Adelaide Hills Wine Region

SAUVIGNON BLANC & SHIRAZ VARIETAL STUDY 2004 - 2007

FINAL REPORT

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Australian Government
Grape and Wine Research and Development Corporation

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EXECUTIVE SUMMARY

The Grape and Wine Research and Development Corporation (GWRDC) and Adelaide Hills Wine Region Association have funded this project, **The Sauvignon Blanc and Shiraz Varietal Study**, for a period of three years, or three growing seasons (2004– 2007).

This report summarises the findings of the study, describing the eleven trial sites, including management practices and grapevine characteristics throughout the duration of the project 2004 - 2007. All sites are located within commercial vineyards, and although the total size of the varietal blocks varied, each trial site was of the same size and selected as being representative of the entire block or of its specific location in the Adelaide Hills region.

The report is purely a 'snapshot' of six blocks of Sauvignon Blanc and five blocks of Shiraz across three seasons. The findings are presented as observations with inferences made relating to the key project objectives where necessary. This final report has been prepared after three complete growing seasons, and the completion of sensory analysis of all project wines in years two and three of the project (carried out by Provisor Pty Ltd).

This study has shown intrinsic differences between both vine behavior and sensory properties of the Shiraz and Sauvignon Blanc wines, despite all sites being generally similar. The report suggests that the observed differences between wines made from these sites should mainly be attributed to terroir as well as the meso and microclimatic characteristics of each site and variety.

The findings for **Shiraz** note that although there are differences between vine behavior at each site, after analysis no clear associations can be made between wine sensory properties.

In contrast the findings for **Sauvignon Blanc** suggest that consistently good wine was produced from vines at a site which had the following attributes;

- high capacity, with high degree of vegetative vigour
- dense canopy with sheltered fruit zone
- deep loamy soil over loamy-clay with good organic matter in topsoil
- gentle south facing slope, sheltered position

The site with these attributes produced wine noted as having the most intense and fresh varietal characters of all trial wines.

1.0 BACKGROUND TO PROJECT

The aim of this project has been to provide a detailed 'snapshot' of how Sauvignon Blanc and Shiraz are grown in the Adelaide Hills and how these varieties are grown and perform within the smaller sub-regions of the greater Adelaide Hills Geographical Indication (GI). This has been achieved by conducting routine measurements at selected vineyard sites throughout the growing season; small batch wines have been produced from sample vines. It is envisaged that the findings may provide indicators of growth habits and management techniques, which may influence, or be used to influence, certain varietal characteristics in these different areas. Alternatively, findings may indicate that terroir is the only reason for the differences in wine quality and vine growth characters.

2.0 LOCATION OF PROJECT VINEYARDS

The vineyards used in this project were selected by the Adelaide Hills Wine Regions Viticulture Committee in conjunction with Davidson Viticulture. The locations were chosen, in an attempt to best represent different growing environments within the Adelaide Hills Wine Region. All sites used in the project are within established commercial vineyards which use 'typical' regional viticultural production techniques.

The Trial vineyards lie between Forreston (north of Gumeracha) and Kuitpo (south of Meadows) These locations are shown on the map in **figure 1**. All vineyards are within the registered Adelaide Hills GI. The vineyard at Lenswood is in the registered sub-region of the Adelaide Hills known as the Lenswood GI.

For more detail and a greater overview of the Adelaide Hills Wine Region, the review *Adelaide Hills Wine Region Profile* should be consulted. (Available from Adelaide Hills Wine Region Inc., prepared by Davidson Viticultural Consulting Services in 2004)

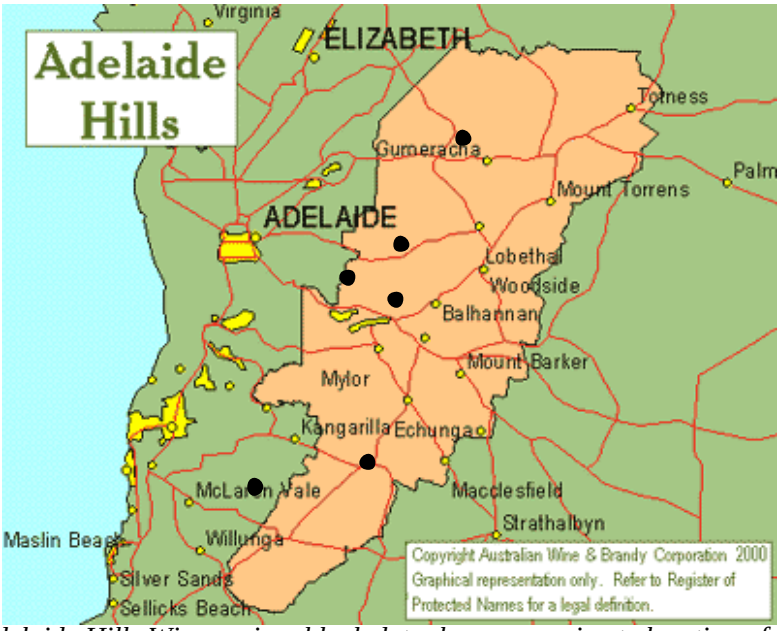

Figure 1. Adelaide Hills Wine region: black dots show approximate location of project sites

3.0 METHODOLOGY

Six vineyard sites were selected; within each of these sites individual vines were selected. Lenswood was the only site not to have both Shiraz and Sauvignon Blanc vines, having only Sauvignon Blanc.

Each vineyard site is in close proximity to an automatic weather station, some of which were purchased by the AHWR and installed at properties to monitor local weather patterns.

The individual vines were selected from areas within each vineyard which were considered to be representative of the block as a whole. This was to ensure that the growth and management of the vines was as uniform as possible within the block as a whole. The vines were tagged and recorded to ensure consistency of recording over the three season period. The vines were positioned across several rows and panels, with no two vines side by side. Details of the specific location of the vines are recorded in **Appendix 1**. At the Lobethal Vineyard site, frost caused significant damage in 2004/2005. In order to avoid similar problems in 2005/2006 and 2006/2007, a new set of vines was identified for future measurement, higher up the slope. At Kuitpo, a pruning trial entered the project area, necessitating the inclusion of two new vines into the trial.

Vine growth characteristics were assessed at approximately two week intervals throughout each growing season. Assessments were classified according to phenologically important growth stages, with major assessments at flowering, veraison and harvest while minor assessments were in between. The type of information captured during these assessments is detailed below.

3.1 MAJOR ASSESSMENT DETAILS

Major assessments were carried out at the phenological stages of flowering, veraison and harvest.

Measurements taken:

Flowering
- Node number per vine
- Count shoot number per vine
- Non count shoot number per vine
- Shoot length
- Internode (5-6) length
- Number lateral shoots per main shoot
- Presence of actively growing shoot tips
- Bunch number per shoot
- Bunch number per vine

Veraison
- Count shoot number per vine
- Non count shoot number per vine
- Shoot length
- Internode (5-6) length
- Number of lateral shoots per main shoot
- Presence of actively growing shoot tips
- Leaf layer number
- Bunch number per shoot
- Bunch number per vine

Harvest
- Degree of shoot lignification
- Leaf layer number
- Bunches per shoot
- Bunches per vine
- Bunch weight
- Berries per bunch
- Berry weight
- Degree of
  -Fruit exposure
  -Bunch compactness
  -Berry shrivel
  -Bunch distribution

3.2 MINOR ASSESSMENT DETAILS

Minor assessments were mainly based upon visual observations. The minor assessments were carried out on a frequency determined by the vine growth, or at least at fortnightly intervals in between major assessments. The following list details some of the observations recorded during minor assessments of the varietal study.

•Phenological development (Modified E-L Stage)
•Main shoot number, length and variability
•Bunch number, berry number and bunch weight
•Percentage of shoots with growing tips
•Lateral shoot number, length and variability
•Shoot periderm development (degree of shoot lignification)
•Leaf condition
•Canopy light conditions
•Bunch exposure
•General observations including points of interest relating to canopy structure, vineyard operations etc.

3.3 DATA COLLECTION AND ANALYSIS OVERVIEW

After revision in the methodology the assessment procedure and resulting data obtained in the 2004/2005 season, areas for improvement were highlighted and specific changes made. These changes were implemented to generate a data-set more targeted towards the Project's aims and to allow better utilisation of the data by growers. The main changes related to achieving more qualitative results which could easily be applied in the field, or used to benchmark against current management practices.

The collection of data over three growing cycles has reduced some of the effects of seasonal variability. The information supplied in this report (unless stated otherwise) is presented as averages or means. These are the combination of all vines at a particular site, or the compilation of site data across seasons. Throughout this report seasons are referred to individually at times. When 'the project' is referred to this means all growing seasons between 2004 and 2007.

In 2005/2006 individual shoot measurements were not made; rather, shoots were assigned to particular categories. This gives the data a better description of the shoot growth at a particular time rather than a simple average number for all shoots.
For example a vine with an average shoot length of 103.4cm would in reality contain many shoots of varying sizes so this one figure has been replaced by a percentage of shoots in specific categories.

4.0 SAUVIGNON BLANC

Despite project vineyards being spread across the entire Adelaide Hills region, similar viticultural practices were employed at all sites. This included general canopy, sward, midrow and fungicide management techniques. Irrigation techniques varied between sites however this was more an indication of the differing soil types than specific management. All sites practised vertical shoot positioning (VSP), but this was more strict at some sites than others.

A brief discussion of the management practices employed with Sauvignon Blanc over the trial period is provided below.

4.1 MANAGEMENT PRACTICES

4.1.1 FORRESTON SAUVIGNON BLANC

Seasonal variation in the vine canopies was noticeable in these vines, particularly in 2006 when the canopy was very dense resulting in high levels of internal leaf senescence and increased disease pressure. This site followed a low input management strategy in 2004/2005 and 2005/2006 with more regimented management in 2006/2007, overall the vine management in terms of inputs has been relatively low compared with other sites in the trial.

Variety,Clone	Sauvignon Blanc, F4V6
Elevation	Approximately 430m.
Aspect	Moderate to steep easterly slope
Row orientation	Rows run East West from mid slope to hillcrest
Soil type	Friable red podzolic Soloth and Solod (**Appendix 4.1**)
Irrigation	As required by visual observation, usually restricted to late in the season. Approximate volume applied ~40-50 litres/vine
Nutrition	Foliar applications included with fungicide sprays,
Trellis	Two offset fruiting wires. Lower fruiting wire is at 1.0m on the southern side of the post the second fruiting wire is at 1.1m on the northern side of the post. Two pairs of foliage wires at 1.4m and 1.75m height
Pruning	Spur pruned (recently converted from cane)
Canopy Manipulation	Foliage wires moved loosely after flowering and again in mid January to direct the majority of shoot growth up. Historically not a 'strict' lift as many shoots still remain outside wires. Shoot tipping and topping is practised late in the season to arrest shoot growth if required.
Vineyard Floor Management	Volunteer growth of wild grasses, including Phalaris mid row grasses were allowed to grow very long in years one and two until mid to late season then slashed. Final year of the project saw more regimented floor management with grass kept low and undervine weeds effectively controlled with herbicides.

FORRESTON SAUVIGNON BLANC

Figure 2. Typical view of slope and structure of Forreston site (22/1/07)

Figure 3. Forreston site close to harvest (2006) showing bunch exposure and VSP technique

Figure 4. Forreston site at flowering (18/12/05)

Figure 5. Forreston fruit detail showing bunch structure (2006, 2007)

4.1.2 LOBETHAL SAUVIGNON BLANC

The Lobethal Sauvignon Blanc site was frosted in the first year of the project, this resulted in 'new' project vines being identified a small distance up-slope. In season 2006 the vineyard was head pruned to two canes on a slightly higher cordon wire with the intention of establishing a spur pruning regime.

The lower parts of these rows are frost prone and therefore strict sward management is employed. This includes regular slashing during the growing season. Throughout the project life this vineyard has remained relatively free of weeds undervine.

Variety/Clone	Sauvignon Blanc, F4V6
Elevation	Approximately 350m
Aspect	Gentle Easterly aspect
Row orientation	Rows run East to West from within a valley up to the hillcrest in the West
Soil Type	Red / Yellow / Grey podzolic (**Appendix 4.3**)
Irrigation	Applied as required, season one and two contrasted greatly with starting time being Nov and Feb. Total irrigation volumes ranged from 120-200L/vine split over irrigations with roughly 20L per irrigation. This includes a large post-harvest irrigation.
Nutrition	Fertiliser regime over trial period has included ground applications during dormancy. Foliar applications in growing season with fungicide program as well as fertigation with Calcium Nitrate during growing season.
Trellis	Two offset fruiting wires. Lower fruiting wire is at 1.0m on the southern side of the post the second fruiting wire is at 1.1m on the northern side of the post. Two pairs of foliage wires first at 1.3m and second at 1.7m
Pruning	Cane pruned to three or four canes, vigour dependant. Converted to single wire, with a permanent arm in final season of trial.
Canopy Manipulation	Generally two foliage wire lifts required, timing dependant on growth rate. Shoot trimming required January or December; tops targeted with minimal removed from sides.
Vineyard Floor Management	Volunteer sward kept under strict control due to frost risk, slashed as required, (up to five times per season). Under-vine weeds were controlled with herbicide during dormancy and with one application during growing season.

Figure 6. Lobethal site looking up-slope (west) (28/12/06)

Figure. 7 Lobethal typical canopy structure and density (7/3/06)

Figure 8. Lobethal site at flowering showing (8/12/05)

Figure 9. Fruit detail

4.1.3 LENSWOOD SAUVIGNON BLANC

Variety/Clone	Sauvignon Blanc, F4V6
Elevation	Approximately 440m
Aspect	Slight Northerly aspect
Row orientation	East West
Soil	Gradational Kilonit (**Appendix 4.5**)
Irrigation Nutrition	Applied as required commencing in November in year one and January in year two. Irrigation ranged from ~1.2-2.6ML/ha, at intervals of 7-14 days. Fertigations were applied during the growing season H-Nib and Secure Can
Trellis	Two offset fruiting wires, lower fruiting wire is at 1.0m on the southern side of the post, the second fruiting wire is at 1.1m on the Northern side of the post.
Pruning Canopy Manipulation	Cane pruned to four canes on offset fruiting wires. Canopy management on this block has included removal of one fruiting cane (year one), and early season shoot thinning of non-count shoots from the crown. Two wire lifts are usually required to obtain a strict VSP canopy.
Vineyard Floor Management	Mid-row volunteer permanent sward, maintained low throughout the season. Vine-row weed control by herbicide application during dormancy and once during the growing season.

Figure 10. Lenswood site looking east (22/1/07)

Figure 11. Lenswood canopy at harvest (2006)

Figure 12. Lenswood site at flowering (10/11/06)

Figure 13. Fruit detail

4.1.4 BALHANNAH SAUVIGNON BLANC

This trial site is part of a larger block which extends on its westerly aspect into an area of high vigour. The project vines are in an area of high vigour and have had canes layered in between vines, with the dripper closed off at the parent vine and moved across to the layered vine.

Variety/Clone	Sauvignon Blanc, F4V6
Elevation	Approximate elevation is 400m.
Aspect	Westerly aspect three quarters of the way up a hill slope
Row Orientation	Rows run North to South along the hillside
Soil Type	Red / Yellow podzolic (**Appendix 4.6**)
Irrigation	As required from moisture monitoring data. Usually applied in shifts from 9-12 hours per week totalling around 1.2 ML/ha to 1.3ML/ha
Nutrition	In Autumn, lime has been broadcast at around 5t/Ha. Seasol root stimulant also applied post harvest in season three.
Trellis	Two offset fruiting wires the lower fruiting wire is at 1.0m on the eastern side of the post the second is at 1.1m on the western side of the post.
Pruning	Two cordons bilaterally trained, Three spur pruned and the 4th is cane pruned. The cane pruned cordon is changed each year to minimise the possibility of shading and vigour reduction associated with double vertical permanent arms.
Canopy Manipulation	Early season shoot thin to remove non-count shoots from the crown area. Foliage wires lifted once or twice during the season as required to contain foliage. Shoot trimming is undertaken late in season targeting tops and removing minimal foliage from sides
Vineyard Floor Management	Mid-row consists of a volunteer permanent sward with broadleaf species controlled by selective herbicide and slashed as required (on average twice) during the season. Vine row weed control is undertaken using one herbicide application during dormancy and one during the growing season

Figure 14. View to South into Balhannah vineyard (31/1/07)

Figure 15. Balhannah vine at harvest (2006)

Figure 16. Balhannah vine at flowering (8/12/05)

Figure 17. Fruit & bunch detail

4.1.5 MEADOWS SAUVIGNON BLANC

The property at Meadows is the only site to have a southerly aspect and is located in a vineyard consisting of short rows. The trial vines are found mid way up a gentle slope.

Vine nutrition on this vineyard over the trial period has included banding and broadcasting of Neutrog. Irrigation is applied from a dam on site and average water applications have been less than 1ML/Ha (0.7-0.8) throughout each season of the project.

Variety/Clone	Sauvignon Blanc, F4V6
Elevation	Approximately 412m
Aspect	Moderate Southerly aspect on a small hillside
Row Orientation	North to South
Soil Type	Acidic sandy loam over brown clay (**Appendix 4.8**)
Irrigation	Applied late in the season only as required on average totaling from 0.75 to 0.85ML/ha
Nutrition	Prior to project Neutrog was applied
Trellis	Two offset fruiting wires, lower fruiting wire is at 1.0m on the eastern side of the post, the second fruiting wire is at 1.1m on the western side. Two pairs of moveable foliage wires.
Pruning	Cane pruned to four canes either side of the crown on offset wires.
Canopy Manipulation	Selective shoot thinning is undertaken if required to remove non-count shoots. Shoot trimming of tops and sides to allow side netting in late Feb/early March to allow side netting. Up to three wire lifts can be required to contain growth.
Vineyard Floor Management	Mid-row volunteer permanent sward, on average slashed twice per season. Vine row weed control using one herbicide during dormancy and one during growing season, pre-emergent herbicides may also be used during dormancy.

Figure 18. Meadows vineyard looking South (down slope) (21/2/06)

Figure 19. Meadows site close to harvest (20/3/06)

Figure 20. Meadows site at flowering (8/12/05)

Figure 21. Fruit & bunch detail

4.1.6 KUITPO SAUVIGNON BLANC

This vineyard is on a neutral to easterly aspect of relatively long rows, the project vines are found at the eastern end of the rows which is also towards the higher end of the block. This area is still prone to some minor frost damage which has been observed during the project period. In year three of the project a spur pruning trial was conducted which overlapped the project vines. Due to this fact several vines used in the project were re-tagged in an adjacent row unaffected by the trail.

Variety/Clone	Sauvignon Blanc, F4V6
Elevation	Approximately 300m
Aspect	North to Easterly aspect
Row Orientation	East West
Soil type	Acidic gradational loam over rock (**Appendix 5.0**)
Irrigation	Minimal irrigation required
Nutrition	5L/ha Foliar plus E-L 18; 5L/ha Zn/Mn pre flowering
Trellis	Two offset fruiting wires. Lower fruiting wire at 1.0m on eastern side of post, second fruiting wire is at 1.1m on the western side of post. Two pairs of moveable foliage wires.
Pruning	Cane pruned to four canes, with two canes either side of the crown on offset wires.
Canopy Manipulation	Shoot thinning if large numbers of non-count shoots arise. Trimming is undertaken once foliage extends ~300mm from tops of posts, hand trimming of sides has been undertaken in year one of project, otherwise mechanical side trimming is used.
Vineyard Floor Management	Mid-row sown to ryegrass/clover permanent sward, slashed as required, some seasons frequent passes required. Under-vine area is mounded weed control is via herbicides.

Figure 22. Kuitpo site looking east into the vineyard ((9/11/06)

Figure 23. Kuitpo site close to harvest (7/3/06)

Figure 24. Kuitpo site at flowering (8/12/05)

Figure 25. Fruit & bunch detail

4.2 VITICULTURAL OVERVIEW OF SAUVIGNON BLANC PROJECT SITES

4.2.1 SOIL

As stated in 4.1 these vineyards are all managed in a similar manner, however the individual vine growth characteristics are all quite different. This can be attributed to many factors however the single strongest influence is likely to be the soil. Soil pits were dug at each of these sites and professionally analysed to observe the major differences. These tests included physical observations as well as chemical analysis at both 30cm and 50cm, this zone being considered indicative of typical root zone depths.

All Sauvignon Blanc sites were observed to have dark coloured soils near the surface; this usually indicates high levels of organic matter and therefore reasonable nutrient content and soil structure. Observation of red and orange colours in the profiles indicates reasonable drainage. Forreston showed the best soil structure in this regard while the Meadows site had a much deeper profile and more grey colouration. No soils were observed to be truly grey or blue/grey which would have indicated water logging or major aeration issues, nor were any soils regarded as being highly pale which may indicate bleaching and leaching through the profile.

Several soils showed some restriction of root growth within the soil profile, either due to physical compaction in the wheel tracks or formation of a Fragipan layer[1]. Formation of a Fragipan layer can form a barrier to root growth over time; this was evident in varying levels at Kuitpo, Meadows and Lobethal. Physical compaction was observed at all sites with the exception of Forreston, while Lenswood and Lobethal showed only minor compaction in the wheel tracks. The Balhannah site showed early signs of compaction but also displayed a soil type with some ability to 'self repair'. Only Forreston showed preferred soil condition and root distribution patterns.

The Adelaide Hills has naturally acidic soils due to its relatively high rainfall and associated leaching. Chemical analysis revealed that soil pH_{CaCl2} ranged from 4.6 to 6.1 across the Sauvignon Blanc sites. See Table 1; full results can be seen in **Appendix 4**.

Table 1. Soil pH and CEC ranges for Sauvignon Blanc sites in Adelaide Hills

	pH at depth			CEC at depth		
	30cm	50cm	General comment	30cm	50cm	General comment
Forreston	5.9	6.1	Moderately acidic	10.1	13.5	Acceptable
Lobethal	4.6	4.9	Strongly acidic	3.8	20.1	Low fertility to Acceptable
Lenswood	5.2	5.3	Strongly acidic	4.6	9.4	Low fertility to Acceptable
Balhannah	5.2	5.6	Strong/Moderately acidic	8.5	7.6	Acceptable
Meadows	5.7	5.4	Moderate/Strongly acidic	12.7	6.4	Acceptable
Kuitpo	5.1	5.5	Strong/Moderately acidic	7.07	9.3	Acceptable

In general, a soil pH_{CaCl2} <4.8 is likely to cause some nutrient related issues which in turn may affect vine performance. Directly linked to the soil pH is the cation exchange capacity (CEC), which refers to the soil's ability to hold and release cations or specific nutrients. The higher a soil's CEC, the greater the potential fertility of the soil. Most sites show generally acceptable CEC levels however Lobethal and Lenswood show lower than desirable CEC levels at 30cm indicating low fertility. The other interesting figures to note are the high CEC levels at 50cm in Lobethal and at 30cm in Meadows. The Lobethal site shows moderate vigour,

[1] A Fragipan layer is created when a slurry of silt moves through the soil through micro-pores until it becomes lodged. As this buildup continues, a compacted silt layer is formed which is impermeable to both water and roots.

while at Meadows the CEC levels could be responsible for the high vigour and vine capacity shown at this site. All soil information can be found in the **appendix**.

4.2.2 CANOPY MANAGEMENT

All of these sites employ a particular style of Adelaide Hills 'cool climate' vertical shoot positioning (VSP) canopy management. Some sites such as Kuitpo strictly adhere to this management, while on the other end of the scale Forreston uses a more relaxed form of VSP in managing the Sauvignon Blanc canopy. The impacts of these differing canopy management techniques should also be considered when assessing links between the vines' performance and their resultant wine flavour characteristics. For example, the Meadows vineyard displayed one of the highest leaf layer numbers in the trial (see section 4.3.5 and 4.4.3) and a bunch zone which was classed as being 'shaded'. However, sensory analysis of completed wine from this site was noted to have equal highest overall fruit intensity, as well as a fresh varietal aroma when tasted alongside all Sauvignon Blanc project wines.

4.2.3 CLIMATE

The location of a weather station near to each site has allowed analysis of the grape growing conditions down to the mesoclimatic level within individual vineyards. While this is very specific to each site, and results may vary from many interactions, certain factors can be extracted and analysed in order to compare key differences between the sites studied.

Key climatic information can be found for all project seasons in Appendices 5-7. Despite all sites being within the Adelaide Hills GI, many small differences in climatic data are observed. The use of this information when comparing sites may give a point of difference and may perhaps also be related in some way to vine growth and even wine sensory characteristics.

Specific climatic data has been collected from all vineyards throughout the project period. From January 2005 all sites have had dedicated weather monitoring instruments operating as close as practicable to the trial vines. Due to the timing of installation, weather data is not available for the entire 2004/2005 growing season, also technical difficulties required that the weather data for the Lobethal property has been supplemented with some data sourced from a nearby Charleston weather station. Where Lobethal(ch) is present indicates that some Charleston figures have been used.

The climatic data collected may be used as an extension tool to make further observations on differences between project sites. The data presented below has been chosen to show how the site specific characteristics of the growing environment can be quite variable, especially in a region such as the Adelaide Hills. **Figure 26** shows the maximum and minimum temperatures recorded for each month during the project period. This chart shows that there is some variability among sites, but they follow a similar trend as would be expected.

The climatic data for all sites is very similar with the largest variation between sites being between temperature minimums. The northern most site at Forreston shows the highest mean minimum temperature throughout the growing season; this site also displays the highest mean January temperature (MJT). In contrast the second most southerly site at Meadows closely follows the Forreston site in regards to the minimum temperature. MJT is an index commonly used in climatic analysis in viticulture since it is easily compared between sites and regions. All sites here have similar MJT recordings within a degree or two, over the three seasons.

