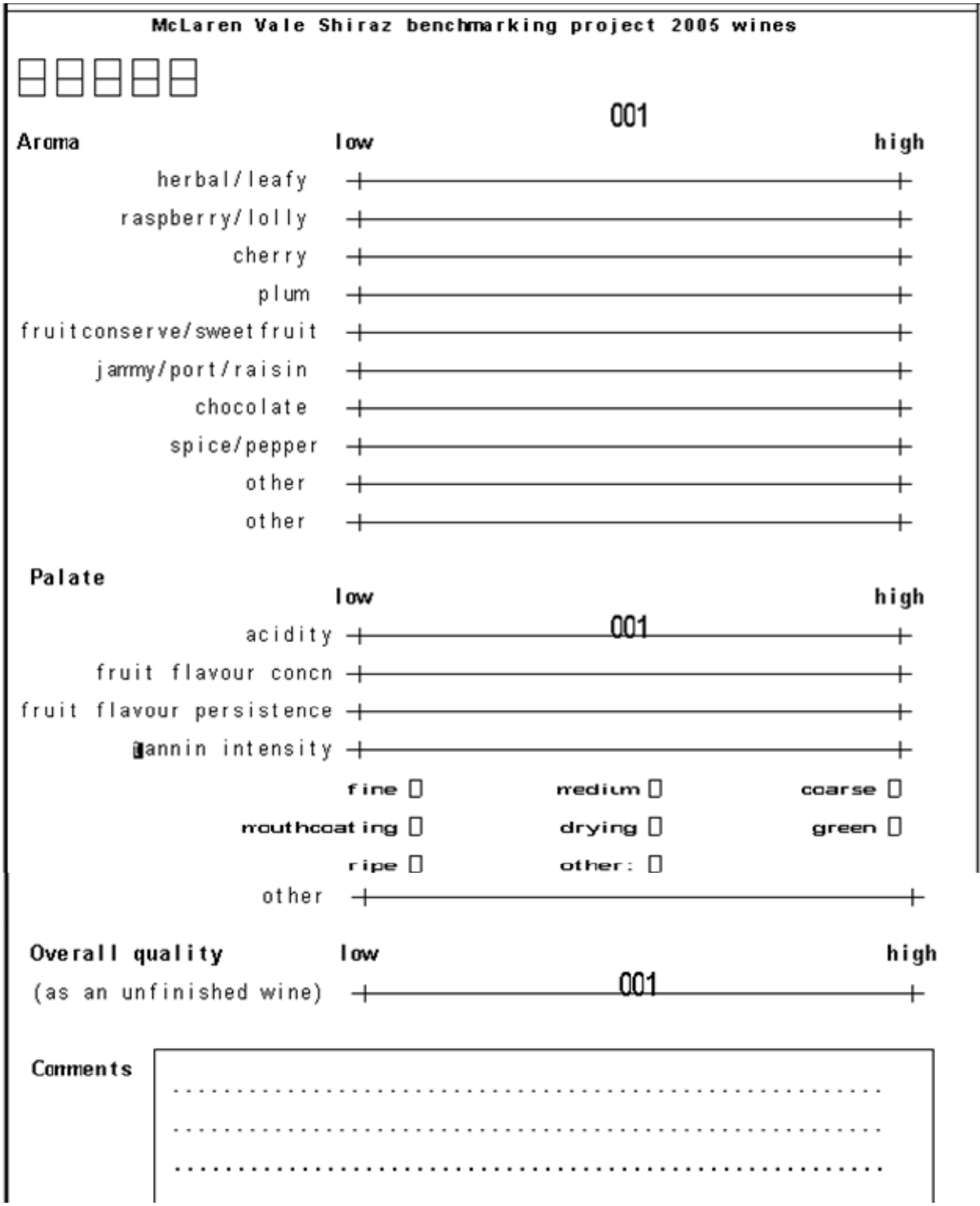


Table 7.1 Analysis of final wines from the respective wineries.

	Hardy Wines	Southcorp	Southcorp	Wirra Wirra	Wirra Wirra	Hardy Wines
	A	B	C	D	E	F
FSO2		22	30	41	24	
TSO2		62	64	86	71	
pH	3.42	3.8	3.7	3.62	3.66	3.47
TA	7.7	6.4	5.5	6.73	7.44	6.5
VA		0.38	0.42			
ALC	14.45	15.4	14.1	14.8	13.9	14.88
RS		2.5	10			
G/F				3.86	0.791	
Glucose	0.11					0.12
Fructose	0.09					0.08
MALIC	1.75	1.96	0.13	1.389	1.815	1.14
Colour				13.88	15.16	
280nm		0.69	0.657			
420nm	8.61	0.121	0.104			6.025
520nm	18.79	0.396	0.349			12.457

Table 7.2 Comments from tasters on wine faults

	Hardy Wines	Southcorp	Southcorp	Wirra Wirra	Wirra Wirra	Hardy Wines
	A	B	C	D	E	F
faults comments from tasters		rel. high RS	v. high RS	rel. high RS		
	no MLF high TA	no MLF	MLF complete	no MLF	no MLF	partially through MLF?
		sugar	stuck ferment, sugar, mousey	sugar		
	H_2S		H_2S	H_2S	H_2S	H_2S

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