4.2.4. MAXIMUM, MINIMUM AND MEAN TEMPERATURES BY MONTH FOR ENTIRE PROJECT PERIOD (GROWING SEASON ONLY 1ST OCT – 30TH APR)

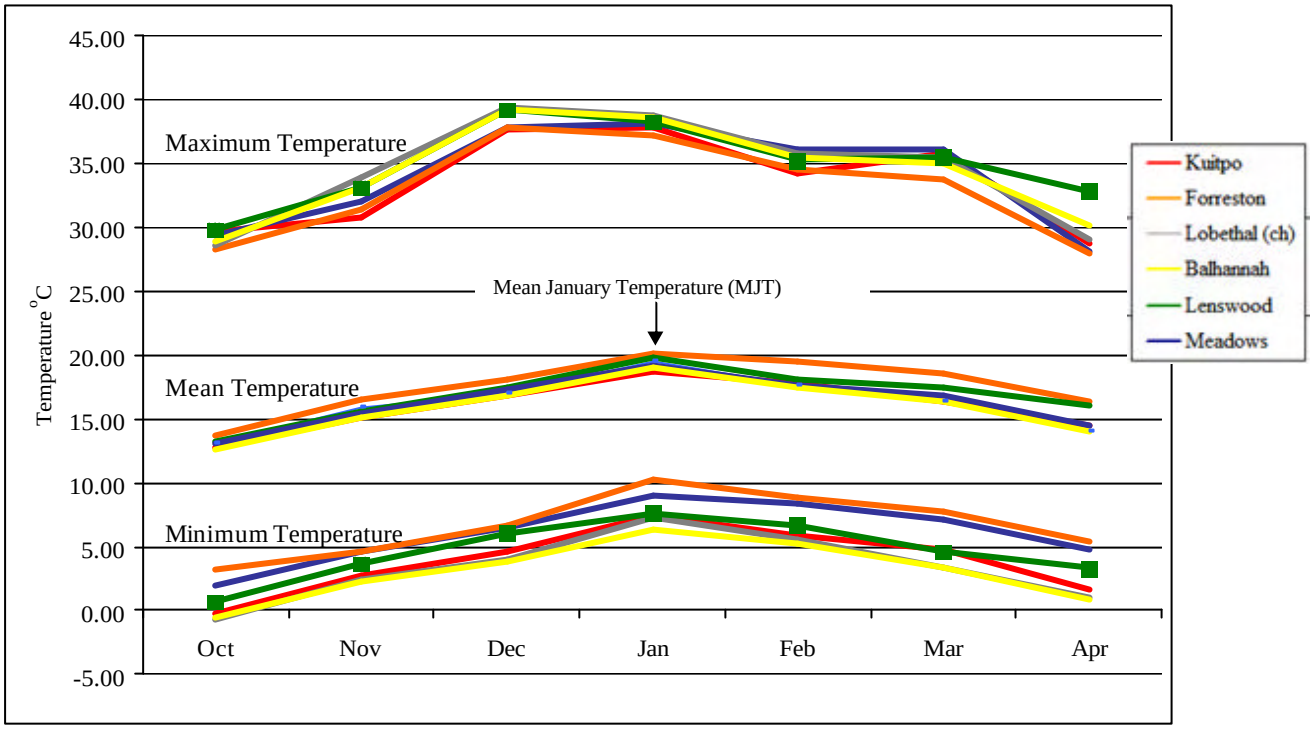

Figure 26. Monthly maximum, minimum and average temperatures measured over trial period 2005 - 2007

To further examine the climatic differences of the project sites a raw summation of biologically effective day degrees (BEDD) has been calculated. This is an index which considers that optimum vine growth occurs between temperatures of 10ºC and 19ºC, as outside of this range, temperatures are not as conducive to phenological growth. Day degrees are calculated allowing the sites to be compared relative to their individual summation of biologically effective temperatures. This BEDD is "raw" meaning that no adjustments have been made for small differences at each site such as altitude, slope, soil type etc. The base temperatures have been adjusted for temperature between 19ºC and 10ºC. **Figure 27** displays the average daily BEDD for the project vineyards over the entire project period. The most Northerly site at Forreston showed the highest average daily BEDD for six out of the seven growing months, with Lenswood showing the second highest daily BEDD for five out of the seven growing months.

4.2.5 AVERAGE DAILY BEDD PER MONTH BY SITE FOR ENTIRE PROJECT PERIOD

(GROWING SEASON ONLY 1ST OCT – 30TH APR)

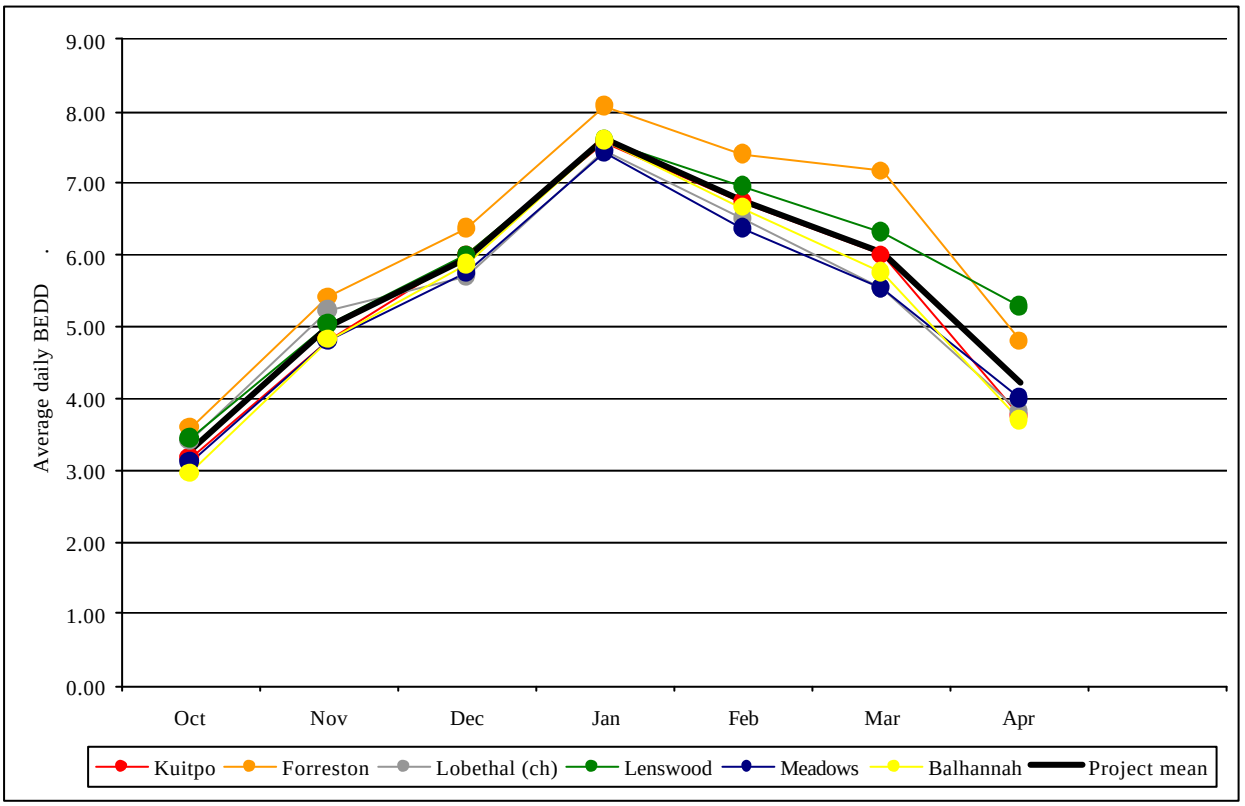

Figure 27. Average daily bio logically effective temperature (adjusted) for each site and mean of all sites.

The growing season totals for BEDD can be seen in table 2, this lists the growing season summation of BEDD averaged over the three project seasons. These figures can be used for determination of theoretical harvest date and also suitability of varieties to a particular site. Further information on this can be found in Gladstones (2002 pp67) which presents groups of varieties which require similar BEDD accumulation to ripen. From this Gladstones (2002) states that Sauvignon Blanc requires 1150º days which is only reached at three out of the six sites. This information highlights the need for good site selection when considering the unadjusted BEDDs. Considering this, in reality all project sites can comfortably grow and ripen Sauvignon Blanc.

Table 2. Growing season BEDD accumulation for project period

Kuitpo	1169.7
Forreston	1269.2
Lobethal (ch)	1118.3
Lenswood	1141.66
Meadows	1254.1
Balhannah	1081.8

While the average BEDD gave a 'snapshot' at a point in time and the total growing season BEDD showed the potential of each site to ripen certain varieties, the accumulated BEDD shows how each site builds to ripeness. To get a picture of how these figures pan out over the season **Figure 28** displays the BEDD accumulation over time and how it varies between sites. This figure shows that the highest monthly degree day readings also translate into the greatest accumulation of BEDD over the growing season. This figure shows that early in the season, many of the sites are similar, however by January Forreston is beginning to accumulate more odays than the other sites slowly followed by Lenswood, Kuitpo, Balhannah, Meadows and Lobethal. The kinks in the accumulation lines shown by Meadows and Lobethal are slight adjustments which occurred due to technical problems with the weather stations.

BEDD ACCUMULATION BY SITE FOR ENTIRE PROJECT PERIOD

(GROWING SEASON ONLY 1ST OCT – 30TH APR)

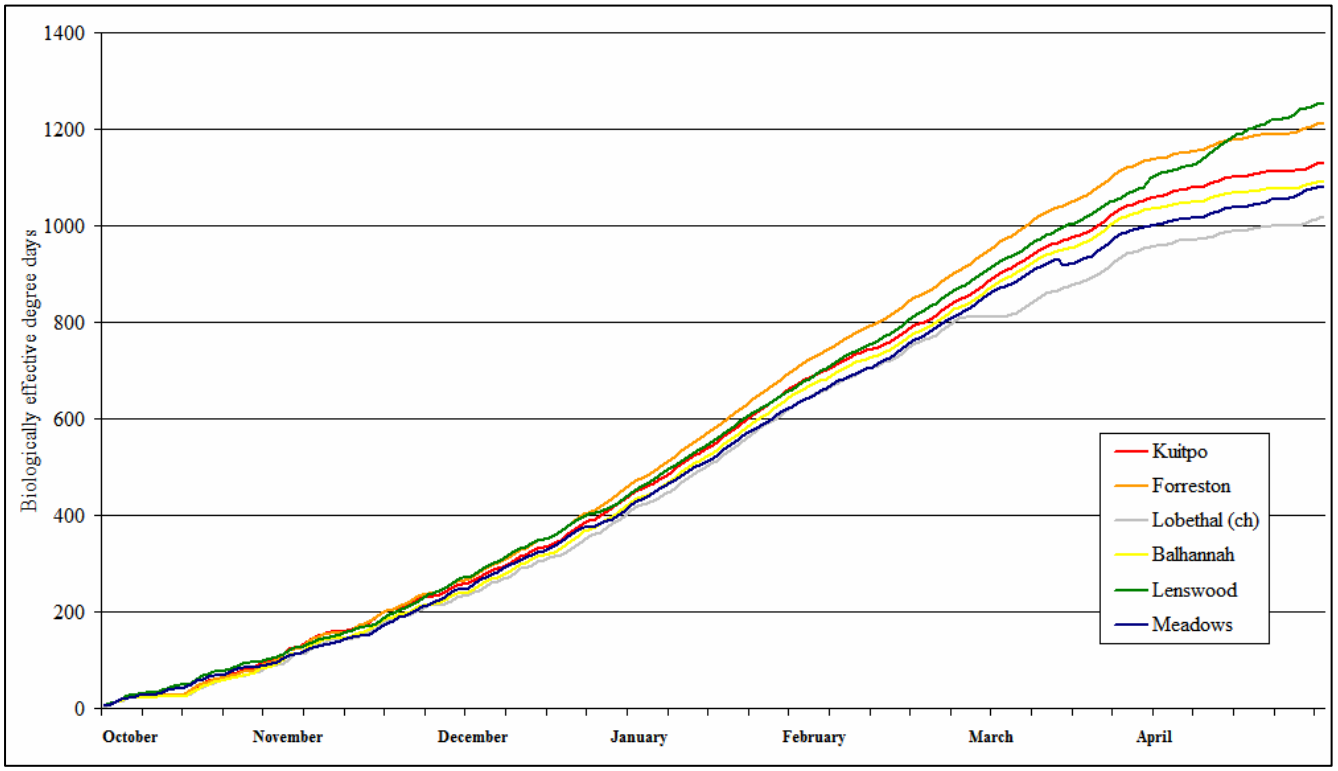

Figure 28. Accumulated BEDD from October to May measured using data collected from 2005 - 2007

4.3 SEASONAL COMPARISONS AND DISCUSSION OF FINDINGS

The following section presents an overview of the findings to date, each site is discussed with special emphasis on key points in relation to wine quality. In an attempt to minimise long term variability, the recorded data set from each site has been averaged and this in turn is shown next to the combined long term averages of all sites and all seasons.

4.3.1 FORRESTON SAUVIGNON BLANC

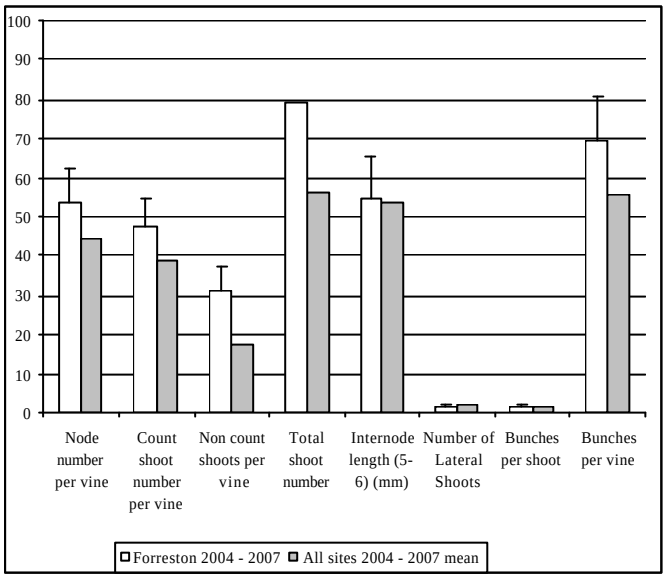

Figure 29. Forreston long term flowering data versus project average.

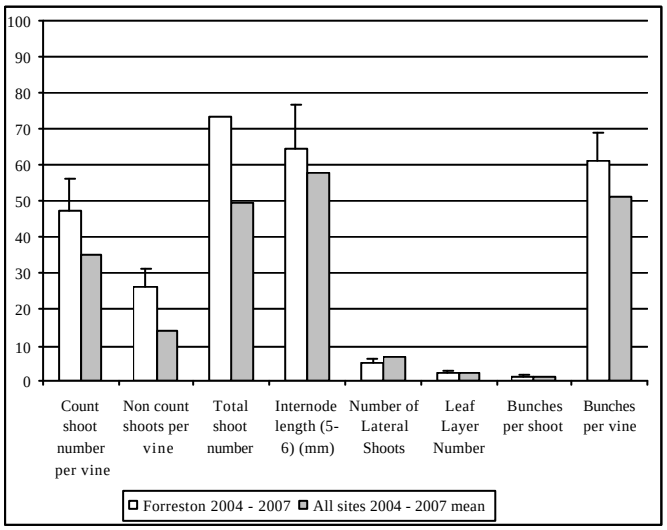

Figure 30. Forreston long term veraison data versus project average.

The Forreston site has had relatively high variations in pruning levels over the course of the project. This is represented in **Figure 29** by the higher than average shoot numbers. In 2005 winter there was a doubling of the count nodes retained which resulted in high shoot numbers. This in turn increased the bunch number per vine in that season which is also shown in the data in **Figure 30**

Over the period of the project shoot numbers are still much higher than the average for all Sauvignon Blanc sites combined.

Large canopy dimensions resulting from long spur arms and spur pruning technique, appeared to cause high levels of internal shading within the canopy. Each season some deterioration and loss of leaf function was observed within the canopy evidenced by basal leaf yellowing, senescence and death of young non count shoots within the canopy. This was especially noted in year two when the canopy was most dense.

The Leaf Layer Number (LLN) represents the number of leaves in a direct line from the exterior of the canopy to the bunch zone. This site had an average LLN over the project period with the lowest recorded LLN at harvest of <1. This site in-turn showed medium to high bunch exposure over the project period.

Wine sensory analysis of 2006 vintage showed this wine to have several unique flavours of 'flint and green apple' not observed in any other wines. In addition to this the Forreston Sauvignon Blanc was one of two wines which showed high acidity, and also was noted as displaying high citrus flavours overall. In 2007 sensory analysis revealed this wine to have 'flat acidity' and no unique sensory characteristics. But was noted as being 'green and fresh'

4.3.2 LOBETHAL SAUVIGNON BLANC

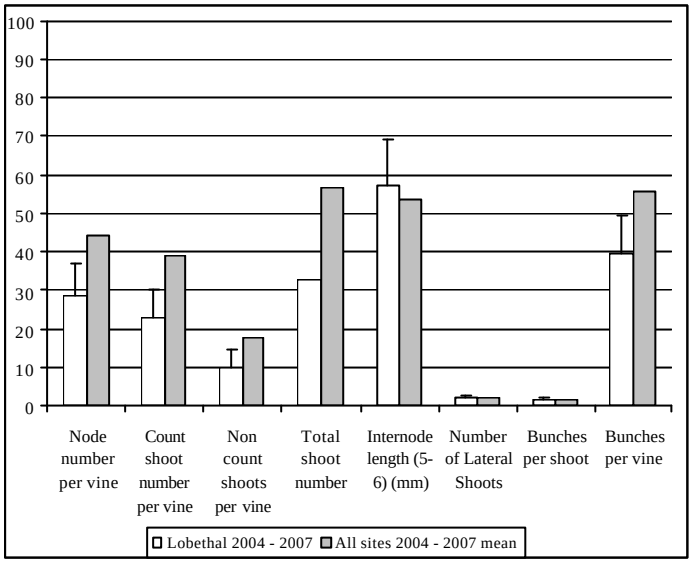

Figure 31. Lobethal long term flowering data versus project average.

The Flowering data recorded from the Lobethal vineyard **Figure 31**, shows a much lower than average total shoot number due to a change in pruning technique.

The cane pruning method changed over the course of the project but across all years the Lobethal site had the lowest node numbers recorded by average. This has been impacted further through a change in management resulting in current seasons node number per vine to be half that of the project average per vine. This has been undertaken in order to convert this site to a spur pruning régime.

Irrespective of this, over the project period this site has dsplayed lower than average count, non count and total shoot numbers along with above average internode length.

The relatively low capacity of the site, along with the position of these vines in the vineyard (mid way down a slope having low vigour above and high vigour below) has helped to control vegetative growth. This is apparent by the relatively even budburst percentage over the project period (reference to within for chart).

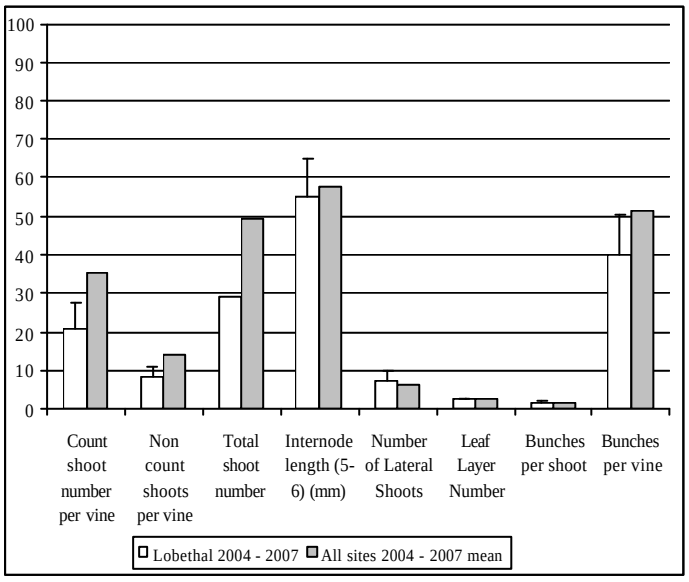

Figure 32. Lobethal long term veraison data versus project average.

Veraison data **Figure 32**, reflects the previously mentioned shoot number anomalies and also shows that lateral shoot growth is just above average for the project period. Despite this lateral growth LLN is noted as being average (~2.4) at veraison but among the three lowest at harvest (~1.4). This lateral growth can be partially attributed to the slight frost effects observed at this site which caused some apical meristems to be damaged early in the season.

Vine vigour and leaf condition decline later time in the season (due to vine placement part way down long rows on a slope). This results in minor basal yellowing and medium to high levels of bunch exposure at harvest.

Sensory analysis of wine made from these vines in was perceived as having 'more body' than other Sauvignon Blanc wines in the project. It also showed alcoholic warmth with a slight bruised apple aroma noted in the 2005 2006 vintage lowering the quality overall making the wine 'dull'. This wine was also unique in terms of showing no (or very low) vegetal characters and more 'ripe-tropical' flavours and aromas. Still in 2007 this wine showed tropical characters with some 'grassiness' perceived on tasting. This wine was noted as having the 'least intense' aroma and being 'slightly dull' in 2007.

4.3.3 BALHANNAH SAUVIGNON BLANC

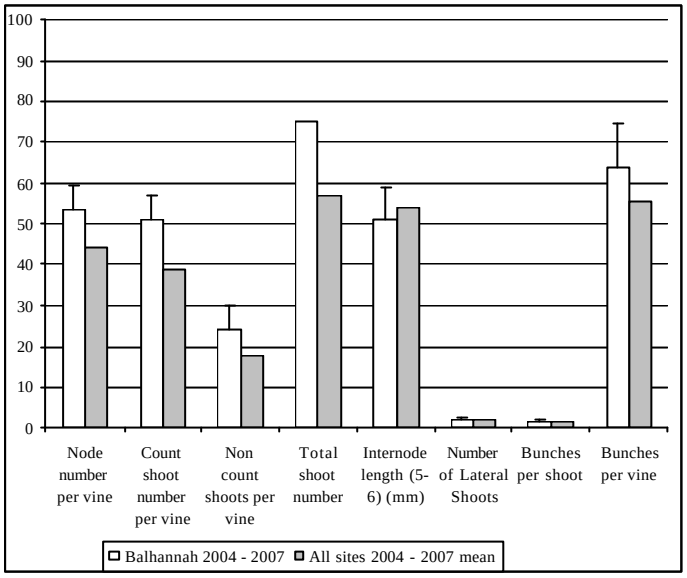

Figure 33. Balhannah long term flowering data versus project average.

The Balhannah site at flowering (**Figure 33**) shows some similarities to the project average data. The node and shoot measurements are higher than average possibly due to the spur pruning technique employed in this vineyard. The higher than average shoot numbers have resulted in lower than average internode length being recorded.

This site practises shoot thinning which can be seen by the reduction of shoot numbers overall and a noticeable reduction in non count shoots at veraison which brings this figure closer to the project average (**Figure 34**).

The layering of canes in the winter of 2006 has also slowed vigour considerably on the parent vines, evidenced by many non count and smaller shoots showing slow growth while main shoots displayed moderate growth in the early part of the 2006 2007 season.

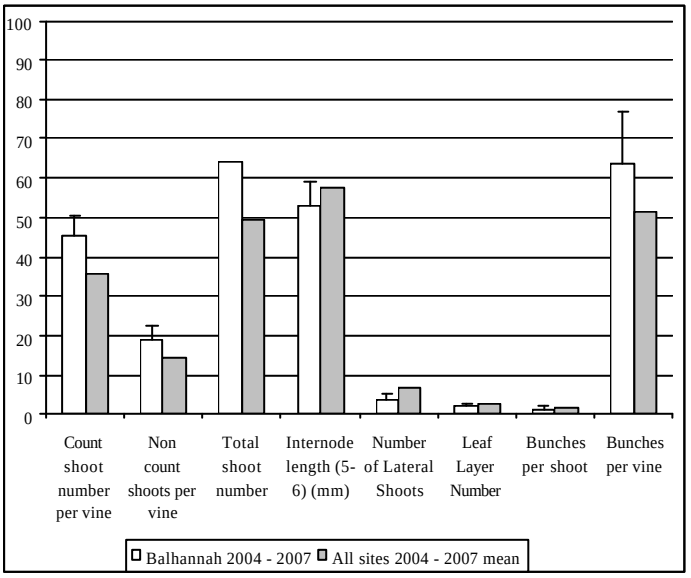

Figure 34 Balhannah long term veraison data versus project average

Bunch number per shoot is below average at this site, however bunch number per vine is higher due to the higher overall shoot number. Visual observations of the bunch zone at harvest time were generally showing medium bunch exposure from the loss of some leaves due to basal senescence later in the season. Also noted at this time was generally medium bunch density in the fruiting zones (dual cordon) and highly compact bunch structure.

Sensory analysis of the wine made from these vines in 2006 showed a unique flavour descriptor among all project wines which was pineapple. This wine was also noted as displaying 'ripe fruit'. This site was the only site not to display a 'confectionary' aroma, despite this the sensory panel noted this wine to have the most intense colour amongst Sauvignon Blanc wines.

In 2007 sensory analysis did not note this wine as differing greatly from the others tasted, it was noted as having 'flat acidity' and 'light-medium body'.

4.3.4 LENSWOOD SAUVIGNON BLANC

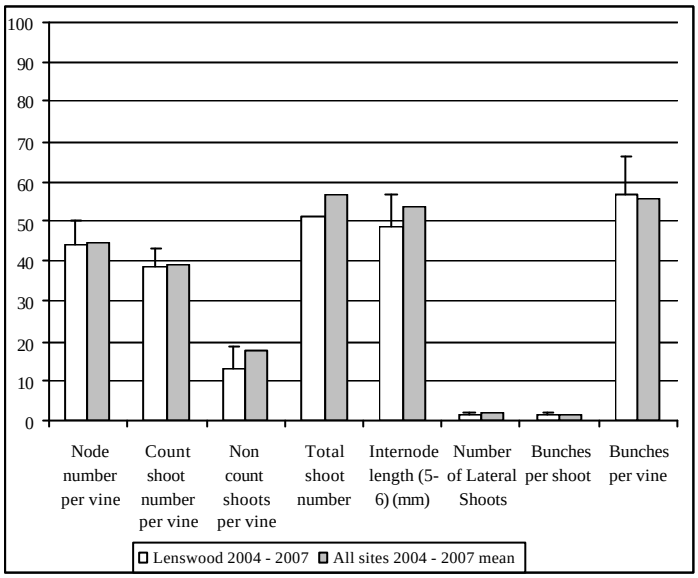

Figure 35. Lenswood long term flowering data versus project average

The Lenswood site measurements show good vine balance between seasons with no great variation in recorded values. The observations of the Lenswood vineyard showed it to be quite uniform and 'balanced'. This is supported by the comparatively low level of non-count shoots compared to other vineyards in this project. Through closer inspection of the data recoded (**Appendix 2.3**) internode length can be seen to be almost static between seasons and the bunch number per vine also has little variation. Lenswood has shown near average values for most indices recorded

The split fruiting zone resulted in good light infiltration at flowering and was at no point noted as being a 'dense' canopy through the project period.

The veraison data still shows observations of this site which are close to the long term averages of all sites in the project. Throughout the project period this site has shown good uniformity in growth from careful management.

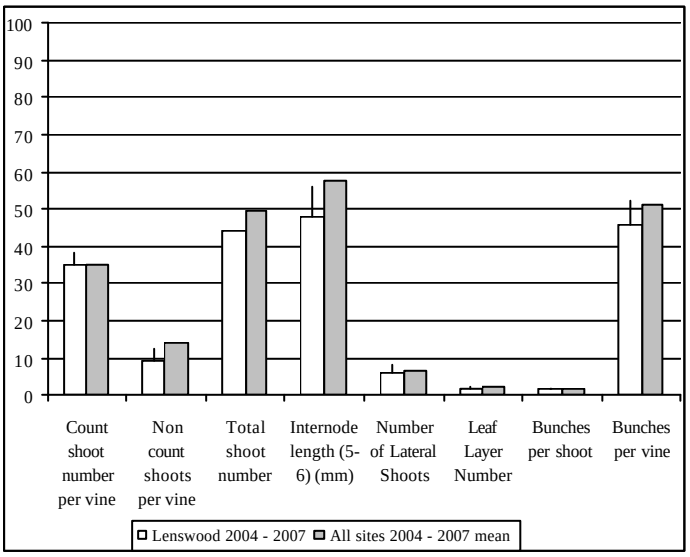

Figure 36 Lenswood long term veraison data versus project average

Leaf condition during all seasons was considered to be healthy, right up to harvest each year. The divided cordons provided good light infiltration and medium to low bunch exposure. The Lenswood site having average LLN at veraison but above average at harvest (**figure 43 section 4.4.3**).

Sensory analysis of wine made in 2006 from this site showed that it was one of two sites which did not display vegetal aromas in the finished wine. The aromas displayed were more tropical and floral while on the palette there were 'vegetal, grassy and green' flavours present. This wine also showed good acid structure with medium to high persistence of acidity.

Sensory analysis in 2007 showed that this wine still displayed some floral blossom aromas and also showed low tropical and floral notes on the palate.

4.3.5 MEADOWS SAUVIGNON BLANC

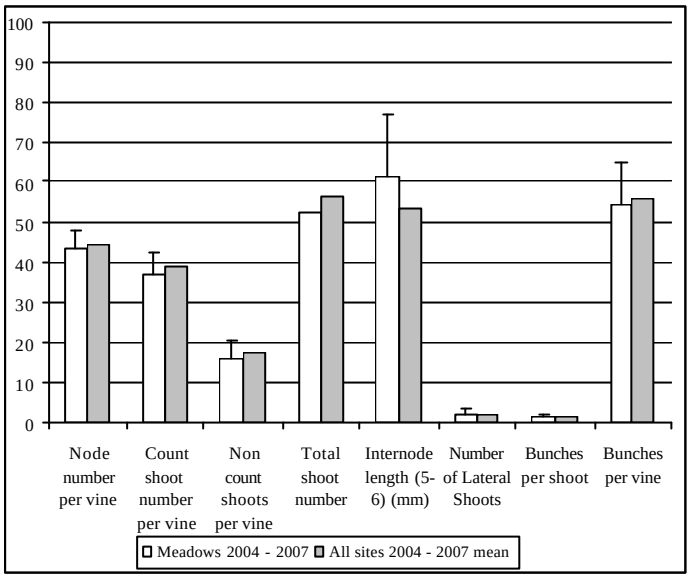

Figure 37 Meadows long term flowering data versus project average

The Meadows Sauvignon Blanc site has had uniform management over the trial period especially in relation to pruning régime. This can be seen by the consistency of nodes retained at pruning (see **appendix 2.5**).

This management has resulted in near average shoot numbers compared with all project sites. Despite these average numbers, the high capacity of this site (see **appendix 2.5**) results in long internodes and very high levels of lateral shoot growth (in 2006 laterals were measured at over 1m in length). This is also the only site which recorded a high percentage of growing tips through to harvest, often mainly from laterals.

Bunch numbers per shoot has shown little change over the project period, the divided bunch zone allows light penetration early in the season. Despite this, by veraison the bunch exposure is noted to be lowest of all project sites; this site also has one of the most compact bunch structures observed.

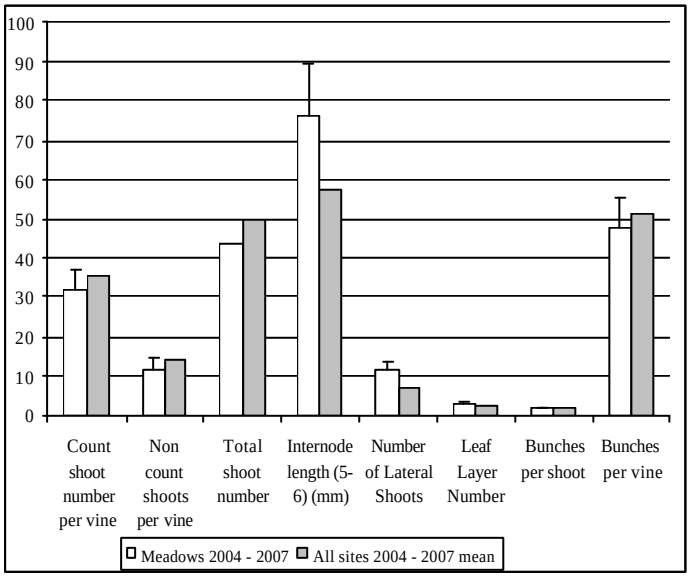

Figure 38 Meadows long term veraison data versus project average

A high degree of leaf shading results in high levels of basal leaf yellowing and necrosis as many internal leaves are well below the light compensation point. This in turn reduces the overall LLN to the second highest at harvest, however at veraison this is by far the most dense canopy.

Heavy trimming is undertaken to arrest growth, especially on the top of the canopy while side trimming is required to facilitate side netting. This has the effect of exacerbate the lateral growth each season.

This high density of vegetative growth and shading may be responsible for the 'fresh, varietal' comment made of this wine after sensory analysis in 2006. This site was the only site amongst all Sauvignon Blanc wines to receive this distinction in both 2006 and 2007 sensory analysis. The 2006 wine was discerned as the only wine to have a perceived high overall tropical flavour, as well as hints of capsicum aroma detected, in 2007 tropical citrus and grassy comments were given to this wine.

4.3.6 KUITPO SAUVIGNON BLANC

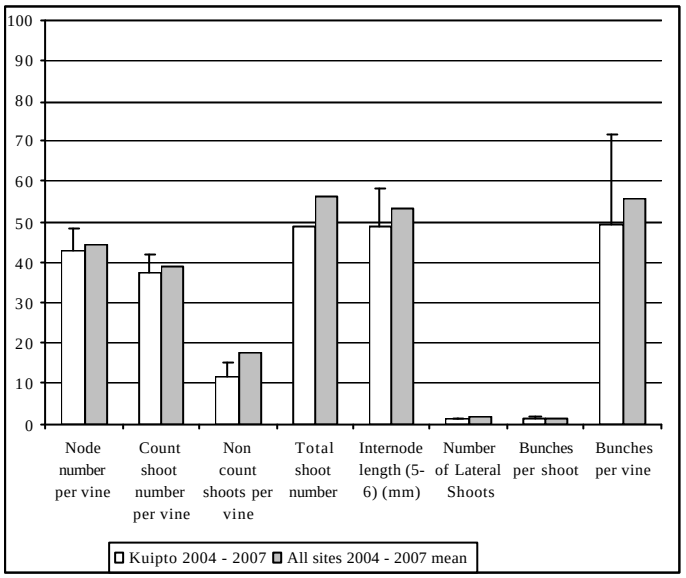

Figure 39. Kuitpo long term flowering data versus project average

This site at Kuitpo has been exposed to minor frost damage each season as a result of its relatively low lying position with little air drainage. The frost has not been severe, mainly resulting in the occasional distorted leaf. However in 2005/2006 frosting was more severe and some inflorescences and shoots were damaged increasing the non count shoot number in that season.

Management of this site has been uniform over the project period and this can be seen in the similar internode spacing as well as node numbers retained after pruning (see **appendix 2.6**).

The divided bunch zone again gives this site good light penetration at flowering while shoots are still growing. At veraison in seasons two and three, the small stunted frost affected shoots became shaded within this canopy and tended to turn yellow and abort.

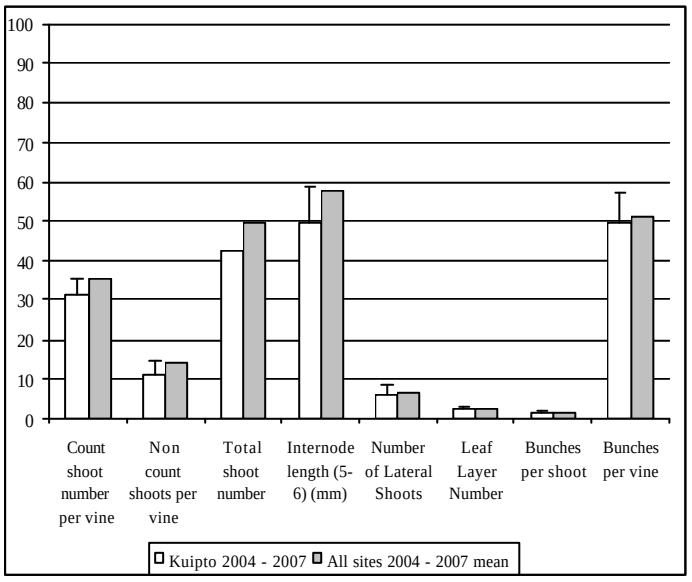

Figure 40. Kuitpo long term veraison data versus project average

Lateral shoot numbers at this site are below average however good leaf condition right up to harvest gives a relatively high LLN and results in low to medium levels of bunch exposure late in the season. Lateral growth observed in response to shoot tipping has occured, but does not show up in the data.

This site has shown some of the shortest shoots among all project sites, which have still provided shade to the bunches without sparsely distributed leaves or excessively long internodes.

Sensory analysis of wine made from this site in 2006 reported unique aroma descriptors of 'Lime and Green Pea' which were not seen at other sites. The perceived flavours of this wine in 2006 were noted as being tropical and green with a 'coarse persistent acid'. Sensory analysis in 2007 showed this wine to have 'high citrus' and 'grassy' characters similar to 2006 also with 'low tropical' notes, acidity again was noted by the panel as being 'sharp' with slight astringency.

4.4 SAUVIGNON BLANC KEY COMPARISONS AND DISCUSSION

4.4.1 SAUVIGNON BLANC MEAN SEASONAL INTERNODE LENGTHS 2004 – 2007

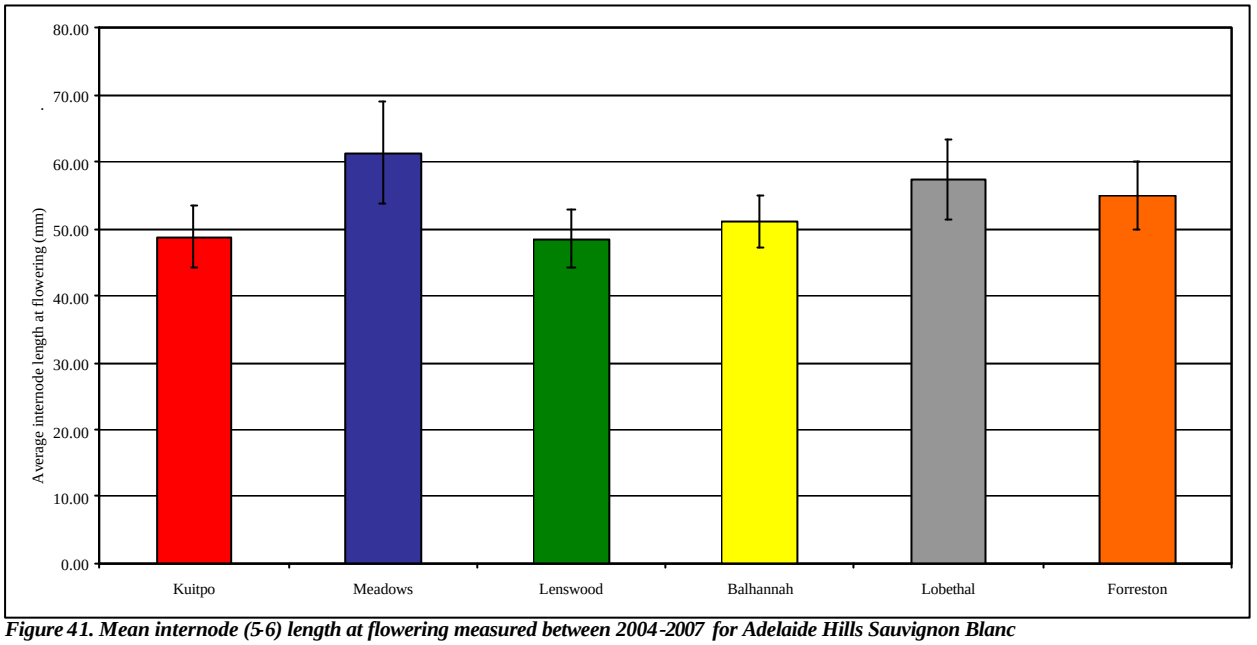

Figure 41. Mean internode (5-6) length at flowering measured between 2004-2007 for Adelaide Hills Sauvignon Blanc

Internode length can be used as a measure of vine vigour or vine balance, longer internodes are likely to be associated with rapid vigorous growth compared with shorter internodes. The rate of vine growth determines the length of the elongating shoot and thus also the internodal regions. This is demonstrated in **Figure 41** which shows the high vigour (and capacity) site at Meadows to have the longest average internode length. The Meadows site also showed the most variation in measured internode length as represented by the bars in **Figure 41**. On the other hand the site with the most uniform node length at flowering was Balhannah. Lobethal is represented here to have the second longest internode length at flowering behind Meadows, it must be taken into consideration that this may be more due to the low bud count at pruning at this site, especially in the final season of the project.

Both Kuitpo and Lenswood have the shortest internode length at this time having 48.8mm and 48.5mm internodes respectively. These sites are noted to have well regulated bud numbers at pruning and also uniform consistent shoot production during the growing season.

These comments are made with some consideration to the effects of vine vigour which can be influenced through vineyard management also. From this figure it can be noted that there is not a great deal of deviation from the project mean which is 53.2mm, thus indicating that within reason none of these sites have a major problem with vigour.

In this project, internode length does not appear to be linked with any wine sensory characteristics, however the implication of internode spacing as an indicator of a vine, or sites capacity may be.

4.4.2 SAUVIGNON BLANC MEAN COUNT TO NON-COUNT SHOOT COMPARISONS FOR PROJECT PERIOD 2004 - 2007

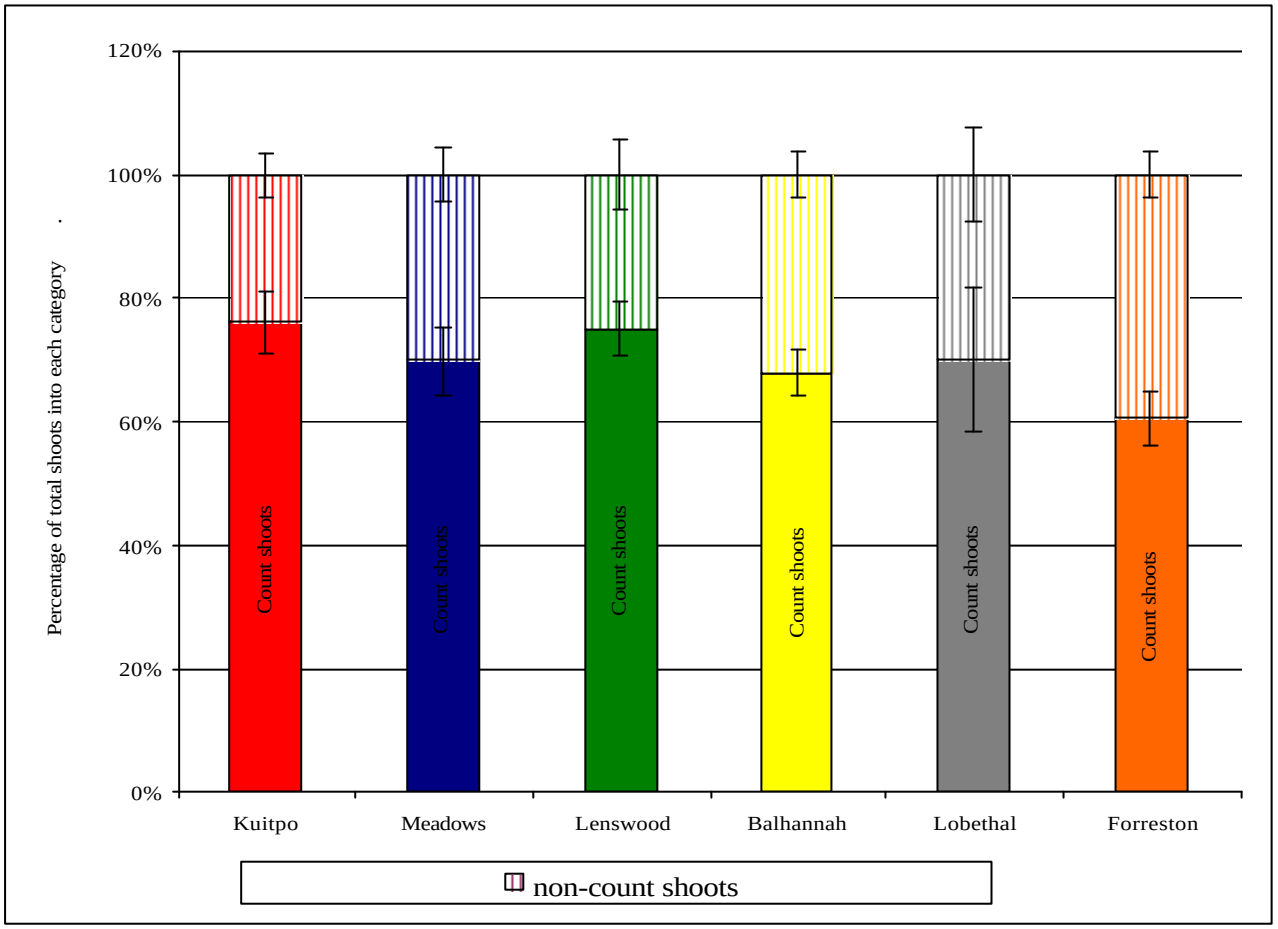

Figure 42. Comparison of mean count to non-count shoots at flowering for seasons 2004 – 2007

Figure 42 represents the mean number of count shoots and non count shoots relative to the total shoot number over the project period. This figure is a percentage of all shoots present at the time of assessment, this should not be confused with the percentage bud burst shown in **Figure 44**.

Both the level of pruning and the pruning method can have an impact on the number of non-count shoots present on a vine. If the pruning level is hard (low number of buds retained) this can result in high numbers of shoots arising from 'blind' or latent buds. Using this as a rough guide it may be possible to observe the relative pruning levels across sites with this chart.

The figure shows that over the project period Forreston had the greatest proportion of its canopy made up of non count shoots at flowering - just less than 40% of its canopy arose from non count shoots.

Of note to mention is that Kuitpo and Lenswood had the highest percentage count shoots and were also among the top three sites with the most fruitful shoots.

4.4.3 SAUVIGNON BLANC MEAN LEAF LAYER NUMBER AT VERAISON AND HARVEST OVER PROJECT PERIOD 2004 - 2007

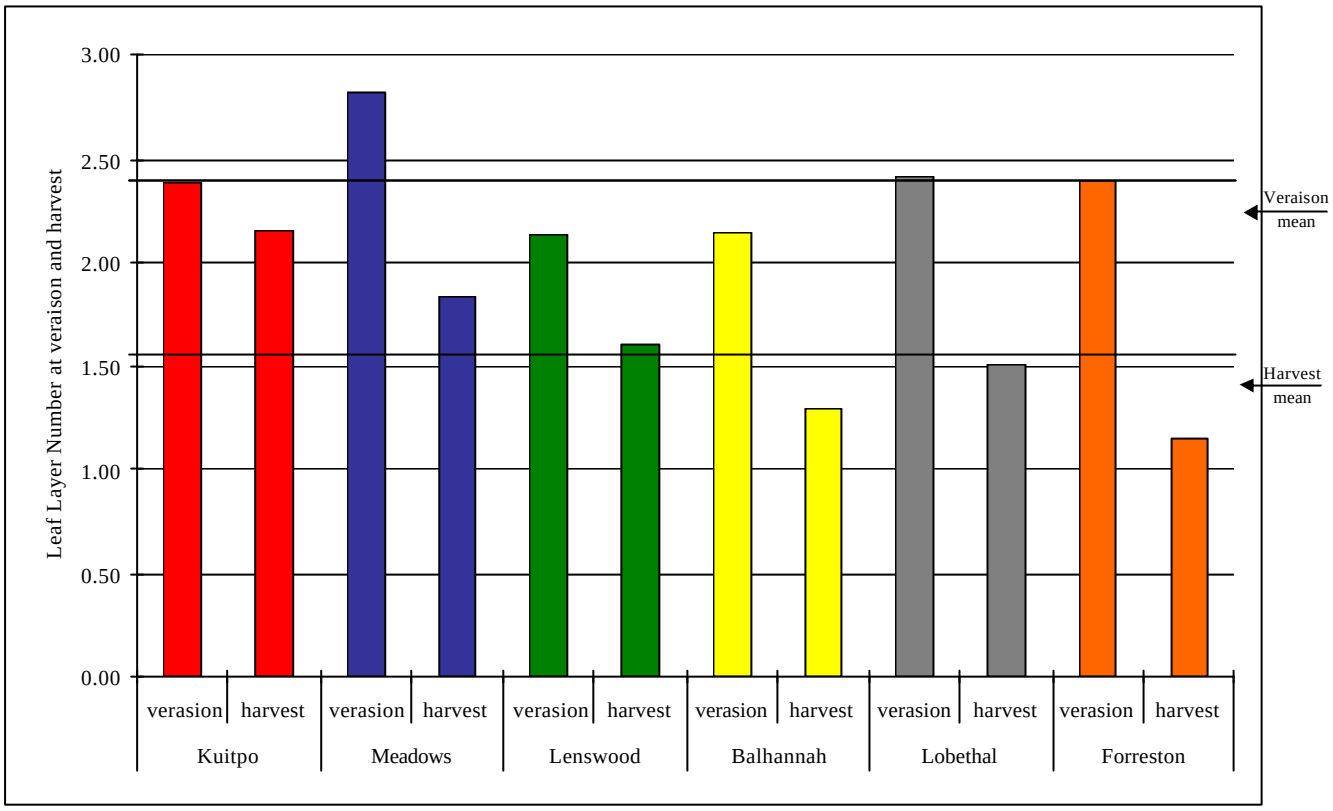

Figure 43. Mean LLN measured at flowering and veraison for Sauvignon Blanc sites 2004 - 2007

Figure 43 represents the Leaf Layer Number at Veraison and harvest. Leaf Layer Number describes the number of leaves in a direct line from the exterior of the canopy to the interior bunch zone. This index may have a high level of relevance to wine quality due to links between wine flavour and bunch exposure or shading.

The two labeled lines represent the project average LLN at both veraison and harvest for all project sites. This is useful as a benchmark initially to observe how sites stand out from the mean and also from each other.

It is interesting to note that the wine which showed the most intense fresh varietal characteristics was that from Meadows in sensory evaluation in both 2006 and 2007 vintages. At veraison Meadows is clearly different from the other sites having a LLN of 2.83, despite this site having the highest LLN at veraison by harvest this is not the case. Due to the high level of internal shading many leaves fall below the light compensation point and abort, this in turn reduces the LLN and by harvest it is at 1.83, still above the average recorded for all sites. At harvest, the site at Kuitpo has the highest LLN above any other sites, by this stage of the season this site has shown leaves generally in good health.

In relation to the sensory analysis it was noted that the wines from 2006 vintage at Balhannah and Forreston showed some phenolic characters. These sites recorded the lowest LLN at harvest indicating that they had the most exposed bunches of the trial sites; this may have influenced wine quality as in 2007 these two sites were alone in recording 'flat acidity' while in 2006 these sites also recorded 'phenolic characters' along with the Lenswood wine.

4.4.4 SAUVIGNON BLANC NODES RETAINED AT PRUNING AND PERCENTAGE BUDBURST OVER PROJECT PERIOD 2004 - 2007

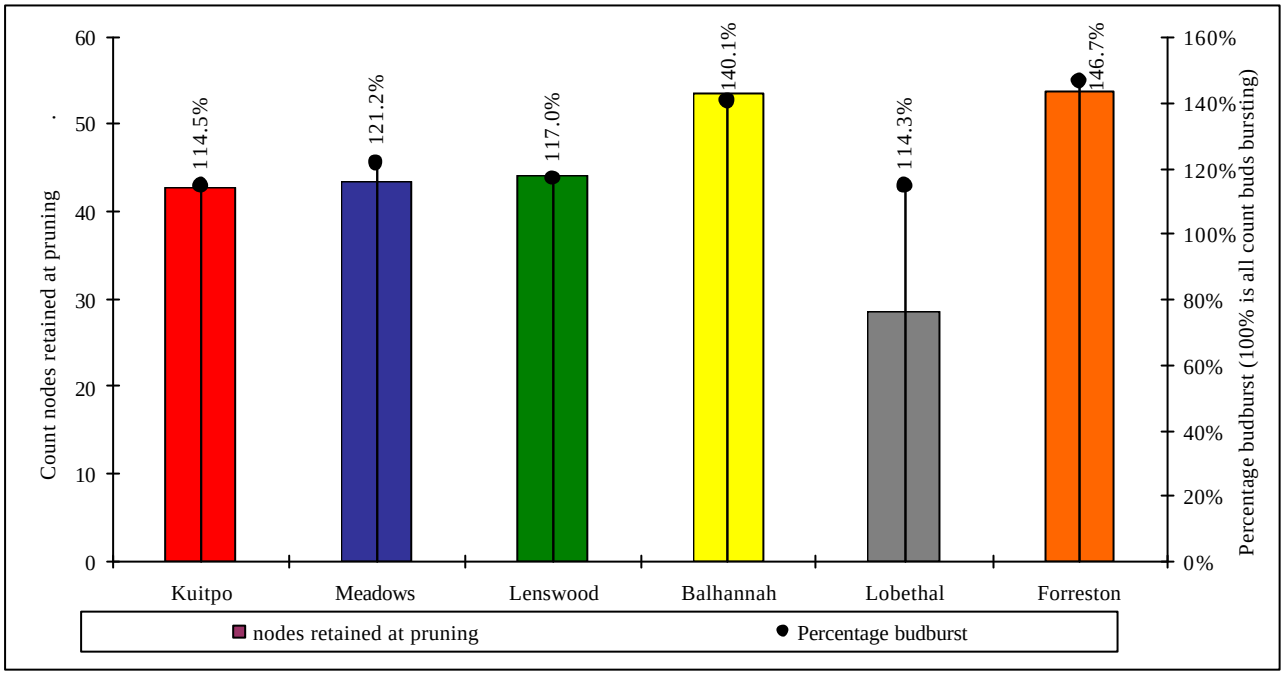

Figure 44. Comparison of nodes retained at pruning and percentage budburst in Sauvignon Blanc 2004 - 2007

Figure 44 shows the total number of count nodes retained at pruning which can be referred to as the pruning level, the percentage budburst is derived by calculating the percentage of shoots on the vine as a proportion of expected shoot number. It appears that Kuitpo, Lenswood and Lobethal sites have been managed well in relation to vine balance, as percentage budburst is close to 100% indicating that mainly count nodes produced shoots by flowering time. By examining the figures further, Lobethal produced 114% which is similar to the other sites (Kuitpo, Lenswood and Meadows) however as a percentage of buds retained 28 versus ~43 this represents a higher percentage of total shoots.

The site at Balhannah showed a high degree of non-count bud burst having 40% more buds burst than those intentionally left (or than were desired). The site at Forreston also showed this high budburst percentage, however of these two sites only Balhannah has its shoot balance regulated through cultural practice by removing some non count shoots. It is interesting to note these two sites are spur pruned, resulting in more total count nodes than any other cane pruned site. As mentioned in section 4.4.3 these sites received the

4.4.5 SAUVIGNON BLANC VINE YIELD AND BUNCH WEIGHT COMPARISONS OVER PROJECT PERIOD 2004 - 2007

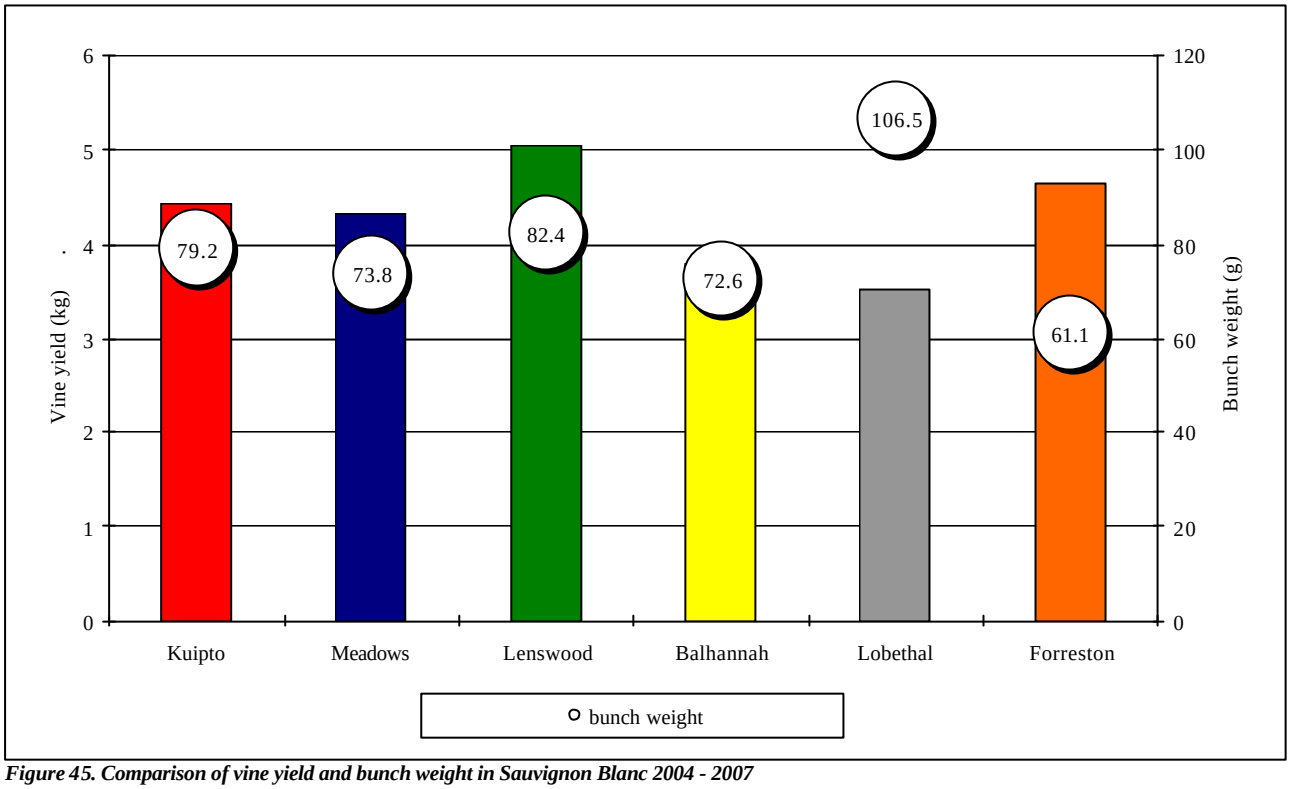

Figure 45. Comparison of vine yield and bunch weight in Sauvignon Blanc 2004 - 2007

Figure 45 represents the mean vine yield as well as the mean bunch weight, which has been recorded at harvest over the project period. This figure highlights the relationship between overall vine yield and that of one of its principal yield components, individual bunch weight. From this figure it can be deduced with some accuracy whether the bunch weight or the bunch number were responsible for the vine yield.

Implications for wine quality related to this index are not yet clear. Despite this the site recording the lowest yield and bunch weight over the project period was also noted as having the most intense varietal character in the resultant wine in both 2006 and 2007. The site with the highest bunch weight (Lobethal) recorded a 'dull' bruised apple aroma in both 2006 and 2007.

Table 3 simply puts these individual vine yields into perspective based on the common industry units of tonnes/hectare.

Table 3. Vine yield per hectare

Normalised vine yield for 3m x 2m spacing		
Kuitpo	7.74	t/ha
Meadows	5.86	t/ha
Lenswood	6.30	t/ha
Balhannah	8.40	t/ha
Lobethal	7.19	t/ha
Forreston	7.36	t/ha

4.4.6 SAUVIGNON BLANC SHOOT LENGTH SUMMARY AT FLOWERING FOR ALL SITES OVER PROJECT PERIOD 2004 - 2007

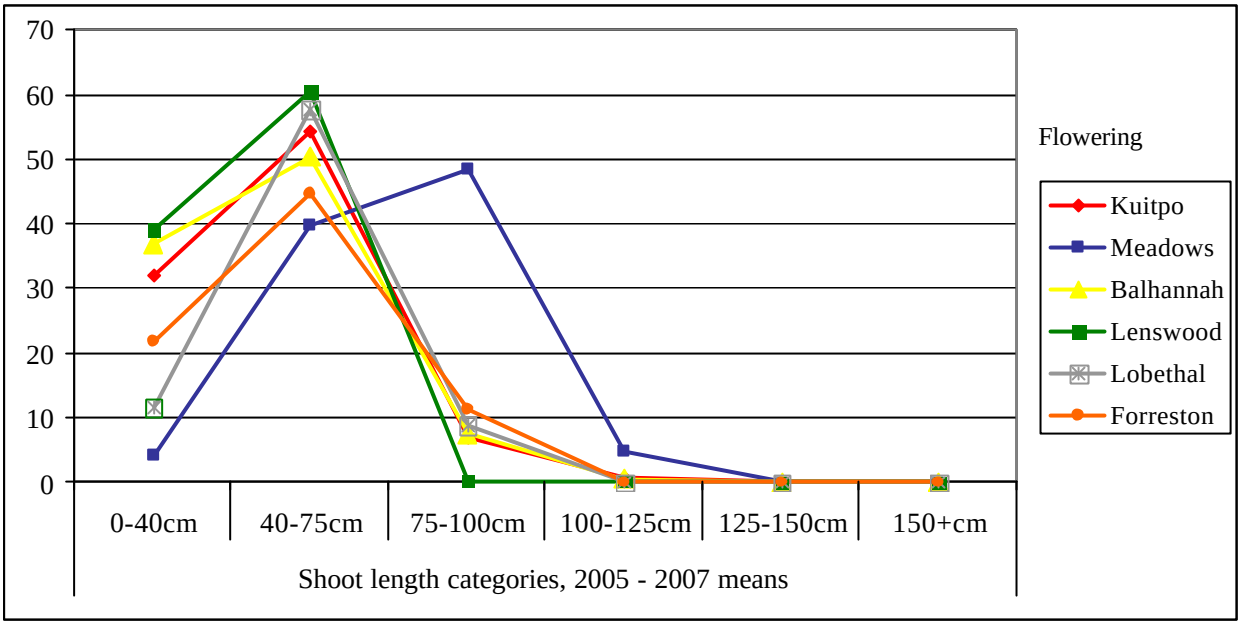

Figure 46. Shoot length summary in Sauvignon Blanc 2004 - 2007

Figure 46 records the measurement of shoot length at flowering using the shoot category system. The peaks recorded at each site indicate the most dominant shoot length at the time of data collection, consistent with visual assessment.

All sites exhibited a majority of shoot lengths below 100cm at flowering. Further observation of the chart shows that the growth characteristics of several sites allow them to be grouped together in terms of shoot length categories. The Meadows site has the longest average shoot length recorded with the majority of shoots in the 40-125cm range. This site is noted as being high in vigour with deep dark well drained soils. Other sites had a majority of shoots less than 75cm at the time of measurement.

4.4.7 SAUVIGNON BLANC SHOOT LENGTH SUMMARY AT VERAISON FOR ALL SITES OVER PROJECT PERIOD 2004 - 2007

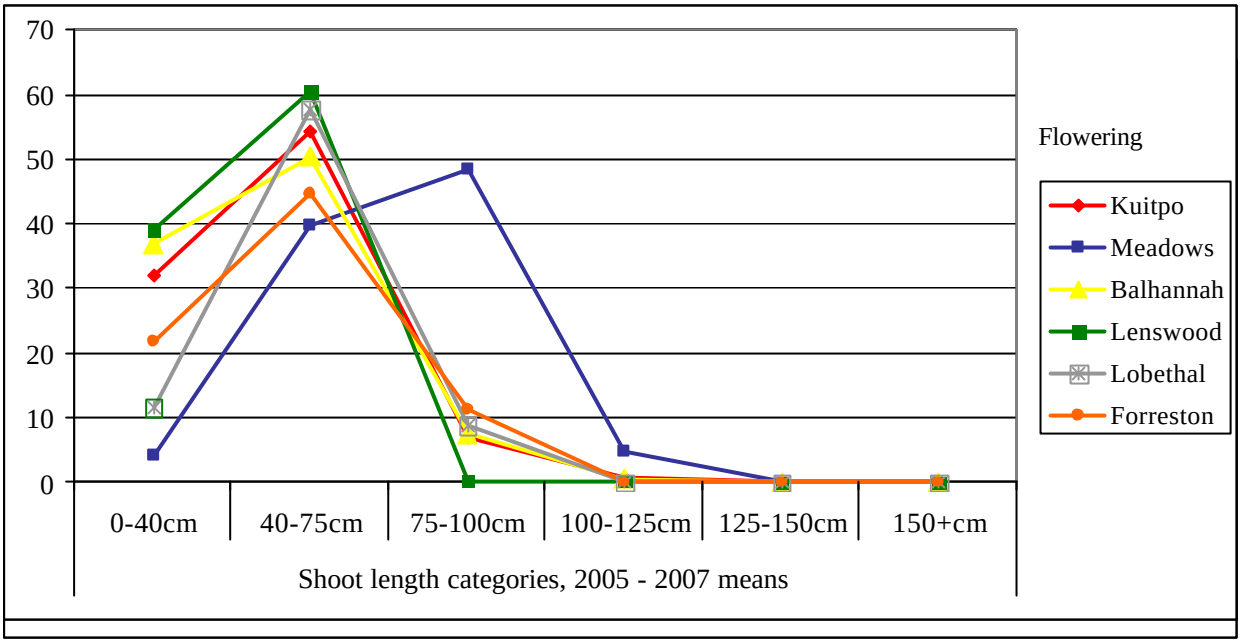

Figure 47. Shoot length summary at veraison in Sauvignon Blanc 2004- 2007

Figure 47 shows shoot length at veraison. The shoot length summary for veraison shows an interesting 'snapshot' of all the sites. The most striking feature is the data for Meadows, however this is due to its being the only un-trimmed site. However the data still indicates the high vigour of this site through the concentration of shoots in the 125-150cm range; this was not changed even after trimming.

All sites show an averaging out of the shoot length categories from flowering to veraison, this can be noticed by the more even spread of shoot length categories. This chart shows that the vegetative growth continued from flowering to veraison with varying degrees of shoot length and spread among categories. Kuitpo also showed this concentration of shoot growth with the majority of shoots in the longer shoot length categories

5.0 SHIRAZ

5.1 MANAGEMENT PRACTICES

5.1.1 FORRESTON SHIRAZ

Variety/Clone	Shiraz, 1654
Elevation	Approximately 430m
Aspect	Gentle Westerly slope
Row orientation	East to West
Soil type	Friable red podzolic Soloth and Solod (**Appendix 4.2**)
Irrigation	Minimal applied, more frequent late in season
Nutrition	Micronutirents including Mn applied with routine foliar sprays
Trellis	Single cordon wire 1m from ground, two sets of foliage wires located at 1.35m and 1.7m above ground.
Pruning	Spur pruned (converted from cane pruning before trial started)
Canopy Manipulation	Wire lifting is undertaken as required. Severe leaf removal was undertaken in year one as was two wire lifts.
Vineyard Floor Management	Volunteer growth within mid row consisting mainly of grasses. This has been allowed to grow very long before being slashed down.

Figure 48. Forreston typical view looking west (22/01/07)

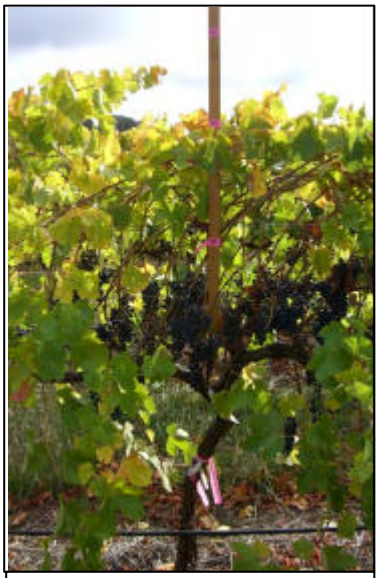

Figure 49. Forreston site near harvest in 2006 (18/04/06)

Figure 50. Forreston vines pre flowering (10/11/06)

Figure 51. Forreston bunch details 2006 -2007

5.1.2 LOBETHAL SHIRAZ

This property has undergone a change of management during year two of the project, therefore there have been some small changes to the viticultural practices employed at this site over the trial period.

Variety/Clone	Shiraz
Elevation	Approximately 350m
Aspect	Gentle to neutral westerly aspect
Row orientation	East West over small hillcrest
Soil type	Red / Yellow / Grey podzolic
Irrigation	Applied as required throughout season, starting from November of January season dependant. Water rates are also variable based on season from 80L/vine up to 156L/vine including post harvest irrigation.
Nutrition	One application of Neutrog at 1T/ha in July Two foliar 1 foliar plus and 1 Zn.
Trellis	Two offset fruiting wires bottom fruiting wire is at 1.0m on the eastern side of the post whilst the second fruiting wire is at 1.1m on the western side of the post. Two pairs of foliage wires.
Pruning	Year one was the second season after conversion to cane pruning. Two canes were left in year one of project then up to four in subsequent years.
Canopy Manipulation	Two foliage wire lifts per season, as required. One trim per season after last wire lift. Late bunch thinning undertaken post verasion to remove green bunches and 2nd crop.
Vineyard Floor Management	Mown volunteer sward with herbicide used to control weeds undervine with glphosate during dormancy and one or two knockdowns during growing season.

Figure 52. Lobethal typical view, looking east (28/12/06)

Figure 53. Lobethal close to maturity (03/04/07)

Figure 54. Lobethal site around flowering (08/12/05)

Figure 55.Lobethal bunch detail

5.1.3 BALHANNAH SHIRAZ

Variety/Clone	Shiraz, 1127
Elevation Aspect	Approximate elevation is 400m. Westerly aspect three quarters of the way up a hill slope
Row orientation Soil type	Rows run North to South along the hillside Red / Yellow podzolic
Irrigation	As required totalling 0.56 ML/ha , total 0.65M/ha up to 0.85 ML/ha
Nutrition	Lime 4.5 t/ha broadcast in Autumn Lime 5 t/ha broadcast in Autumn
Trellis	Two offset fruiting wires bottom fruiting wire is at 1.0m on the eastern side of the post whilst the second fruiting wire is at 1.1m on the western side of the post.
Pruning	Cane pruned to four canes.
Canopy Manipulation	Foliage wires lifted twice during the season. Significant bunch thinning twice during the season and lateral leaf removal. Thinning of weak shoots late October, First wire lift mid November, second wire lift mid December. Canopy trimmed early January (mainly tops) second trim early February (sides)
Vineyard Floor Management	Mid-row of volunteer permanent sward, slashed twice throughout the season. Vine row weed control using one herbicide application during dormancy and one during the growing season Dormancy vine-row spray of glyphosate, Midrow sprayed with Jaguar (broadleaf selective) two vine-row sprays. Midrow slashed twice Dec and Feb.

Figure 56. Balhannah typical view looking south (10/11/06)

Figure 57. Balhannah vine pre harvest (15/04/06)

Figure 58. Balhannah pre flowering (10/11/06)

Figure 59. Balhannah bunch detail

5.1.4 MEADOWS SHIRAZ

The shiraz vine on this site have historically been pruned to four canes, the final year of the project has seen a slightly different pruning technique employed with only two canes laid down and no replacement spurs left.

Variety/Clone	Shiraz, BVRC12
Elevation	Approximately 412m
Aspect	Moderate Northerly aspect mid-way up a gentle hillside
Row orientation	North South
Soil type	Acidic sandy loam over brown clay
Irrigation	From 3rd week in January then weekly until harvest, totalling 0.75ML/ha As required late in season totalling ~0.8ML/ha
Nutrition	This season 2.5t/(planted)ha Neutrog banded under-vine. (~1t/ha broadcast). None
Trellis	Two offset fruiting wires, bottom fruiting wire is at 1.0m on the eastern side of the post, the second fruiting wire is at 1.1m on the western side. Two pairs of movable foliage wires. There are 2 pairs of movable foliage wires.
Pruning	Cane pruned to four arched canes either side of the crown.
Canopy Manipulation	Both wires clipped below cordon at start of season Mid November the first pair was raised. Mid December the second foliage wire was clipped to the 2nd clip at approximately 30cm above the cordon. Early February 1 of the 4 canes was selected and cut back at the crown. Canes were left in the canopy for crop regulation. Trimmed tops and sides early march to allow side netting Three wire lifts as required, Post flowering, Pre and Post veraison
Vineyard Floor Management	Mid-row of volunteer permanent sward slashed twice. Vine row weed control using one herbicide application during dormancy and one during the growing season Mid-row slashed twice, weed control using one herbicide during dormancy and one during growing season.

Figure60. Meadows typical view looking south up hill (22/01/07)

Figure 61. Meadows pre harvest (15/04/06)

Figure62. Meadows post flowering (08/12/05)

Figure 63. Meadows bunch detail

5.1.5 KUITPO SHIRAZ

Variety/Clone	Shiraz, 1127
Elevation	Approximately 320m
Aspect	Gentle Easterly aspect
Row Orientation	East West with sample vines found near the top of a gentle rise
Soil type	Acidic gradational loam over rock
Irrigation	Minimal required
Nutrition	5L/ha Foliar plus E-L 18. 5L/ha Zn/Mn pre flowering
Trellis	Two offset fruiting wires, bottom fruiting wire is at 1.0m on the southern side of the post the second fruiting wire is at 1.1m on the northern side of the post.
Pruning	Cane pruned to four canes.
Canopy Manipulation	Mid January foliage wires raised. Two wire lifts 1st late Nov, 2nd late Dec. Mechanical trim (tops only) late Dec, Hand trim (tops and sides) Jan, crown shoot this early Feb. Green bunch thin mid Mar.
Vineyard Floor Management	Mid-row sown to a ryegrass/clover permanent sward, slashed twice. Undervine is mounded and weeds controlled using herbicide. Undervine herbicide early Sept and mid Oct. Slashed approx every three weeks.

Figure 64. Kuitpo typical view looking east down row (09/11/06)

Figure 65. Kuitpo site pre harvest (21/04/06)

Figure 66. Kuitpo site flowering (08/12/06)

Figure 67. Kuitpo bunch detail

5.2 VITICULTURAL OVERVIEW OF SHIRAZ PROJECT SITES

5.2.1 SOIL

The importance and influence of soil on the performance of these vineyards has been previously mentioned in section 5.1. As with the Sauvignon Blanc sites the Shiraz sites had soil pits dug, with physical observations and chemical analysis undertaken within the rootzone at depths of 30cm and 50cm.

Many general features were in common between Shiraz sites. This includes observations of dark colours near the surface horizon, and good levels of organic matter. In general red and orange colours were observed in the profiles at most sites indicating aerated conditions and reasonable drainage properties. The only exception to this was at Balhannah which showed some yellowing from leached iron oxides in the Shiraz site.

Inhibition of root growth within the soil profile was observed at several sites, either from physical compaction in the wheel tracks or due to an abrupt change in soil structure. The Forreston site showed a pronounced transition between soil layers just below the surface, resulting in a sharp interface. This impacted on root growth by promoting lateral flow of water and nutrients down slope, thus reducing their potential uptake by the plants. The Forreston sites soil displayed a columnar structure at this abrupt change; this is an unfavourable structure in relation to root growth and permeability, resulting in reduced root branching and vertical root growth patterns preventing nutrient and water uptake.

Physical compaction was observed at Lobethal, Kuitpo and to a lesser extent at Balhannah, each site showing more horizontal roots. The greatest wheel track compaction was noted at Kuitpo which was noted to be reducing the root area and possibly preventing water penetration and resulting in lateral water flow down the slope.

In the Shiraz sites the naturally acidic soils of the Adelaide Hills presented pH_{CaCl2} values from 5.0 to 6.2. This is summarised **Table 4**. Full results of chemical analysis can be seen in **appendix 4** .

Table 4. Soil pH and CEC ranges for Shiraz sites in Adelaide Hills

	pH at depth			CEC at depth		
	30cm	50cm	General comment	30cm	50cm	General comment
Forreston	5.8	6.2	Moderately acidic	21.46	23.03	Acceptable
Lobethal	5.0	5.0	Strongly acidic	4.6	5.01	Low fertility
Balhannah	5.2	5.3	Strongly acidic	11.65	10.63	Acceptable
Meadows	6.1	5.6	Moderately acidic	11.93	8.23	Acceptable
Kuitpo	6.2	6.0	Moderately acidic	12.20	8.96	Acceptable

Most Shiraz sites show acceptable CEC levels with the exception of Lobethal which shows lower than desirable CEC levels indicating low inherent fertility. The other interesting figures to note are the high CEC levels at Forreston.

5.2.2 CANOPY MANAGEMENT

The canopy management of the Shiraz vines associated with this project are all based on a general VSP principal, but the form that this takes as the season progresses results in quite different canopies at different sites. For example the low input used at Forreston resulted in shoot positioning far less strict than at any other site. On the other hand, the site at Balhannah had greater control over shoot position resulting in more evenly spaced shoots and canopy.

Overall the Shiraz sites had different canopy management though the season, however the greatest difference in the canopies' structure was close to harvest. It was at this time that the vines lost leaf function as winemakers sought higher maturity levels, resulting in loss of basal leaves. Due to vine stress and late season ripening this is when some of the greatest differences were observed between sites, in relation to the bunch exposure late in the season. This data is discussed in greater detail in section 11.3 where the leaf layer numbers are compared between sites, this is effectively a comparison of the canopies at this time.

5.2.3 CLIMATE

See section 4.2.3 as climatic features of the Shiraz sites were identical to the Sauvignon Blanc sites. Gladstones (2002) states that Shiraz is in group 5 requiring 1250° days to ripen fully, this implies that Shiraz will only ripen at two of these sites using this method. The BEDD used here is only raw and site specific adjustments may indeed bring this calculation closer to the suggested value however this further calculation is beyond the scope of this project. Similar calculations and charts of including adjustments can be found in the *Adelaide Hills Wine Region Profile* (Available from Adelaide Hills Wine Region Inc., prepared by Davidson Viticultural Consulting Services in 2004)

5.3 SEASONAL COMPARISONS AND DISCUSSION OF FINDINGS

The following section presents an overview of the findings to date, each site is discussed with special emphasis on key points in relation to wine quality. In an attempt to minimise long term variability from the recorded data set, each site has been averaged and this in turn is shown next to the long term averages of all sites and all seasons combined.

5.3.1 FORRESTON SHIRAZ

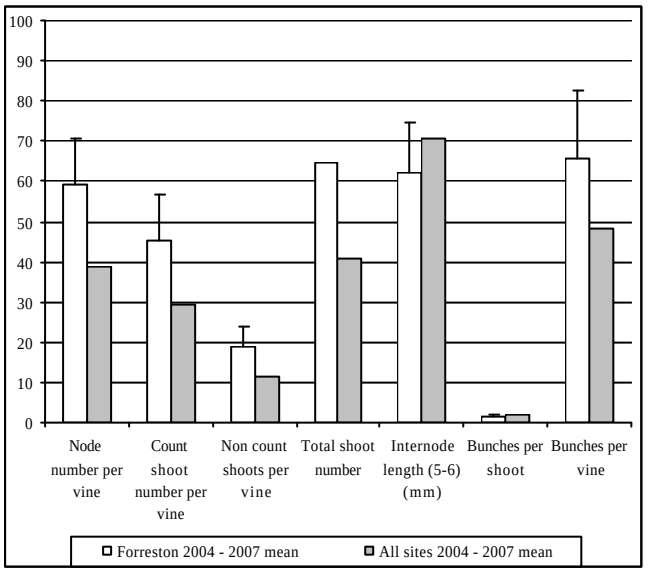

Figure 68. Forreston long term flowering data versus project average

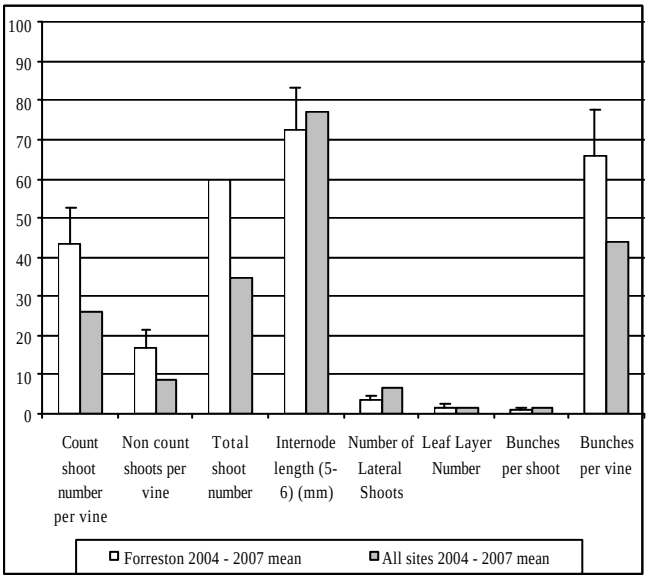

Figure 69. Forreston long term veraison data versus project average

The Forreston Shiraz site has had distinctly different bud numbers retained at pruning changing from 40 to 80 to 60 in each project season. The large number of buds left has not seen a great decrease in the number of non count shoots which may be expected.

A result of this variation in pruning technique there are large fluctuations in most indices measured over the trial period, even when averaged over three seasons. Overall this site produced a very high total shoot number due to the previously mentioned spur pruning technique employed. This has proven to give rise to long single shoots with relatively low levels of observed lateral growth.
Common among seasons at this site is the late season basal senescence (see picture archive) abortion of small shoots and basal laterals. This all combines to leave the bunch zone relatively bare of leaves and results in very high levels of bunch exposure, this is combined with the sites inherently low density bunch zone and very loose bunches.

Minimal irrigation is applied to this site. This may have a bearing on the late season leaf observations and high bunch exposure which resulted in high levels of berry shrivel.

Sensory analysis of the wine made in 2006 from this site was the only Shiraz wine to display a 'dusty/smoky' aroma. This wine was also unique amongst the trial wines as it had flavours noted as 'jammy and sweet' with 'herbaceousness' also perceived by the panel. The panel also perceived this wine as having among the highest levels of 'berry fruit' aroma, as well as the most body in regards to mouth feel. In 2007 this wine was assessed as having one the lowest aroma intensities and was also the only Shiraz in 2007 to be noted as slightly 'dull' and 'unripe'.

5.3.2 LOBETHAL SHIRAZ

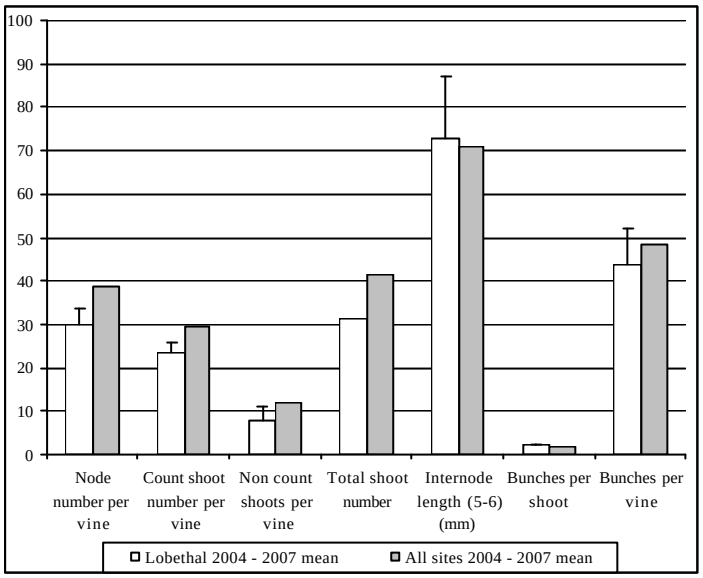

Figure 70. Lobethal long term flowering data versus project average

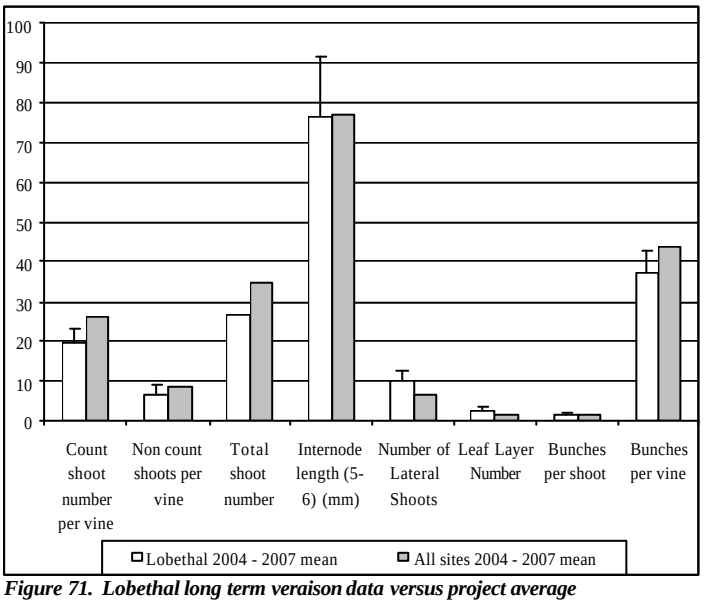

Figure 71. Lobethal long term veraison data versus project average

At the Lobethal site, lower node numbers were retained at pruning when compared with all other project sites combined over the same period. It also showed above average internode length over the trial period; this may be a direct result of the low bud numbers retained.

Bunch number per shoot (1.53) is slightly higher at this site than the project average of 1.44. This site also had a "green harvest" or selective bunch thinning post verasion in two out of three seasons (many of these bunches were on lateral shoots).

At veraison this lateral growth is evident (**Figure 70**), with the site showing the highest lateral growth over the project period.

Despite the lateral growth and subsequent density of shoots, leaf condition was noted as being healthy right up to harvest with several growing tips still visible at this time. This high degree of vegetative growth is reflected in the LLN which of all sites was the highest pre-harvest. As a consequence, there was low bunch exposure with some high levels of shading of bunches.

Wine sensory analysis in 2006 showed some unique aroma characteristics, these being the presence of 'red berry, raspberry, lolly and caramel' aromas. Similarly in 2007 this wine showed 'red berry, raspberry codial' aromas and 'medium red berry' on the palate. In 2006 this was the only Shiraz wine sampled which did not display any 'sweet spice' or 'black fruit' aromas, while in 2007 this wine was the only one not to show any 'dark berry' characters. Overall this wine was perceived as having a 'fresh primary fruit character' which was not noted for any other wines in 2006 and was described as 'fresh and balanced' in 2007 also.

5.3.3 BALHANNAH SHIRAZ

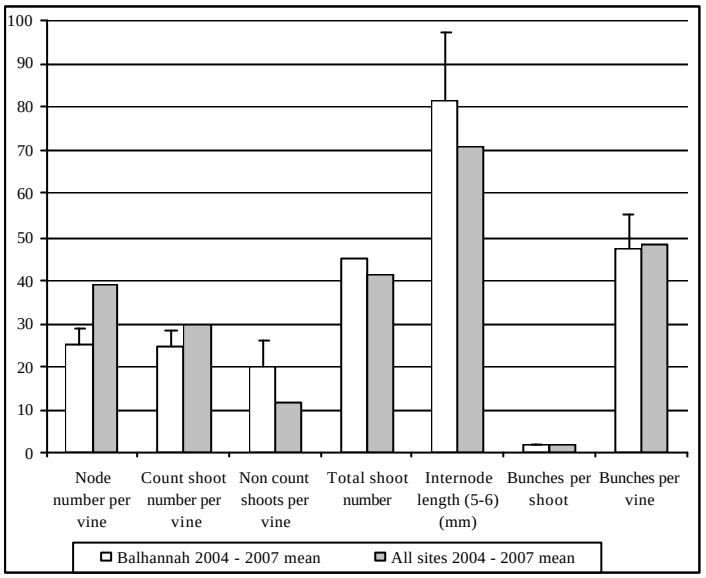

Figure 72. Balhannah long term flowering data versus project average

When the Balhannah site is compared with other project sites, one of the most noticeable features is the lower than average node number per vine (**Figure 72**). The project average is 38.8 nodes/vine while this site average is just 25.1 nodes/vine.

This low bud number results in a high number of non count shoots arising. However this site routinely undergoes shoot thinning to remove these non count shoots, the result of which can be seen in **Figure 73**. This also has the effect of bringing the total shoot number below the project average number.

The larger than average internode length displayed (**Figure 73**) may also be a result of the lower (reduced) total shoot number pushing more growth into fewer shoots.

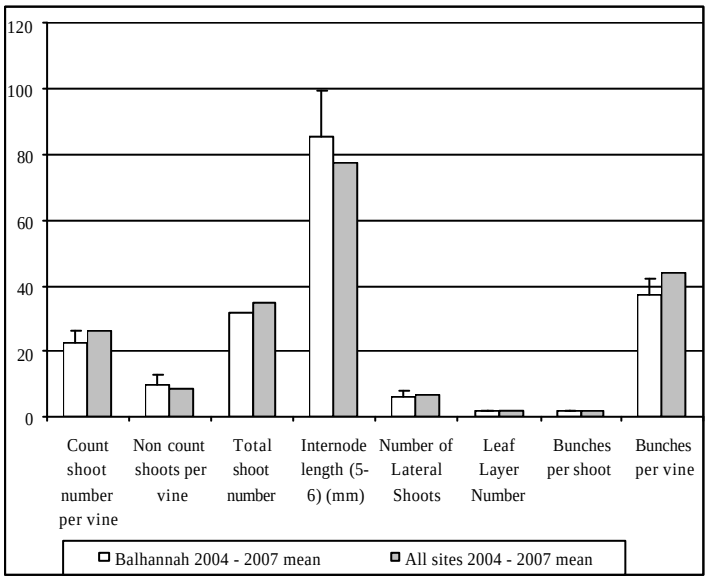

Figure 73. Balhannah long term veraison data versus project average

It is not uncommon for this site also to undertake crop level manipulation in the form of bunch thinning. With this in mind, the Shiraz vines at this site show the lowest bunch count per vine of any Shiraz vines in the project.

Over the project period the LLN at this site has been quite low, especially mid to late season. This is due to the loss of basal leaves, few lateral shoots and lack of smaller non count shoots filling in the bunch zone. This all results in some of the most exposed Shiraz bunches observed in the project. This high bunch exposure also coincides with observed late season berry shrivel.

Sensory analysis of wine made for this site revealed unique aromas not seen in any other wines in 2006. These included 'stewed plums' and 'black olives'. In the same season this wine was among the two which had the highest perceived body and most persistent drying tannins. The other site noted with this character was Forreston, which also has a high degree of basal leaf senescence, bunch exposure and berry shrivel. The flavour profile of this wine was noted as having 'medium black fruit, savoury' and also showed some low levels of bitterness. The 2007 wine sensory analysis reported this wine to have a 'rubbery' odour with a 'slightly burnt' aroma also. This site also showed the character of 'ripe dark berry' which was not noted with a any other shiraz wines in 2007.

5.3.4 MEADOWS SHIRAZ

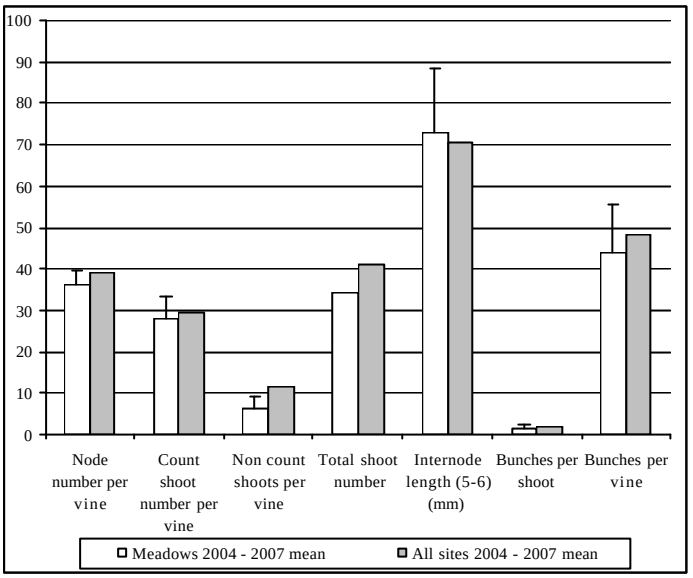

Figure 74. Meadows long term flowering data versus project average

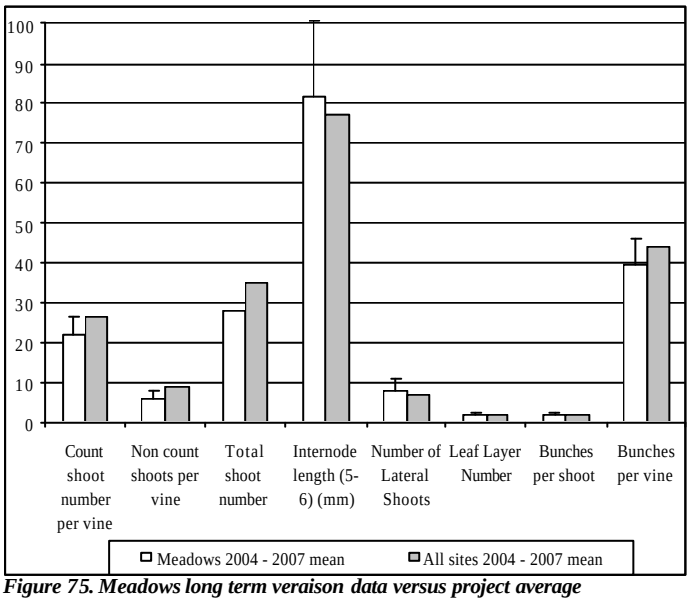

Figure 75. Meadows long term veraison data versus project average

The Meadows site has had similar management over first two seasons of the trial period, but the final season saw a slight change in pruning technique resulting in much lower node numbers retained. In fact node number retained has dropped from 47 per vine to 23 per vine.

In the final season this lower node number resulted in a reduction in most indices; this in-turn has lowered the averages observed over the project period. This has brought the shoot characteristics closer to the project average figures than they previously might have been.

Prior to the change in pruning and reduction in node numbers, separate fruiting wires were quite effective in creating an un-crowded bunch zone at flowering time. Since only two canes were left per vine, the canopy has opened up somewhat. This halving of the node number has in fact had the effect of opening up the canopy even more right up until harvest, causing high bunch exposure and low bunch density in the bunch zone. The opening up of the canopy in this final season was also compounded by selected canes showing strong apical dominance, leaving blind buds and weak shoots in the mid-cane region.

These small shoots were slow to grow and even slower if they carried a bunch. Despite these small shoots, and the higher than average lateral shoot growth, bunch exposure was not greatly affected.

Sensory analysis showed the wine from 2006 to be the only one to display 'stalky, chocolate and mint' aromas. 'Stalky' and 'vegetal' flavours were also perceived; this wine was the only Shiraz noted to be 'concentrated and ripe' by the panel. In 2007 similar attributes were noted for this wine including; 'leafy' and 'ripe fruit' aromas and 'ripe berry' flavours complementing overall more intense ripe fruit flavours than were seen in the other wines.

5.3.5 KUITPO SHIRAZ

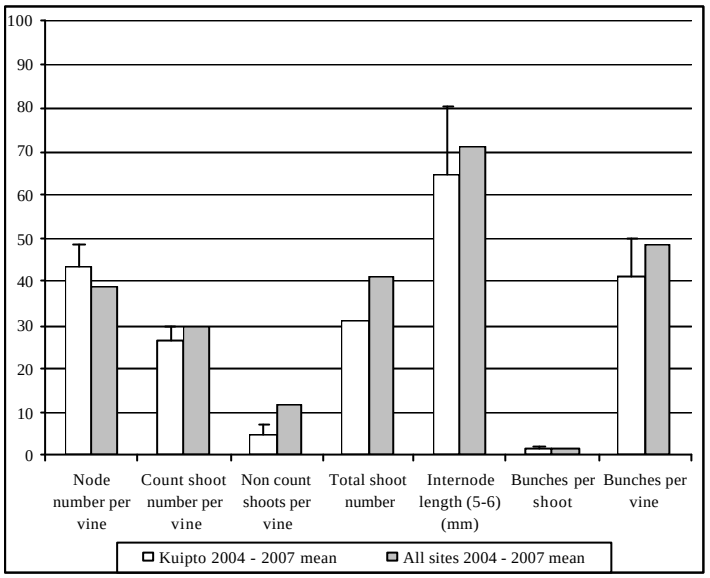

Figure 76.Kuitpo long term flowering data versus project average

The management of this site has been consistent across the trial period, which has included being pruned to 40 – 50 nodes per vine on four (occasionally five) canes, wrapped onto two fruiting wires. Despite this being among the highest bud retention of all Shiraz sites, in terms of shoot numbers this site was below the project average (**Figure 76**). Blind budding was evident on same canes, which reduced the count shoot and subsequent total shoot numbers.

This canopy was the most dense around flowering time when all shoots were about the same length. After internode elongation, basal senescence and yellowing and abortion of small shoots within the canopy opened up the bunch zone resulting in an 'average' LLN.

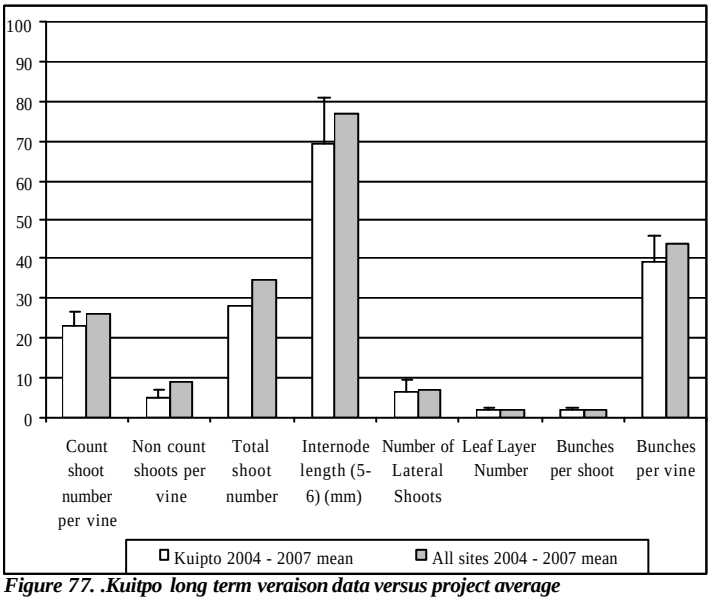

Figure 77. .Kuitpo long term veraison data versus project average

Bunch number per vine is found to be just below the project average for Shiraz, in terms of the bunches, at harvest this site was noted as having medium to high bunch exposure due to the aforementioned senescence.

Wine sensory analysis from this fruit showed unique aroma attributes seen in no other wines these being 'stewed rhubarb' and 'menthol' in 2006 and 2007 respectively. In 2006 the wine was considered to have the lowest overall fruit intensity among all wines, while in 2007 this was not noted it did record 'low' and 'light' descriptors for perceived flavours and aromas. The acid strength was considered persistent and unique to this wine in 2006 while in 2007 it was noted to be 'medium to high' with 'reasonable balance'

5.4 SHIRAZ KEY COMPARISONS AND DISCUSSION

5.4.1 SHIRAZ MEAN SEASONAL INTERNODE LENGTHS 2004 – 2007

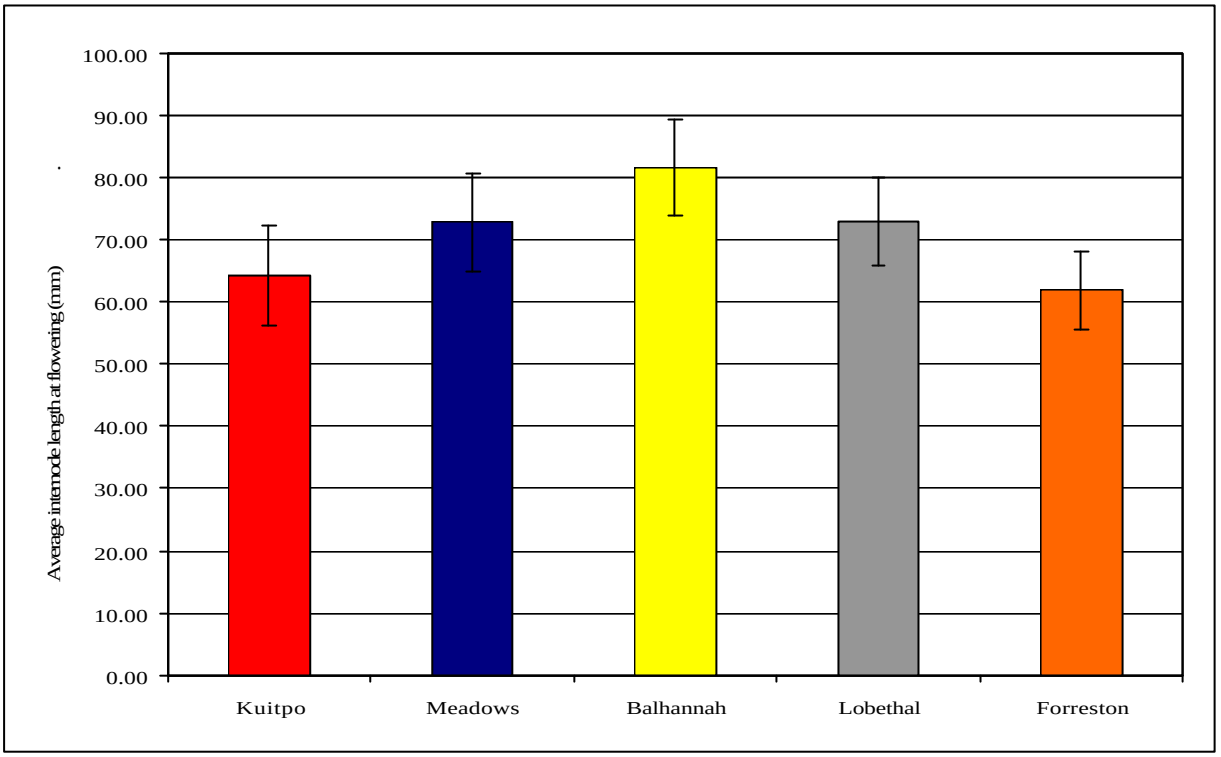

Figure 78 Mean internode (5-6) length at flowering measured between 2004 -2007 for Adelaide Hills Shiraz

As previously discussed internode length can be related to vine vigour or site capacity, an interesting relationship when observed with the pruning levels for each site. It shows the sites with the greatest node numbers retained (see **Figure 79**) measured the shortest internodes, while the site which retained the least nodes (Balhannah) was measured to have the greatest internode length.

Balhannah's long internodes are likely to be one cause of the low LLN displayed at this site, as sparsely spaced leaves along the canes leave an open canopy, particularly in the bunch zone area. This has been discussed previously in relation to relation to the fruit quality and indeed wine sensory attributes.

5.4.2 SHIRAZ NODES RETAINED AT PRUNING AND PERCENTAGE BUDBURST OVER PROJECT PERIOD FROM 2004 - 2007

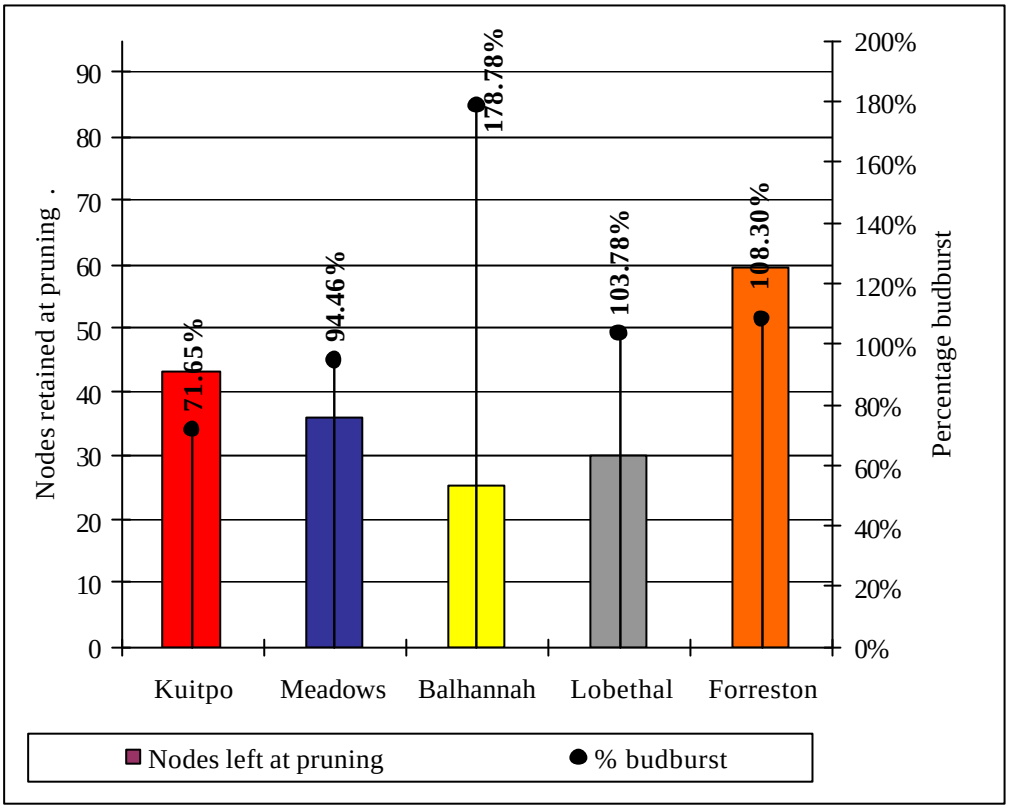

Figure 79. Nodes retained at pruning versus percentage budburst combined from 2004-2007 for Shiraz sites

The relationship between node number retained at pruning and expected percentage budburst is well understood and has been discussed previously in the Sauvignon Blanc section. **Figure 79** displays the mean node number retained at pruning for each site over the project period. From this it is clear that of the measurements made this one in particular is variable between sites, with Balhannah having 25.13 nodes retained on average from 2004-2007, while Forreston had 59.47 over the same period.

The low node count at Balhannah and the very high bud burst suggests that this site has been pruned hard each season and produces many latent or double shoots. At this site cultural practices are undertaken to eliminate weak or non count shoots if they are a problem, therefore this same figure measured later in the season may not appear as dramatic.

Figure 80 further shows these pruning level relationships by representing the shoot and count shoot numbers as a proportion of total shoots, or 100% of shoots as shown. This is just another illustration of the mean count to non count shoot numbers recorded over the project period for each site.

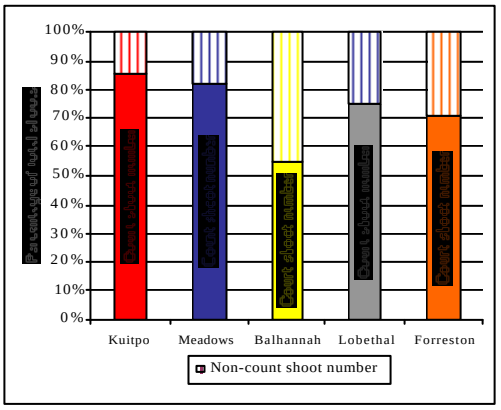

Figure 80. Comparison of mean count to non-count shoots at flowering in Adelaide Hills Shiraz sites 2004 – 2007

5.4.3 SHIRAZ MEAN LEAF LAYER NUMBER AT VERAISON AND HARVEST OVER PROJECT PERIOD 2004 - 2007

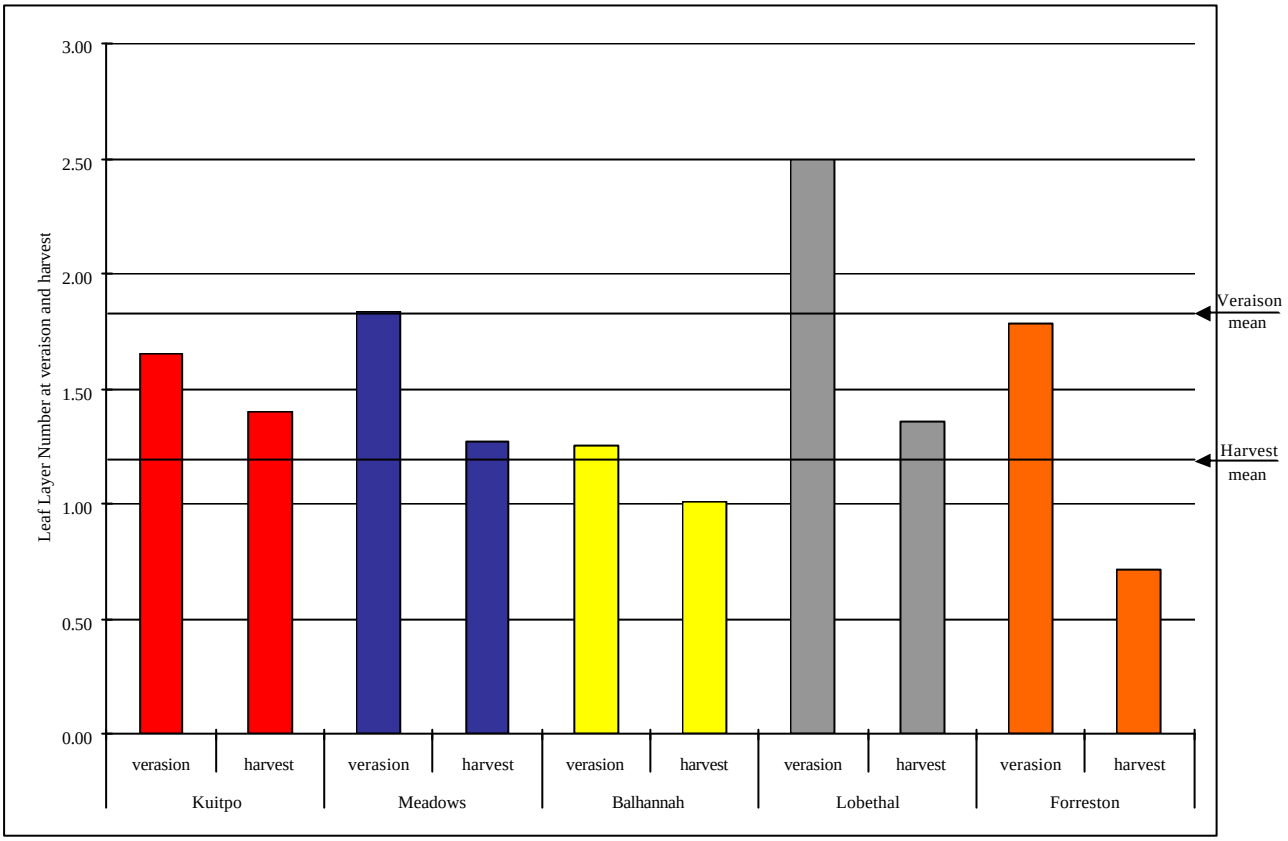

Figure 81. Mean LLN measured at flowering and veraison for Adelaide Hills Shiraz sites 2004 - 2007

Leaf Layer Number describes the number of leaves in a direct line from the exterior of the canopy to the interior bunch zone. This index is of a high level of relevance to wine quality due to links between wine flavour and bunch exposure or shading

Due to the canopy structure of the Shiraz vines associated with this project, observed LLNs remained quite low for all sites. Lobethal showed the highest LLN at verasion among the sites at a LLN of 2.5, but by harvest this had dropped to below 1.5. This was among the most dramatic reductions in LLN displayed across all sites between veraison and harvest.

A pattern which emerged and may be nothing more than coincidence was that the more northern sites of Lobethal and Forreston showed the largest difference between LLN at veraison and harvest over the trial period. This was compared to the cooler more southern sites of Kuipto and Meadows which showed less of a reduction over the same period.

Only small differences were observed between all sites in relation to wine quality in 2006.In 2006 and 2007 Forreston and Lobethal recorded unique aroma characters including ‘dusty, rubbery, burnt match, and ‘smoky’. These characters may be similarly grouped which may be attributed to the high bunch exposure late in the season.

5.4.4 SHIRAZ MEAN VINE YIELD AND INDIVIDUAL BUNCH WEIGHT COMPARISON OVER PROJECT PERIOD 2004 - 2007

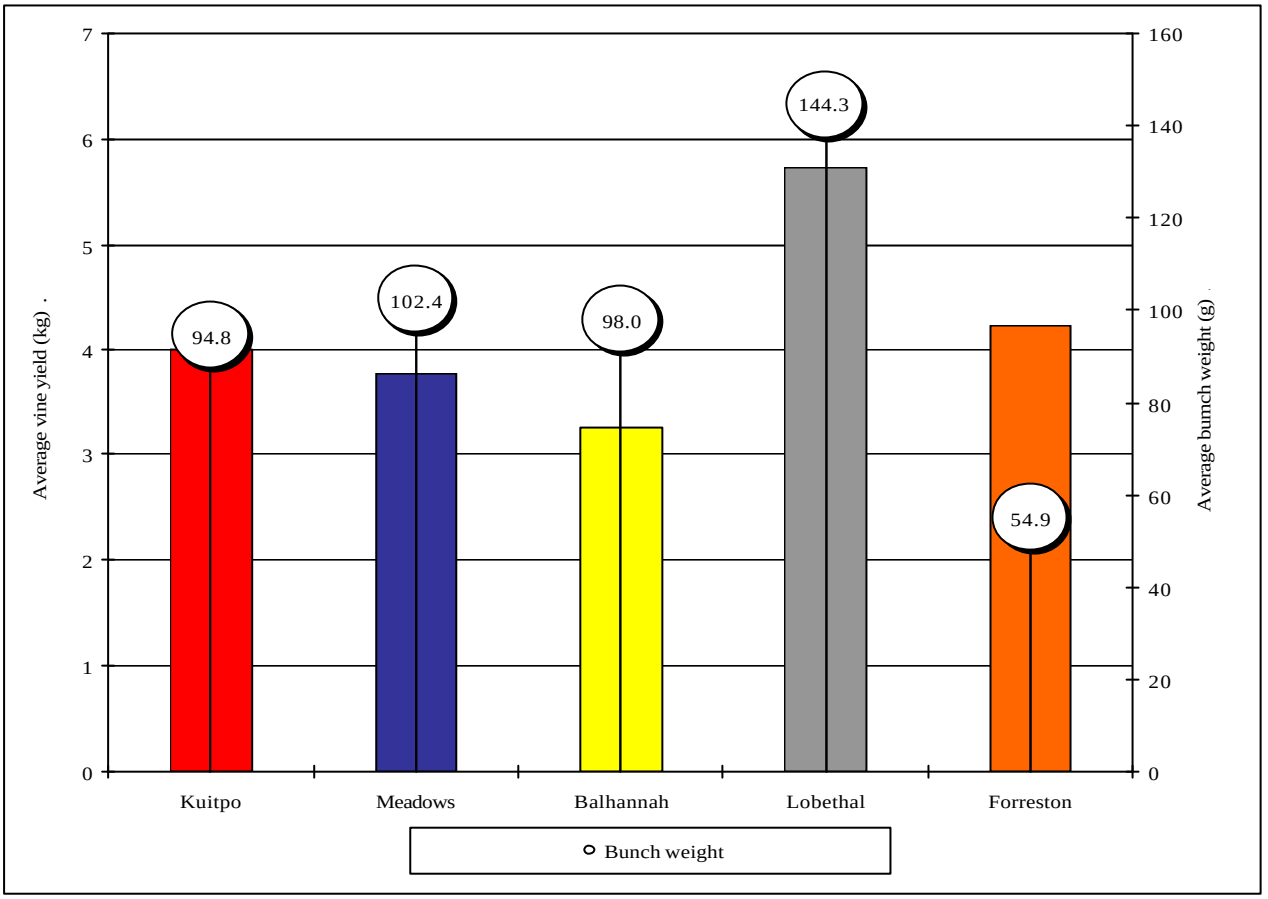

Figure 82. Comparison of vine yield and individual bunch weight in Adelaide Hills Shiraz combined over seasons 2004 - 2007

Figure 82 displays the individual vine yield and the mean bunch weights over the project period. The figure shows that mean bunch weights varied considerably between sites even when the data is averaged over three seasons. Bunch weights ranged from 54.9g at Forreston to 144.3g at Lobethal; the site at Lobethal also recorded the highest bunch weight of the project period with 180g mean bunch weight in 2005.

These bunch weights are not totally indicative of the vine yield as they represent only one yield component. For example Kuipto had a mean bunch weight of 94g and vine yield of 4kg, while Forreston had a mean bunch weight much lower at 54g but a marginally higher vine yield of 4.2kg. Despite the higher bunch weight shown by Kuipto, the site at Forreston produced more bunches and achieved a higher overall yield.

Sensory analysis of the wine from 2006 and 2007 showed that the site with the highest yield and bunch weight (Lobethal) produced wine with sweet confectionary characters and was noted in each year as having 'fresh primary fruit' characters also.

Table 5. Vine yields as per hectare for reference

Normalised vine yield for 3m x 2m spacing		
Forreston	7.0	t/ha
Lobethal	9.5	t/ha
Balhannah	5.4	t/ha
Meadows	6.3	t/ha
Kuitpo	6.7	t/ha

5.4.5 KUITPO SHOOT LENGTH AT FLOWERING

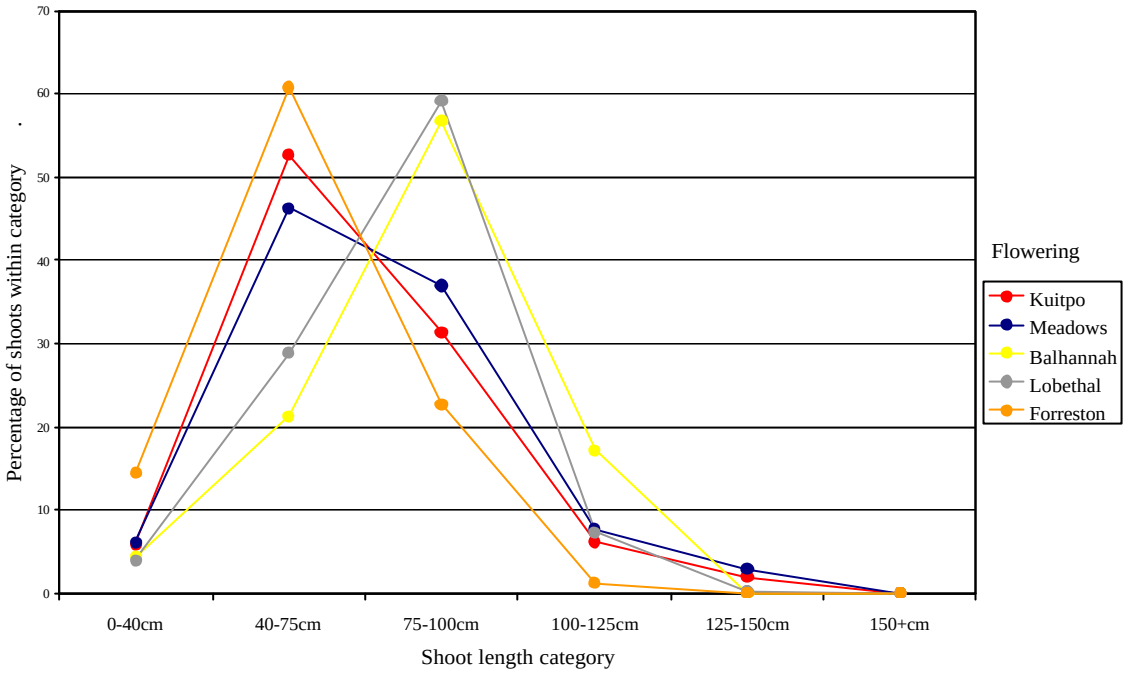

Figure 83. Shoot length summary at flowering in Adelaide Hills Shiraz

By examining the shoot length summary (**Figure 83**) and as noted in the progress report the sites can be loosely arranged into two main groups - those with 40-60% of shoots in the 40-75cm category at flowering, and those with 50-60% in the 75-100cm category at flowering. Of all the sites Balhannah and Lobethal had longer shoots at flowering. The site at Forreston shows the shortest shoots at flowering with 15% of shoots less than 40cm in length, with very few shoots over 100cm in length.

Data from these benchmark sites can be used as a guide to assess how a canopy is performing at the same phenological stage. For example we can see that Balhannah and Lobethal both have greater shoot growth early in the season: this may be linked to wine quality through other subsequent variables previously discussed.

5.4.6 KUITPO SHOOT LENGTH AT VERAISON

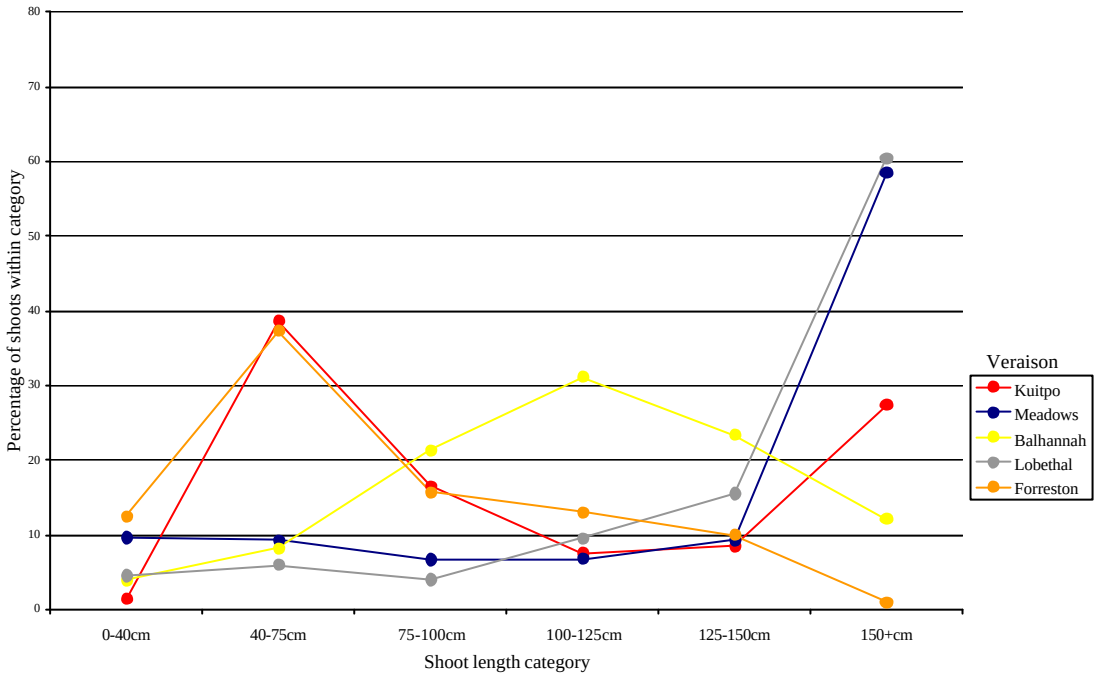

Figure 84. ***Shoot length summary at veraison in Adelaide Hills Shiraz***

Figure 84 shows measured shoot lengths at veraison, which is significantly greater than at flowering. **Figure 84** shows that there are three groupings of sites based on their shoot length category;

- More than 50% of shoots 40-100cm in length with the remainder over 100cm – Kuitpo and Forreston
- Over 75% of shoots in the 75-150cm category - Balhannah
- Over 50% of shoots more than 150cm in length – Lobethal and Meadows

This information gives an indication of shoot length at veraison, but it is around this time that shoot tipping is carried out. This would have the effect of reducing the variability shown in the longer lengths by bringing all shoots back to around 100cm in length (if tipped just above the post as is common practice).

APPENDIX 1

VINEYARD LOCATIONS

FORRESTON
4.5 km north of Forreston on the Forreston to Williamstown Road.

LOBETHAL
1.9 km south of Lobethal, located on Buckley's Road.

BALHANNAH
1.6km south east of Balhannah on Junction Creek Road.

LENSWOOD
4.4km north east of Oakbank on Vickers Road.

MEADOWS
2.9 km north east of the township of Meadows. The vineyard is on Greenhills Road.

KUITPO
11.2km south west of Meadows. The vineyard is located on Tynan Road.

APPENDIX 2

2.1 SAUVIGNON BLANC FORRESTON RAW DATA

Table 6. Summary of data collected from Forreston Sauvignon Blanc site during project period 2005 - 2007

PRE FLOWERING	2004 - 2005		2005 - 2006		2006 - 2007		2004-2007	
	mean	**stdev**	**mean**	**stdev**	**mean**	**stdev**	**mean**	**stdev**
Node number per vine	41.80	4.66	71.80	12.64	48.00	8.60	**53.87**	**8.63**
Count shoot number per vine	36.80	5.02	62.00	10.22	44.80	5.76	**47.87**	**7.00**
Non count shoots per vine	30.80	4.32	30.60	6.19	32.00	8.31	**31.13**	**6.27**
Total shoot number	67.60		92.60		76.80		**79.00**	
Shoot length (cm)	23.57	9.79						
Internode length (5-6) (mm)	45.40	1.28	65.07	18.10	54.52	10.61	**55.00**	**10.00**
Number of Lateral Shoots	0.00	0.00	0.00	0.00	4.00	1.22	**1.33**	**0.41**
Bunches per shoot	1.30	0.65	1.57	0.21	1.54	0.13	**1.47**	**0.33**
Bunches per vine	42.80	6.46	96.60	15.96	69.00	11.05	**69.47**	**11.16**
VERAISON								
Count shoot number per vine	42.80	5.45	60.80	13.37	38.80	7.60	**47.47**	**8.80**
Non count shoots per vine	32.60	3.65	23.60	5.08	22.40	6.58	**26.20**	**5.10**
Total shoot number	75.40		84.40		61.20		**73.67**	
Shoot length (cm)	115.67	32.32						
Internode length (5-6) (mm)	58.50	1.42	66.53	15.57	67.80	19.64	**64.28**	**12.21**
Number of Lateral Shoots	4.97	2.51	5.40	0.55	5.00	1.00	**5.12**	**1.35**
Percent growing tips			0.40	0.89	0.50	0.00	**0.45**	**0.45**
Leaf Layer Number	3.10	0.55	3.20	0.31	0.88	0.11	**2.39**	**0.32**
Bunches per shoot	1.33	0.61	1.48	0.23	1.44	0.31	**1.42**	**0.38**
Bunches per vine	40.40	5.86	87.40	8.02	54.80	10.35	**60.87**	**8.08**
HARVEST								
Internode length (5-6) (mm)			71.63	17.62	67.80	19.64	**69.71**	**18.63**
No Lateral shoots			6.20	1.48	5.00	1.00	**5.60**	**1.24**
Degree of lignification			94.80	3.19	98.00	4.47	**96.40**	**3.83**
LLN	2.40	0.55	1.42	0.28	0.88	0.11	**1.15**	**0.19**
Bunches per shoot	1.33	0.61	1.78	0.39	1.51	0.38	**1.65**	**0.39**
Bunches per vine	40.00	3.87	105.00	12.17	57.40	15.27	**81.20**	**13.72**
Bunch weight (g)	54.49	22.01	77.46	25.27	51.34	17.51	**61.09**	**21.60**
Berry number	46.43	18.91	54.11	15.00	53.11	17.87	**51.22**	**17.26**
Berry Weight (g)	1.17		1.27	0.17	0.93	0.07	**1.13**	**0.12**
Rachis weight (g)			3.19	1.54	1.96	0.76	**2.58**	**1.15**
Vine yield (kg)	2.18		8.13		2.95		**4.42**	

APPENDIX 2 CONT.

2.2 SAUVIGNON BLANC LOBETHAL RAW DATA

Table 7. Summary of data collected from Lobethal Sauvignon Blanc site during project period 2005 - 2007

PRE FLOWERING	2004 - 2005		2005 - 2006		2006 - 2007		2004-2007	
	mean	stdev	mean	stdev	mean	stdev	mean	stdev
Node number per vine	25.60	7.16	40.00	12.06	20.00	6.32	**28.53**	**8.52**
Count shoot number per vine	23.00	6.89	33.80	9.04	11.80	6.72	**22.87**	**7.55**
Non count shoots per vine	13.00	3.08	9.40	4.34	6.80	7.29	**9.73**	**4.90**
Total shoot number	36.00		43.20		18.60		**32.60**	
Shoot length (cm)	42.80	8.78						
Internode length (5-6) (mm)	68.60	1.72	49.80	16.70	54.00	17.20	**57.47**	**11.87**
Number of Lateral Shoots	0.00	0.00	0.00	0.00	7.20	1.10	**2.40**	**0.37**
Bunches per shoot	2.07	0.37	1.24	0.22	1.40	0.34	**1.57**	**0.31**
Bunches per vine	52.60	8.41	40.60	9.02	26.20	11.19	**39.80**	**9.54**
VERAISON								
Count shoot number per vine	19.40	5.73	28.00	9.25	15.40	4.67	**20.93**	**6.55**
Non count shoots per vine	7.60	1.34	12.80	5.22	4.40	1.14	**8.27**	**2.57**
Total shoot number	27.00		40.80		19.80		**29.20**	
Shoot length (cm)	109.60	32.70						
Internode length (5-6) (mm)	65.50	1.37	47.28	13.13	53.00	14.79	**55.26**	**9.76**
Number of Lateral Shoots	6.76	4.59	7.80	1.79	6.80	3.03	**7.12**	**3.14**
Percent growing tips			0.00	0.00	0.40	0.38	**0.20**	**0.19**
Leaf Layer Number	1.90	0.74	3.89	0.69	1.44	0.26	**2.41**	**0.56**
Bunches per shoot	2.03	0.42	1.50	0.34	1.71	0.34	**1.75**	**0.37**
Bunches per vine	52.00	8.00	41.20	16.32	26.00	8.28	**39.73**	**10.86**
HARVEST								
Internode length (5-6) (mm)			41.72	12.64	53.00	14.79	**47.36**	**13.72**
No Lateral shoots			6.60	2.41	6.80	3.03	**6.70**	**2.72**
Degree of lignification			99.00	0.00	98.00	0.00	**98.50**	**0.00**
LLN	0.60	0.55	1.61	0.29	1.40	0.55	**1.50**	**0.42**
Bunches per shoot	1.86	0.35	1.59	0.45	1.60	0.24	**1.59**	**0.35**
Bunches per vine	51.40	8.02	41.60	10.83	26.00	8.28	**33.80**	**9.55**
Bunch weight (g)	135.83	39.04	76.76	24.81	107.00	60.18	**106.53**	**41.34**
Berry number	109.21	33.66	52.00	14.40	90.20	41.48	**83.80**	**29.85**
Berry Weight (g)	1.24		1.33	0.14	1.11	0.15	**1.23**	**0.14**
Rachis weight (g)			2.69	0.84	2.64	0.47	**2.66**	**0.65**
Vine yield (kg)	6.98		3.19		2.78		**4.32**	

APPENDIX 2 CONT.

2.3 SAUVIGNON BLANC LENSWOOD RAW DATA

Table 8. Summary of data collected from Lenswood Sauvignon Blanc site during project period 2005- 2007

PRE FLOWERING	2004 - 2005		2005 - 2006		2006 - 2007		2004-2007	
	mean	stdev	mean	stdev	mean	stdev	mean	stdev
Node number per vine	37.20	2.95	39.00	6.63	55.80	9.65	**44.00**	**6.41**
Count shoot number per vine	33.20	3.35	33.80	4.87	49.00	5.24	**38.67**	**4.49**
Non count shoots per vine	10.20	3.56	13.40	6.35	14.80	7.36	**12.80**	**5.76**
Total shoot number	43.40		47.20		63.80		**51.47**	
Shoot length (cm)	37.30	10.68						
Internode length (5-6) (mm)	49.40	1.23	49.60	10.95	46.50	13.58	**48.50**	**8.59**
Number of Lateral Shoots	0.00	0.00	0.00	0.00	4.80	1.30	**1.60**	**0.43**
Bunches per shoot	1.83	0.38	1.44	0.07	1.42	0.19	**1.57**	**0.21**
Bunches per vine	52.20	7.85	48.40	5.03	70.20	15.24	**56.93**	**9.37**
VERAISON								
Count shoot number per vine	36.40	3.36	30.00	2.55	38.40	4.83	**34.93**	**3.58**
Non count shoots per vine	5.60	2.70	13.60	5.41	8.20	2.39	**9.13**	**3.50**
Total shoot number	42.00		43.60		46.60		**44.07**	
Shoot length (cm)	73.60	35.38						
Internode length (5-6) (mm)	48.00	1.38	50.28	12.93	45.40	11.08	**47.89**	**8.46**
Number of Lateral Shoots	1.27	1.48	9.20	1.10	8.00	3.16	**6.16**	**1.91**
Percent growing tips			0.00	0.00	1.00	0.00	**0.50**	**0.00**
Leaf Layer Number	1.50	0.50	3.26	0.26	1.64	0.33	**2.13**	**0.36**
Bunches per shoot	1.70	0.60	1.63	0.32	1.34	0.11	**1.56**	**0.34**
Bunches per vine	37.60	3.65	49.00	10.39	51.20	4.87	**45.93**	**6.30**
HARVEST								
Internode length (5-6) (mm)			46.60	12.14	45.40	11.08	**46.00**	**11.61**
No Lateral shoots			6.80	0.84	8.00	3.16	**7.40**	**2.00**
Degree of lignification			95.40	3.51	98.00	0.00	**96.70**	**1.75**
LLN	1.20	0.45	1.58	0.35	1.64	0.33	**1.61**	**0.34**
Bunches per shoot	1.86	0.35	1.70	0.26	1.34	0.11	**1.52**	**0.18**
Bunches per vine	35.80	4.44	51.40	10.48	51.20	4.87	**51.30**	**7.67**
Bunch weight (g)	85.81	29.08	90.64	47.50	70.65	37.55	**82.37**	**38.04**
Berry number	64.85	27.46	56.89	28.01	53.40	25.45	**58.38**	**26.97**
Berry Weight (g)	1.32		1.50	0.13	1.28	0.13	**1.37**	**0.13**
Rachis weight (g)			4.22	2.52	1.53	0.97	**2.88**	**1.75**
Vine yield (kg)	3.07		4.66		3.62		**3.78**	

APPENDIX 2 CONT

2.4 SAUVIGNON BLANC BALHANNAH RAW DATA

Table 9. Summary of data collected from Balhannah Sauvignon Blanc site during project period 2005 - 2007

PRE FLOWERING	2004 - 2005		2005 - 2006		2006 - 2007		2004-2007	
	mean	stdev	mean	stdev	mean	stdev	mean	stdev
Node number per vine	49.20	2.17	62.20	11.05	49.00	5.61	**53.47**	**6.28**
Count shoot number per vine	48.20	2.05	61.20	11.54	43.20	3.70	**50.87**	**5.76**
Non count shoots per vine	14.60	7.64	23.80	4.55	33.80	5.54	**24.07**	**5.91**
Total shoot number	62.80		85.00		77.00		**74.93**	
Shoot length (cm)	25.37	7.19						
Internode length (5-6) (mm)	33.40	1.49	65.04	13.33	55.00	8.04	**51.15**	**7.62**
Number of Lateral Shoots	0.00	0.00	0.00	0.00	5.40	2.07	**1.80**	**0.69**
Bunches per shoot	0.83	0.65	1.37	0.59	1.70	0.36	**1.30**	**0.53**
Bunches per vine	39.80	1.64	79.80	21.28	72.60	8.91	**64.07**	**10.61**
VERAISON								
Count shoot number per vine	40.20	2.39	55.00	8.86	41.20	4.21	**45.47**	**5.15**
Non count shoots per vine	6.40	1.82	23.40	3.78	26.60	5.41	**18.80**	**3.67**
Total shoot number	46.60		78.40		67.80		**64.27**	
Shoot length (cm)	74.97	31.23						
Internode length (5-6) (mm)	39.80	1.25	63.61	8.79	55.40	8.77	**52.94**	**6.27**
Number of Lateral Shoots	1.07	1.66	5.60	1.14	4.60	0.89	**3.76**	**1.23**
Percent growing tips			0.20	0.45	0.00	0.00	**0.10**	**0.22**
Leaf Layer Number	2.10	0.55	2.88	0.21	1.43	0.36	**2.14**	**0.38**
Bunches per shoot	0.90	0.66	1.64	0.28	1.58	0.46	**1.38**	**0.47**
Bunches per vine	37.80	6.53	90.20	19.46	63.80	12.97	**63.93**	**12.99**
HARVEST								
Internode length (5-6) (mm)			64.40	9.05	55.40	8.77	**59.90**	**8.91**
No Lateral shoots			5.20	1.10	4.60	0.89	**4.90**	**0.99**
Degree of lignification			97.60	1.52	99.00	0.00	**98.30**	**0.76**
LLN	1.50	0.50	1.14	0.42	1.43	0.36	**1.29**	**0.39**
Bunches per shoot	0.93	0.52	2.14	0.19	1.69	0.39	**1.91**	**0.29**
Bunches per vine	35.80	6.22	103.40	19.86	68.60	10.62	**86.00**	**15.24**
Bunch weight (g)	76.07	41.20	77.12	22.41	64.59	22.38	**72.59**	**28.66**
Berry number	62.36	32.81	60.89	18.63	67.00	23.51	**63.42**	**24.99**
Berry Weight (g)	1.22		1.15	0.13	1.01	0.49	**1.13**	**0.31**
Rachis weight (g)			3.19	1.76	2.29	0.52	**2.74**	**1.14**
Vine yield (kg)	2.72		7.97		4.43		**5.04**	

APPENDIX 2 CONT.

2.5 SAUVIGNON BLANC MEADOWS RAW DATA

Table 10. Summary of data collected from Meadows Sauvignon Blanc site during project period 2005 - 2007

PRE FLOWERING	2004 - 2005		2005 - 2006		2006 - 2007		2004-2007	
	mean	stdev	mean	stdev	mean	stdev	mean	stdev
Node number per vine	42.40	1.67	43.00	4.06	44.80	7.26	**43.40**	**4.33**
Count shoot number per vine	37.00	4.74	38.60	4.16	34.80	8.26	**36.80**	**5.72**
Non count shoots per vine	9.00	3.08	18.80	6.98	19.60	3.65	**15.80**	**4.57**
Total shoot number	46.00		57.40		54.40		**52.60**	
Shoot length (cm)	42.70	9.88					**42.70**	
Internode length (5-6) (mm)	61.60	1.93	50.00	27.00	72.60	17.09	**61.40**	**15.34**
Number of Lateral Shoots	0.00	0.00	1.20	2.68	5.80	1.30	**2.33**	**1.33**
Bunches per shoot	1.57	0.57	1.67	0.19	1.54	0.20	**1.59**	**0.32**
Bunches per vine	44.40	7.50	64.60	10.16	53.60	14.47	**54.20**	**10.71**
VERAISON								
Count shoot number per vine	33.40	2.70	31.20	3.90	31.20	8.32	**31.93**	**4.97**
Non count shoots per vine	4.80	1.48	13.80	4.15	16.40	3.21	**11.67**	**2.95**
Total shoot number	38.20		45.00		47.60		**43.60**	
Shoot length (cm)	149.40	48.29						
Internode length (5-6) (mm)	94.20	2.30	67.96	20.99	67.00	15.00	**76.39**	**12.76**
Number of Lateral Shoots	9.63	2.53	12.40	0.89	13.00	2.12	**11.68**	**1.85**
Percent growing tips			8.00	2.74	1.00	0.00	**4.50**	**1.37**
Leaf Layer Number	2.80	0.84	3.68	0.52	2.00	0.65	**2.83**	**0.67**
Bunches per shoot	1.43	0.68	1.74	0.15	1.74	0.30	**1.64**	**0.37**
Bunches per vine	36.40	5.59	54.40	8.79	52.60	7.67	**47.80**	**7.35**
HARVEST								
Internode length (5-6) (mm)			67.96	20.99	67.00	15.00	**67.48**	**17.99**
No Lateral shoots			9.80	2.28	13.00	2.12	**11.40**	**2.20**
Degree of lignification			90.00	6.12	86.00	2.24	**88.00**	**4.18**
LLN	2.10	0.74	2.26	0.41	1.40	0.55	**1.83**	**0.48**
Bunches per shoot	1.45	0.57	1.74	0.42	1.48	0.11	**1.61**	**0.26**
Bunches per vine	36.20	4.15	53.60	0.42	52.60	0.11	**53.10**	**0.26**
Bunch weight (g)	71.74	35.28	80.37	32.83	69.19	32.90	**73.77**	**33.67**
Berry number	49.05	22.46	51.50	20.42	52.80	24.75	**51.12**	**22.54**
Berry Weight (g)	1.46		1.50	0.15	1.26	0.09	**1.41**	**0.12**
Rachis weight (g)			2.41	1.30	2.05	1.28	**2.23**	**1.29**
Vine yield (kg)	2.60		4.31		3.64		**3.51**	

APPENDIX 2 CONT.

2.6 SAUVIGNON BLANC KUITPO RAW DATA

Table 11. Summary of data collected from Kuitpo Sauvignon Blanc site during project period 2005 - 2007

PRE FLOWERING	2004 - 2005		2005 - 2006		2006 - 2007		2004-2007	
	mean	stdev	mean	stdev	mean	stdev	mean	stdev
Node number per vine	36.60	2.88	49.80	4.76	41.80	8.35	**42.73**	**5.33**
Count shoot number per vine	30.20	2.86	44.40	5.37	37.20	6.38	**37.27**	**4.87**
Non count shoots per vine	3.60	0.89	17.20	7.29	14.20	2.59	**11.67**	**3.59**
Total shoot number	33.80		61.60		51.40		**48.93**	
Shoot length (cm)	34.40	6.64					**34.40**	
Internode length (5-6) (mm)	50.00	1.04	49.24	14.67	47.20	12.42	**48.81**	**9.38**
Number of Lateral Shoots	0.00	0.00	0.00	0.00	3.60	1.14	**1.20**	**0.38**
Bunches per shoot	1.83	0.38	1.22	0.22	1.13	0.15	**1.39**	**0.25**
Bunches per vine	53.00	4.85	53.40	53.40	42.00	9.59	**49.47**	**22.61**
VERAISON								
Count shoot number per vine	26.40	1.95	36.80	3.35	30.80	6.61	**31.33**	**3.97**
Non count shoots per vine	3.40	0.55	15.40	6.84	14.40	2.88	**11.07**	**3.42**
Total shoot number	29.80		52.20		45.20		**42.40**	
Shoot length (cm)	104.30	35.88						
Internode length (5-6) (mm)	55.80	1.74	46.15	12.67	46.60	13.36	**49.52**	**9.26**
Number of Lateral Shoots	4.07	3.63	7.20	1.79	6.80	1.30	**6.02**	**2.24**
Percent growing tips			3.80	3.90	0.80	0.21	**2.30**	**2.05**
Leaf Layer Number	2.00	0.00	3.04	0.96	2.13	0.26	**2.39**	**0.41**
Bunches per shoot	1.85	0.46	1.66	0.19	1.48	0.13	**1.66**	**0.26**
Bunches per vine	42.20	3.90	61.00	8.86	45.40	10.48	**49.53**	**7.75**
HARVEST								
Internode length (5-6) (mm)			53.50	19.72	46.60	13.36	**50.05**	**16.54**
No Lateral shoots			5.80	1.79	6.80	1.30	**6.30**	**1.55**
Degree of lignification			90.60	6.84	90.00	0.00	**90.30**	**3.42**
LLN			2.18	0.14	2.13	0.26	**2.15**	**0.20**
Bunches per shoot			1.66	0.20	1.66	0.20	**1.66**	**0.20**
Bunches per vine			60.80	0.20	51.60	0.20	**56.20**	**0.20**
Bunch weight (g)			84.79	29.76	80.12	42.64	**82.45**	**36.20**
Berry number			55.80	19.36	64.64	34.70	**60.22**	**27.03**
Berry Weight (g)			0.96	0.01	1.45	0.12	**1.20**	**0.06**
Rachis weight (g)			2.54	1.97	2.10	1.36	**2.32**	**1.66**
Vine yield (kg)			5.16		4.13		**4.64**	

APPENDIX 2 CONT.

2.7 SAUVIGNON BLANC COMBINED SHOOT LENGTH SUMMARY

(seasons 2005-2006, 2006-2007)

Table 12. Shoot length measurements based on categories of growth from 2005 - 2007

Flowering *Shoot length categories, 2005 - 2007 means*

Site	0-40cm	40-75cm	75-100cm	100-125cm	125-150cm	150+cm
Kuitpo	*31.8*	*54.2*	*7.0*	*1.0*	*0.0*	*0.0*
Meadows	*4.2*	*39.7*	*48.1*	*5.0*	*0.0*	*0.0*
Balhannah	*36.9*	*50.3*	*7.6*	*0.5*	*0.0*	*0.0*
Lenswood	*39.0*	*60.3*	*0.3*	*0.3*	*0.0*	*0.0*
Lobethal	*11.5*	*57.7*	*8.8*	*0.0*	*0.0*	*0.0*
Forreston	*21.9*	*44.7*	*11.3*	*0.0*	*0.0*	*0.0*

Verasion *Shoot length categories, 2005 - 2007 means*

Site	0-40cm	40-75cm	75-100cm	100-125cm	125-150cm	150+cm
Kuitpo	*18.5*	*18.0*	*12.5*	*17.5*	*27.0*	*9.5*
Meadows	*4.2*	*4.8*	*3.6*	*8.9*	*43.4*	*34.0*
Balhannah	*17.6*	*29.0*	*31.6*	*15.1*	*9.5*	*0.5*
Lenswood	*11.3*	*15.0*	*17.5*	*28.9*	*24.1*	*2.5*
Lobethal	*12.2*	*28.0*	*25.5*	*23.0*	*24.3*	*4.0*
Forreston	18.5	31.0	22.8	24.0	4.2	0.5

Harvest *Shoot length categories, 2005 - 2007 means*

Site	0-40cm	40-75cm	75-100cm	100-125cm	125-150cm	150+cm
Kuitpo	*20.1*	*16.5*	*11.5*	*18.5*	*28.4*	*5.0*
Meadows	*4.2*	*4.8*	*3.6*	*8.9*	*43.4*	*34.0*
Balhannah	*17.6*	*29.0*	*31.3*	*15.8*	*6.5*	*0.5*
Lenswood	*13.0*	*15.5*	*12.5*	*22.5*	*36.5*	*0.0*
Lobethal	*17.0*	*18.0*	*17.0*	*20.5*	*18.5*	*7.5*
Forreston	*17.1*	*23.5*	*10.0*	*24.2*	*22.5*	*2.9*

APPENDIX 3 SHIRAZ

3.1 SHIRAZ FORRESTON RAW DATA

Table 13. Summary of data collected from Forreston Shiraz site during project period 2005 - 2007

PRE FLOWERING	2004 - 2005		2005 - 2006		2006 - 2007		2004 - 2007	
	mean	stdev	mean	stdev	mean	stdev	mean	stdev
Node number per vine	37.80	4.15	81.60	11.80	59.00	17.99	**59.47**	**11.31**
Count shoot number per vine	23.80	4.97	70.20	14.64	42.60	14.36	**45.53**	**11.32**
Non count shoots per vine	18.20	1.92	12.40	5.18	26.00	8.63	**18.87**	**5.24**
Total shoot number	42.00		82.60		68.60	0.00	**64.40**	
Av Shoot length	21.83	5.61						
Internode length (5-6) (mm)	41.87	1.24	69.25	13.36	74.40	23.60	**61.84**	**12.73**
Number of Lateral Shoots	0.00	0.00	0.00	0.00	4.40	1.14	**1.47**	**0.38**
Bunches per shoot	0.69	0.66	1.53	0.13	1.67	0.29	**1.30**	**0.36**
Bunches per vine	18.20	2.28	106.80	18.17	72.40	30.08	**65.80**	**16.84**
VERAISON								
Count shoot number per vine	24.40	6.35	65.40	10.31	39.60	11.17	**43.13**	**9.28**
Non count shoots per vine	21.40	5.46	15.80	3.42	12.60	6.43	**16.60**	**5.10**
Total shoot number	45.80		81.20		52.20	0.00	**59.73**	
Av Shoot length	96.54	56.18						
Internode length (5-6) (mm)	66.00	1.60	69.63	13.33	81.80	18.19	**72.48**	**11.04**
Number of Lateral Shoots	1.70	1.37	4.80	1.92	3.40	1.14	**3.30**	**1.48**
Percent growing tips			0.00	0.00	0.20	0.27	**0.10**	**0.14**
Leaf Layer Number	1.50	0.50	3.15	0.88	0.72	0.30	**1.79**	**0.56**
Bunches per shoot	1.25	0.75	1.56	0.43	1.33	0.16	**1.38**	**0.45**
Bunches per vine	46.40	7.40	98.80	12.40	52.60	15.24	**65.93**	**11.68**
HARVEST								
Internode length			69.63	13.33	81.80	18.19	**75.72**	**15.76**
No Lateral shoots			3.00	1.00	3.40	1.14	**3.20**	**1.07**
Degree of lignification			97.60	2.51	100.00	0.00	**98.80**	**1.25**
LLN	0.00	0.00	0.72	0.72	0.72	0.30	**0.72**	**0.51**
Bunches per shoot	1.25	0.75	1.87		1.33	0.00	**1.60**	
Bunches per vine	45.40	5.77	122.40	26.02	52.60	15.24	**87.50**	**20.63**
Bunch weight (g)	63.83	27.73	63.76	27.26	37.03	16.88	**50.39**	**22.07**
Berry number	57.28	25.91	61.56	24.76	33.73	16.23	**47.64**	**20.50**
Berry Weight (g)	1.11		0.99	0.17	1.04	0.00	**1.02**	**0.08**
Rachis weight (g)			2.83	1.12	1.96	0.78	**2.39**	**0.95**
Vine yield (kg)	2.90		7.80		1.95		**4.88**	

APPENDIX 3 CONTD

3.2 SHIRAZ LOBETHAL RAW DATA

Table 14. Summary of data collected from Lobethal Shiraz site during project period 2005 - 2007

PRE FLOWERING	2004 - 2005		2005 - 2006		2006 - 2007		2004 - 2007	
	mean	**stdev**	**mean**	**stdev**	**mean**	**stdev**	**mean**	**stdev**
Node number per vine	25.00	4.53	30.60	3.65	34.40	2.70	**30.00**	**3.63**
Count shoot number per vine	19.40	4.16	25.80	2.28	24.40	1.52	**23.20**	**2.65**
Non count shoots per vine	5.20	0.84	7.20	4.02	11.40	4.45	**7.93**	**3.10**
Total shoot number	24.60		33.00		35.80	0.00	**31.13**	
Av Shoot length	50.53	21.73						
Internode length (5-6) (mm)	67.90	3.21	80.30	19.33	70.80	19.46	**73.00**	**14.00**
Number of Lateral Shoots	0.00	0.00	0.00	0.00	6.60	0.89	**2.20**	**0.30**
Bunches per shoot	2.10	0.66	1.65	0.37	2.17	0.28	**1.97**	**0.44**
Bunches per vine	35.80	6.42	42.20	8.29	53.20	9.63	**43.73**	**8.11**
VERAISON								
Count shoot number per vine	14.00	4.53	24.60	3.78	20.60	2.41	**19.73**	**3.57**
Non count shoots per vine	5.00	1.22	7.40	3.13	7.60	2.07	**6.67**	**2.14**
Total shoot number	19.00		32.00		28.20	0.00	**26.40**	
Av Shoot length	115.83	83.82						
Internode length (5-6) (mm)	74.89	2.91	77.25	23.73	76.80	19.14	**76.31**	**15.26**
Number of Lateral Shoots	7.50	6.39	8.00	2.35	14.00	0.00	**9.83**	**2.91**
Percent growing tips			1.40	2.19	1.00	0.00	**1.20**	**1.10**
Leaf Layer Number	2.10	0.89	3.79	0.58	1.60	0.28	**2.50**	**0.59**
Bunches per shoot	1.87	0.63	1.62	0.24	1.78	0.21	**1.76**	**0.36**
Bunches per vine	35.00	4.85	39.80	7.79	36.40	4.51	**37.07**	**5.71**
HARVEST								
Internode length			77.25	23.73	76.80	19.14	**77.02**	**21.44**
No Lateral shoots			7.40	0.89	14.00	0.00	**10.70**	**0.45**
Degree of lignification			98.80	0.84	99.00	0.00	**98.90**	**0.42**
LLN	0.80	0.84	1.32	0.84	1.40	0.55	**1.36**	**0.70**
Bunches per shoot	1.80	0.85	1.53		1.77	0.00	**1.65**	
Bunches per vine	45.60	4.51	37.60	9.56	36.40	4.51	**37.00**	**7.03**
Bunch weight (g)	135.67	58.54	115.55	38.32	181.81	38.73	**148.68**	**38.53**
Berry number	126.33	41.81	127.30	119.95	112.50	23.37	**119.90**	**71.66**
Berry Weight (g)	1.07		1.18	0.39	1.59	0.14	**1.39**	**0.27**
Rachis weight (g)			4.72	2.01	3.46	0.83	**4.09**	**1.42**
Vine yield (kg)	6.19		4.34		6.62		**5.48**	

APPENDIX 3 CONTD

3.3 SHIRAZ BALHANNAH RAW DATA

Table 15. Summary of data collected from Balhanna Shiraz site during project period 2005 - 2007

PRE FLOWERING	**2004 - 2005**		**2005 - 2006**		**2006 - 2007**		**2004 - 2007**	
	mean	**stdev**	**mean**	**stdev**	**mean**	**stdev**	**mean**	**stdev**
Node number per vine	23.80	5.93	33.20	3.96	18.40	1.34	**25.13**	**3.75**
Count shoot number per vine	22.60	5.37	31.00	2.92	21.00	2.74	**24.87**	**3.67**
Non count shoots per vine	28.60	8.35	8.20	0.45	23.40	9.10	**20.07**	**5.97**
Total shoot number	51.20	42.20	39.20		44.40	0.00	**44.93**	
Av Shoot length	50.72	17.77						
Internode length (5-6) (mm)	73.86	2.61	81.56	21.06	89.40	22.88	**81.61**	**15.52**
Number of Lateral Shoots	0.00	0.00	0.00	0.00	5.80	1.48	**1.93**	**0.49**
Bunches per shoot	1.70	0.60	1.73	0.10	1.92	0.32	**1.78**	**0.34**
Bunches per vine	47.00	9.82	53.60	6.88	40.40	8.56	**47.00**	**8.42**
VERAISON								
Count shoot number per vine	18.40	3.36	29.80	4.66	18.80	3.96	**22.33**	**3.99**
Non count shoots per vine	9.80	2.59	9.00	2.35	9.80	4.15	**9.53**	**3.03**
Total shoot number	28.20	23.80	38.80		28.60	0.00	**31.87**	
Av Shoot length	144.81	64.61						
Internode length (5-6) (mm)	79.26	2.06	90.40	18.98	88.00	19.53	**85.89**	**13.52**
Number of Lateral Shoots	5.74	2.63	8.20	1.79	3.80	1.92	**5.91**	**2.11**
Percent growing tips			12.40	8.44	0.80	0.00	**6.60**	**4.22**
Leaf Layer Number	0.40	0.55	2.62	0.67	0.76	0.55	**1.26**	**0.59**
Bunches per shoot	1.15	0.53	1.69	0.18	1.85	0.15	**1.56**	**0.29**
Bunches per vine	25.80	2.17	50.00	6.96	34.80	7.56	**36.87**	**5.57**
HARVEST								
Internode length			90.40	18.98	88.00	19.53	**89.20**	**19.25**
No Lateral shoots			6.60	1.14	3.80	1.92	**5.20**	**1.53**
Degree of lignification			95.60	5.18	100.00	0.00	**97.80**	**2.59**
LLN	0.00	0.00	1.02	0.45	1.00	0.00	**1.01**	**0.22**
Bunches per shoot	1.37	0.81	1.22		1.85	0.00	**1.54**	
Bunches per vine	29.20	7.26	36.40	9.15	34.80	7.56	**35.60**	**8.36**
Bunch weight (g)	109.93	40.47	115.60	49.12	68.47	18.66	**92.04**	**33.89**
Berry number	95.02	34.74	100.44	48.42	101.90	27.78	**101.17**	**38.10**
Berry Weight (g)	1.16		1.07	0.07	0.66	0.15	**0.87**	**0.11**
Rachis weight (g)			5.94	2.58	2.10	0.73	**4.02**	**1.65**
Vine yield (kg)	3.21		4.21		2.38		**3.30**	

APPENDIX 3 CONTD

3.4 SHIRAZ MEADOWS RAW DATA

Table 16. Summary of data collected from Meadows Shiraz site during project period 2005 - 2007

PRE FLOWERING	2004 - 2005		2005 - 2006		2006 - 2007		2004 - 2007	
	mean	stdev	mean	stdev	mean	stdev	mean	stdev
Node number per vine	37.60	2.88	47.00	4.30	23.80	2.95	**36.13**	**3.38**
Count shoot number per vine	29.60	6.88	35.80	6.26	18.00	2.92	**27.80**	**5.35**
Non count shoots per vine	6.80	3.11	7.00	2.74	5.20	2.59	**6.33**	**2.81**
Total shoot number	36.40		42.80		23.20	0.00	**34.13**	
Av Shoot length	50.07	11.92						
Internode length (5-6) (mm)	73.03	2.40	63.74	19.93	81.40	24.39	**72.72**	**15.58**
Number of Lateral Shoots	0.00	0.00	0.00	0.00	6.60	2.07	**2.20**	**0.69**
Bunches per shoot	1.83	0.70	1.55	0.24	1.41	0.33	**1.60**	**0.42**
Bunches per vine	50.00	11.53	55.80	14.02	26.00	8.83	**43.93**	**11.46**
VERAISON								
Count shoot number per vine	16.20	2.77	33.00	5.70	17.00	3.16	**22.07**	**3.88**
Non count shoots per vine	5.40	1.34	6.40	1.14	5.80	2.95	**5.87**	**1.81**
Total shoot number	21.60		39.40		22.80	0.00	**27.93**	
Av Shoot length	160.05	83.57						
Internode length (5-6) (mm)	91.36	2.72	71.40	25.02	82.00	30.14	**81.59**	**19.29**
Number of Lateral Shoots	7.73	5.67	8.60	0.89	7.00	2.24	**7.78**	**2.93**
Percent growing tips			6.40	4.10	1.00	0.00	**3.70**	**2.05**
Leaf Layer Number	1.40	0.42	3.10	0.56	1.00	0.24	**1.83**	**0.41**
Bunches per shoot	1.86	0.77	1.67	0.16	1.48	0.48	**1.67**	**0.47**
Bunches per vine	39.20	4.49	54.60	8.76	24.60	6.58	**39.47**	**6.61**
HARVEST								
Internode length			71.40	25.02	82.00	30.14	**76.70**	**27.58**
No Lateral shoots			7.00	1.00	7.00	2.24	**7.00**	**1.62**
Degree of lignification			95.60	1.34	98.20	1.79	**96.90**	**1.57**
LLN	1.60	0.82	1.55	0.22	1.00	0.00	**1.28**	**0.11**
Bunches per shoot	1.68	0.80	1.48		1.45	0.00	**1.46**	
Bunches per vine	39.20	4.49	48.80	10.01	24.60	6.58	**36.70**	**8.30**
Bunch weight (g)	102.88	42.38	93.62	47.42	110.58	44.86	**102.10**	**46.14**
Berry number	91.14	41.13	75.50	37.59	97.22	36.82	**86.36**	**37.20**
Berry Weight (g)	1.13		1.13	0.08	0.96	0.01	**1.05**	**0.04**
Rachis weight (g)			5.45	2.82	4.29	2.06	**4.87**	**2.44**
Vine yield (kg)	4.03		4.57		2.72		**3.64**	

APPENDIX 3 CONTD

3.5 SHIRAZ KUITPO RAW DATA

Table 17. Summary of data collected from Kuitpo Shiraz site during project period 2005 - 2007

PRE FLOWERING	2004 - 2005		2005 - 2006		2006 - 2007		2004 - 2007	
	mean	stdev	mean	stdev	mean	stdev	mean	stdev
Node number per vine	40.00	2.00	46.40	9.66	43.40	3.58	**43.27**	**5.08**
Count shoot number per vine	25.80	3.49	28.40	3.51	25.00	1.87	**26.40**	**2.96**
Non count shoots per vine	3.20	2.17	7.40	4.67	3.20	1.10	**4.60**	**2.64**
Total shoot number	29.00		35.80		28.20	0.00	**31.00**	
Av Shoot length	39.57	14.93						
Internode length (5-6) (mm)	57.03	2.67	68.86	26.81	67.20	18.26	**64.36**	**15.91**
Number of Lateral Shoots	0.00	0.00	0.00	0.00	5.00	1.22	**1.67**	**0.41**
Bunches per shoot	2.17	0.38	1.49	0.42	1.52	0.34	**1.73**	**0.38**
Bunches per vine	44.40	7.50	42.00	10.37	37.80	7.66	**41.40**	**8.51**
VERAISON								
Count shoot number per vine	18.40	2.30	30.00	5.10	20.60	3.51	**23.00**	**3.64**
Non count shoots per vine	4.40	1.52	5.60	3.29	4.60	1.14	**4.87**	**1.98**
Total shoot number	22.80		35.60		25.20	0.00	**27.87**	
Av Shoot length	124.14	55.90						
Internode length (5-6) (mm)	68.48	2.68	72.00	19.74	66.40	14.47	**68.96**	**12.30**
Number of Lateral Shoots	4.76	4.47	7.80	2.68	5.80	2.05	**6.12**	**3.07**
Percent growing tips			12.40	8.44	0.80	0.00	**6.60**	**4.22**
Leaf Layer Number	1.30	0.27	2.62	0.47	1.03	0.38	**1.65**	**0.38**
Bunches per shoot	1.88	0.44	1.38	0.19	1.96	0.39	**1.74**	**0.34**
Bunches per vine	36.80	3.96	41.60	10.33	39.60	5.86	**39.33**	**6.72**
HARVEST								
Internode length			72.00	19.74	66.40	14.47	**69.20**	**17.10**
No Lateral shoots			6.60	6.60	5.80	2.05	**6.20**	**4.32**
Degree of lignification			98.40	0.89	85.00	0.00	**91.70**	**0.45**
LLN	0.60	0.42	1.20	0.32	1.60	0.55	**1.40**	**0.43**
Bunches per shoot	1.84	0.55	1.62		1.92	0.00	**1.77**	
Bunches per vine	36.60	4.04	48.60	11.41	39.60	5.86	**44.10**	**8.64**
Bunch weight (g)	71.37	35.11	107.40	34.62	105.52	37.63	**106.46**	**36.13**
Berry number	64.63	29.04	82.10	19.60	87.80	39.36	**84.95**	**29.48**
Berry Weight (g)	1.10		1.25	0.19	0.97	0.01	**1.11**	**0.10**
Rachis weight (g)			4.19	1.45	3.24	1.75	**3.72**	**1.60**
Vine yield (kg)	2.61		5.22		4.18		**4.70**	

APPENDIX 3 CONTD

3.6 SHIRAZ COMBINED SHOOT LENGTH SUMMARY

(SEASON 2005-2006, 2006-2007)

Table 18. Shoot length measurements based on categories of growth from 2005 - 2007

Flowering	*Shoot length categories, 2005 - 2007 means*					
Site	0-40cm	40-75cm	75-100cm	100-125cm	125-150cm	150+cm
Kuitpo	*5.9*	*52.7*	*31.4*	*6.2*	*2.0*	*0.0*
Meadows	*6.1*	*46.3*	*37.0*	*7.7*	*2.9*	*0.0*
Balhannah	*4.4*	*21.3*	*56.8*	*17.2*	*0.0*	*0.0*
Lobethal	*4.0*	*28.9*	*59.2*	*7.3*	*0.2*	*0.0*
Forreston	*14.5*	*60.8*	*22.7*	*1.2*	*0.0*	*0.0*

Verasion	*Shoot length categories, 2005 - 2007 means*					
Site	0-40cm	40-75cm	75-100cm	100-125cm	125-150cm	150+cm
Kuitpo	*1.4*	*38.7*	*16.5*	*7.5*	*8.5*	*27.4*
Meadows	*9.6*	*9.3*	*6.7*	*6.8*	*9.3*	*58.5*
Balhannah	*3.9*	*8.2*	*21.3*	*31.1*	*23.3*	*12.1*
Lobethal	*4.5*	*6.0*	*4.0*	*9.5*	*15.5*	*60.5*
Forreston	*12.5*	*37.3*	*15.7*	*13.0*	*10.0*	*1.0*

Harvest	*Shoot length categories, 2005 - 2007 means*					
Site	0-40cm	40-75cm	75-100cm	100-125cm	125-150cm	150+cm
Kuitpo	*1.8*	*7.4*	*9.0*	*10.0*	*17.0*	*54.8*
Meadows	*13.0*	*10.0*	*6.4*	*4.6*	*6.0*	*60.0*
Balhannah	*2.4*	*9.0*	*28.7*	*41.3*	*18.7*	*0.0*
Lobethal	*7.0*	*10.0*	*6.0*	*14.0*	*22.0*	*41.0*
Forreston	*23.0*	*59.6*	*11.4*	*6.0*	*0.0*	*0.0*

APPENDIX 4 – SOIL PIT OBSERVATIONS DESCRIPTIONS AND CHEMICAL ANALYSIS

SOIL PITS ANALYSED BY JOHN RASIC , FEBRUARY 8 2006
Chemical analysis from 2004/2005 season

4.1 FORRESTON SAUVIGNON BLANC SOIL

- Friable Red Podzolic non-reactive soil with no sharp breaks between layers. Good physical condition and consequently good root distribution. This is a "physically perfect soil structure and profile with no intervention required to improve the soil".

Figure A.4.1. Forreston Sauvignon Blanc soil pit

FORRESTON SAUVIGNON BLANC SOIL:

	Depth	30 cm	50 cm
	Texture	**3.5**	**3.5**
Measurement	**Unit**	**Result**	**Result**
pH (water)	pH	**6.8**	**6.9**
pH(CaCl)	pH	**5.9**	**6.1**
	Comment	Moderately acidic	Moderately acidic
Phosphorus	mg/kg	**16**	**5**
	Comment	Low	Low
Potassium	mg/kg	**348**	**302**
	Comment	Adequate	Adequate
Sulphur	mg/kg	**10**	**24.9**
		Adequate	Adequate
Organic Carbon	%	**1.02**	**0.54**
	Comment	Low	Low
Iron	mg/kg	**959**	**907**
	Comment		
Salinity (EC)	dS/m	**0.062**	**0.047**
Estimated ECe	dS/m	**0.403**	**0.306**
	Comment	Low salinity	Low salinity
Nitrogen: Nitrate	mg/kg	**5**	**1**
	Comment	May be acceptable	May be low
Ammonium	mg/kg	**1**	**1**
Exch. Calcium	meq/100g	**6.54**	**6.51**
Exch. Magnesium	meq/100g	**2.53**	**5.97**
Exch. Sodium	meq/100g	**0.2**	**0.24**
Exch. Potassium	meq/100g	**0.88**	**0.79**
Exch. Aluminium	meq/100g	**n/a**	**n/a**
CEC	meq/100g	**10.15**	**13.51**
	Comment	Acceptable	Acceptable
Calcium	%	**64**	**48**
	Comment	Low	Low
Magnesium	%	**25**	**44**
	Comment	High	High
Sodium ESP	%	**2**	**2**
	Comment	Non sodic	Non sodic
Potassium	%	**9**	**6**
	Comment	High	Acceptable
Aluminium	%	**n/a**	**n/a**
	Comment		
Calcium:Magnesium		**2.6**	**1.1**
	Comment	Acceptable	Structural problems
Aluminium	mg/kg	**0**	**0**
	Comment	Acceptable	Acceptable
DPTA Copper	mg/kg	**1.51**	**0.63**
DPTA Zinc	mg/kg	**6.32**	**0.4**
DPTA Manganese	mg/kg	**1.58**	**-0.01**
DTPA Iron	mg/kg	**7.65**	**2.87**
Boron	mg/kg	**0.6**	**0.6**
	mg/kg	**26**	**11**
CHLORIDE	Comment	Below critical	Below critical

4.2 FORRESTON SHIRAZ SOIL

Below the top organic layer are a Soloth and Solod soil with columnar structure pronounced in the transition layer. This produces a sharp interface between the top soil layer and columnar structured layer. Root growth is vertical within the columnar structures reducing branching and preventing the ability to extract water and nutrients. Roots follow vertical pores formed in these columnar structures which have been formed from the release of gases following drying.

The sharp interface promotes lateral sub-surface seepage leaching of water and nutrients down the slope. Some amelioration would be required to improve water infiltration and root penetration.

Figure A.4.2. Forreston Shiraz soil pit

FORRESTON SHIRAZ SOIL

		Depth	30 cm	50 cm
		Texture	2.5	3
Measurement	**Unit**		**Result**	**Result**
pH_w	pH		**6.8**	**7.1**
pH_{Ca}	pH		**5.8**	**6.2**
	Comment		Moderately acidic	Moderately acidic
Phosphorus	mg/kg		**4**	**3**
	Comment		Low	Low
Potassium	mg/kg		**298**	**271**
	Comment		Adequate	Adequate
Sulphur	mg/kg		**6.4**	**11.5**
	Comment		Marginal to low	Adequate
Organic Carbon	%		**0.87**	**0.66**
	Comment		Low	Low
Iron	mg/kg		**1113**	**921**
	Comment			
Salinity (EC)	dS/m		**0.039**	**0.045**
Estimated ECe	dS/m		**0.254**	**0.293**
	Comment		Low salinity	Low salinity
Nitrogen: Nitrate	mg/kg		**3**	**2**
	Comment		could be low	could be low
Ammonium	mg/kg		**1**	**1**
Exch. Calcium	meq/100g		**10.99**	**10.82**
Exch. Magnesium	meq/100g		**9.49**	**11.2**
Exch. Sodium	meq/100g		**0.27**	**0.4**
Exch. Potassium	meq/100g		**0.71**	**0.61**
Exch. Aluminium	meq/100g		**n/a**	**n/a**
CEC	meq/100g		**21.46**	**23.03**
	Comment		Acceptable	Acceptable
Calcium	%		**51**	**47**
	Comment		low	low
Magnesium	%		**44**	**49**
	Comment		High	High
Sodium ESP	%		**1**	**2**
	Comment		Non sodic	Non sodic
Potassium	%		**3**	**3**
	Comment		Acceptable	low
Aluminium	%		**n/a**	**n/a**
	Comment			
Calcium:Magnesium			**1.2**	**1.0**
	Comment		Structural problems	Structural problems
Aluminium	mg/kg		**0**	**0**
	Comment		Acceptable	Acceptable
DPTA Copper	mg/kg		**1.07**	**0.81**
DPTA Zinc	mg/kg		**0.47**	**0.33**
DPTA Manganese	mg/kg		**-0.01**	**0.01**
DTPA Iron	mg/kg		**19.15**	**9.14**
Boron	mg/kg		**0.5**	**0.6**
CHLORIDE	mg/kg		**13**	**10**
	Comment		**below critical**	**below critical**

4.3 LOBETHAL SAUVIGNON BLANC SOIL

- Grey Podzolic soil with some blue mottling inherent from sandy parent material, and slight formation of saprolite.
- Thick organic layer which prevents compaction although there is evidence of the development of a fragipan layer indicated by horizontal cracking.
- Good root distribution above fragipan layer, however below fragipan layer there is a well structured brown/yellow clay that is inaccessible to roots because of the fragipan layer.
- Compaction in the wheel tracks in combination with the fragipan layer promotes lateral sub-surface seepage leaching of water and nutrients down the slope. Some amelioration would be required to improve water infiltration and root penetration.

Figure A.4.3. Lobethal Sauvignon Blanc soil pit

LOBETHAL SAUVIGNON BLANC SOIL

	Depth (cm)	30 cm	50 cm
	Texture	3.5	3.5
Measurement	**Unit**	**Result**	**Result**
pH_w	pH	**5.6**	**6**
pH_{Ca}	pH	**4.6**	**4.9**
	Comment	Strongly acidic	Strongly acidic
Phosphorus	mg/kg	**22**	**5**
	Comment	Low	Low
Potassium	mg/kg	**63**	**128**
	Comment	Low	Adequate
Sulphur	mg/kg	**4.5**	**11.2**
	Comment	Marginal to low	Adequate
Organic Carbon	%	**0.8**	**0.66**
	Comment	Low	Low
Iron	mg/kg	**1700**	**1625**
	Comment		
Salinity (EC)	dS/m	**0.028**	**0.043**
Estimated ECe	dS/m	**0.182**	**0.280**
	Comment	Low salinity	Low salinity
Nitrogen: Nitrate	mg/kg	**4**	**2**
	Comment	May be low	May be low
Ammonium	mg/kg	**2**	**3**
CEC	meq/100g	**3.82**	**20.17**
	Comment	Low fertility	Acceptable
Calcium	%	**71**	**52**
	Comment	Acceptable	Low
Magnesium	%	**22**	**44**
	Comment	High	High
Sodium ESP	%	**3**	**2**
	Comment	Non sodic	Non sodic
Potassium	%	**4**	**2**
	Comment	Acceptable	Low
Calcium:Magnesium		**3.2**	**1.2**
	Comment	Acceptable	Structural problems
Aluminium	mg/kg	**0.06**	**0.04**
	Comment	Acceptable	Acceptable
DPTA Copper	mg/kg	**0.76**	**1.32**
DPTA Zinc	mg/kg	**1.29**	**0.65**
DPTA Manganese	mg/kg	**6.39**	**2.65**
DTPA Iron	mg/kg	**172.2**	**58.97**
Boron	mg/kg	**0.3**	**0.6**
Chloride	mg/kg	**7**	**10**
	Comment	Below critical	Below critical

4.4 LOBETHAL SHIRAZ SOIL

- Red /Yellow Podzolic soil to 1.5 – 2.0m with good structure, drainage and permeability which has allowed good root growth through profile.
- Ideal soil profile and structure apart from the clearly evident soil compaction under wheel tracks which has caused some flattening of roots.

Figure A.4.4. Lobethal Shiraz soil pit

LOBETHAL SHIRAZ SOIL

	Depth (cm)	30 cm	50 cm
	Texture	3.5	3
Measurement	**Unit**	**Result**	**Result**
pH_w	pH	**6**	**5.9**
pH_{Ca}	pH	**5**	**5**
	Comment	Strongly acidic	Strongly acidic
Phosphorus	mg/kg	**9**	**4**
	Comment	Low	Low
Potassium	mg/kg	**67**	**74**
	Comment	Low	Low
Sulphur	mg/kg	**7.8**	**13.4**
	Comment	Marginal to low	Adequate
Organic Carbon	%	**0.91**	**0.72**
	Comment	Low	Low
Iron	mg/kg	**1363**	**1142**
	Comment		
Salinity (EC)	dS/m	**0.031**	**0.044**
Estimated ECe	dS/m	**0.202**	**0.286**
	Comment	Low salinity	Low salinity
Nitrogen: Nitrate	mg/kg	**3**	**4**
	Comment	May be low	May be low
Ammonium	mg/kg	**2**	**1**
CEC	meq/100g	**4.61**	**5.01**
	Comment	Low fertility	Acceptable
Calcium	%	**68**	**54**
	Comment	Acceptable	Low
Magnesium	%	**26**	**40**
	Comment	High	High
Sodium ESP	%	**3**	**3**
	Comment	Non sodic	Non sodic
Potassium	%	**3**	**4**
	Comment	Acceptable	Acceptable
Calcium:Magnesium		**2.6**	**1.4**
	Comment	Acceptable	Structural problems
Aluminium	mg/kg	**0.02**	**0.02**
	Comment	Acceptable	Acceptable
DPTA Copper	mg/kg	**1.03**	**0.91**
DPTA Zinc	mg/kg	**0.84**	**0.53**
DPTA Manganese	mg/kg	**0.83**	**0.13**
DTPA Iron	mg/kg	**69.51**	**29.36**
Boron	mg/kg	**0.4**	**0.5**
Chloride	mg/kg	**12**	**16**
	Comment	Below critical	Below critical

4.5 LENSWOOD SAUVIGNON BLANC SOIL

- Kolinit – Top layer has dark organic layer, with a gradual transition to a white horizon below, some horizontal cracks, but over all deep profile with no evident physical limitation, very friable with good root growth in 1st 2nd and 3rd layer.
- Some minor compaction issues in the wheel tracks.
- The gradual transition in colour in the planted area compared to the mid row area indicates that the initial ripping at development has improved the soil structure in the planted area compared to the mid row area.

Figure A4.5. Lenswood Sauvignon Blanc soil pit

LENSWOOD SAUVIGNON BLANC SOIL

		Depth (cm)	30 cm	50 cm
		Texture	3.5	3.5
Measurement	**Unit**		**Result**	**Result**
pH_w	pH		**6.3**	**6.3**
pH_{Ca}	pH		**5.2**	**5.3**
	Comment		Strongly acidic	Strongly acidic
Phosphorus	mg/kg		**4**	**3**
	Comment		Low	Low
Potassium	mg/kg		**88**	**103**
	Comment		Marginal	Marginal
Sulphur	mg/kg		**6.4**	**18.3**
	Comment		Marginal to low	Adequate
Organic Carbon	%		**0.73**	**0.9**
	Comment		Low	Low
Iron	mg/kg		**983**	**998**
	Comment			
Salinity (EC)	dS/m		**0.025**	**0.034**
Estimated ECe	dS/m		**0.163**	**0.221**
	Comment		Low salinity	Low salinity
Nitrogen: Nitrate	mg/kg		**1**	**1**
	Comment		May be low	May be low
Ammonium	mg/kg		**1**	**3**
CEC	meq/100g		**4.66**	**9.45**
	Comment		Low fertility	Acceptable
Calcium	%		**56**	**47**
	Comment		Low	Low
Magnesium	%		**35**	**48**
	Comment		High	High
Sodium ESP	%		**4**	**2**
	Comment		Non sodic	Non sodic
Potassium	%		**5**	**3**
	Comment		Acceptable	Acceptable
Calcium:Magnesium			**1.6**	**1.0**
	Comment		Structural problems	Structural problems
Aluminium	mg/kg		**0.01**	**0.01**
	Comment		Acceptable	Acceptable
DPTA Copper	mg/kg		**0.4**	**0.33**
DPTA Zinc	mg/kg		**0.46**	**0.4**
DPTA Manganese	mg/kg		**0.42**	**0.39**
DTPA Iron	mg/kg		**30.61**	**27.98**
Boron	mg/kg		**0.4**	**0.5**
Chloride	mg/kg		**19**	**16**
	Comment		Below critical	Below critical

4.6 BALHANNAH SAUVIGNON BLANC SOIL

- Red Podzolic soil, with a deep organic layer 15 – 20cm at the surface changing to red silty clay with no bleaching. Intermixed with small pockets of ironstone and quartz, good structure allowing approximately 80% of root growth to at least 80cm mainly in the red layer.
- Drainage and aeration should not be a problem. The inherent nature of the soil provides a mechanism of self repair following compaction. However there is some evidence of traffic compaction issues in the wheel track that may increase over time.

Figure A.4.6. Balhannah Sauvignon Blanc soil pit

BALHANNAH SAUVIGNON BLANC SOIL

		Depth (cm)	30	50
		Texture	3	3
Measurement	**Unit**		**Result**	**Result**
pH_w	pH		**5.8**	**6.1**
pH_{Ca}	pH		**5.2**	**5.6**
	Comment		Strongly acidic	Moderately acidic
Phosphorus	mg/kg		**23**	**11**
	Comment		Low	Low
Potassium	mg/kg		**265**	**182**
	Comment		Adequate	Adequate
Sulphur	mg/kg		**20.1**	**22.1**
	Comment		Adequate	Adequate
Organic Carbon	%		**2.56**	**1.4**
	Comment		High	Acceptable
Iron	mg/kg		**1898**	**1454**
	Comment			
Salinity (EC)	dS/m		**0.24**	**0.299**
Estimated ECe	dS/m		**1.560**	**1.944**
	Comment		Low salinity	Low salinity
Nitrogen: Nitrate	mg/kg		**66**	**79**
	Comment		May be acceptable	May be acceptable
Ammonium	mg/kg		**5**	**13**
CEC	meq/100g		**8.57**	**7.67**
	Comment		Acceptable	Acceptable
Calcium	%		**70**	**63**
	Comment		Acceptable	Low
Magnesium	%		**20**	**25**
	Comment		High	High
Sodium ESP	%		**3**	**7**
	Comment		Non sodic	Sodic
Potassium	%		**7**	**5**
	Comment		Acceptable	Acceptable
Calcium:Magnesium			**3.4**	**2.5**
	Comment		Acceptable	Acceptable
Aluminium	mg/kg		**0.01**	**0**
	Comment		Acceptable	Acceptable
DPTA Copper	mg/kg		**3.71**	**2.59**
DPTA Zinc	mg/kg		**2.71**	**1.74**
DPTA Manganese	mg/kg		**5.91**	**4.88**
DTPA Iron	mg/kg		**216.02**	**106.19**
Boron	mg/kg		**0.6**	**0.4**
Chloride	mg/kg		**82**	**120**
	Comment		Below critical	Below critical

4.7 BALHANNAH SHIRAZ SOIL

- Shallow Red/Yellow Podzolic soil profile of 50cm over a clay loam with mica and saprolite intermixed. Yellow indicates that there is evidenced iron oxide leached.
- Some traffic compaction issues but minor.
- There is some evidence of traffic compaction issues in the wheel track indicated by some flattening of roots in that area and this may increase over time.

Figure A.4.7. Balhannah Shiraz soil pit

BALHANNAH SHIRAZ SOIL

	Depth (cm)	30 cm	50 cm
	Texture	3	3.5
Measurement	**Unit**	**Result**	**Result**
pH_w	pH	**5.9**	**6**
pH_{Ca}	pH	**5.2**	**5.3**
	Comment	Strongly acidic	Strongly acidic
Phosphorus	mg/kg	**43**	**39**
	Comment	Adequate	Adequate
Potassium	mg/kg	**335**	**291**
	Comment	Adequate	Adequate
Sulphur	mg/kg	**16.1**	**11.3**
	Comment	Adequate	Adequate
Organic Carbon	%	**3.24**	**2.71**
	Comment	High	High
Iron	mg/kg	**1966**	**1795**
	Comment		
Salinity (EC)	dS/m	**0.156**	**0.133**
Estimated ECe	dS/m	**1.014**	**0.865**
	Comment	Low salinity	Low salinity
Nitrogen: Nitrate	mg/kg	**40**	**25**
	Comment	May be acceptable	May be acceptable
Ammonium	mg/kg	**1**	**1**
CEC	meq/100g	**11.65**	**10.63**
	Comment	Acceptable	Acceptable
Calcium	%	**64**	**63**
	Comment	Low	low
Magnesium	%	**29**	**29**
	Comment	High	High
Sodium ESP	%	**1**	**2**
	Comment	Non sodic	Non sodic
Potassium	%	**6**	**6**
	Comment	Acceptable	Acceptable
Calcium:Magnesium		**2.2**	**2.2**
	Comment	Acceptable	Acceptable
Aluminium	mg/kg	**0.01**	**0.01**
	Comment	Acceptable	Acceptable
DPTA Copper	mg/kg	**3.43**	**3.28**
DPTA Zinc	mg/kg	**5.04**	**4.2**
DPTA Manganese	mg/kg	**7.29**	**6.12**
DTPA Iron	mg/kg	**253.43**	**264.93**
Boron	mg/kg	**0.8**	**0.6**
Chloride	mg/kg	**38**	**37**
	Comment	Below critical	Below critical

4.8 MEADOWS SAUVIGNON BLANC SOIL

- Top soil with organic layer 10-15cm over a clay loam with a gradual transition in colour down the profile to a clean cut between a bleached horizon with the development of a fragipan layer at 50cm.
- Some ironstone deposits and organic colloids throughout profile and porosity decreases down the profile.
- The sol profile becomes deeper down the slope.
- The Bleached layer is created from water moving down through profile to the hard layer and the moving laterally down the slope faster than it can move down into the layer below.

Figure A.4.8. Meadows Sauvignon Blanc soil pit

MEADOWS SAUVIGNON BLANC SOIL

	Depth (cm)	30 cm	50 cm
Texture		**3.5**	**3.5**
Measurement	**Unit**	**Result**	**Result**
pH_w	pH	**6.4**	**6.3**
pH_{Ca}	pH	**5.7**	**5.4**
	Comment	Moderately acidic	Strongly acidic
Phosphorus	mg/kg	**23**	**11**
	Comment	Low	Low
Potassium	mg/kg	**105**	**82**
	Comment	Marginal	Marginal
Sulphur	mg/kg	**8**	**10.2**
	Comment	Marginal to low	Adequate
Organic Carbon	%	**3.01**	**1.3**
	Comment	High	Acceptable
Iron	mg/kg	**2353**	**1786**
	Comment		
Salinity (EC)	dS/m	**0.11**	**0.059**
Estimated ECe	dS/m	**0.715**	**0.384**
	Comment	Low salinity	Low salinity
Nitrogen: Nitrate	mg/kg	**17**	**7**
	Comment	May be acceptable	May be acceptable
Ammonium	mg/kg	**2**	**2**
CEC	meq/100g	**12.73**	**6.41**
	Comment	Acceptable	Acceptable
Calcium	%	**74**	**71**
	Comment	Acceptable	Acceptable
Magnesium	%	**22**	**22**
	Comment	High	High
Sodium ESP	%	**2**	**3**
	Comment	Non sodic	Non sodic
Potassium	%	**2**	**3**
	Comment	Low	Acceptable
Calcium:Magnesium		**3.3**	**3.2**
	Comment	Acceptable	Acceptable
Aluminium	mg/kg	**0**	**0**
	Comment	Acceptable	Acceptable
DPTA Copper	mg/kg	**0.81**	**0.72**
DPTA Zinc	mg/kg	**1.19**	**0.81**
DPTA Manganese	mg/kg	**4.47**	**2.63**
DTPA Iron	mg/kg	**111.54**	**67.33**
Boron	mg/kg	**0.5**	**0.6**
Chloride	mg/kg	**62**	**29**
	Comment	Below critical	Below critical

4.9 MEADOWS SHIRAZ SOIL

- Litho soil – Idealised soil profile with no sharp breaking points.
- Pockets of clay and rock fragments that have developed in-situ from parent material, which naturally prevent soil compaction and allow very good root penetration, excellent drainage and infiltration allowing a large distribution of roots.
- This soil type allows the roots to explore a large amount of soil much larger than can seen from pit.
- Very good profile with no compaction issues.

Figure A.4.9. Meadows Shiraz soil pit

MEADOWS SHIRAZ SOIL

	Depth (cm)	30 cm	50 cm
	Texture	**3.5**	**3.5**
Measurement	**Unit**	**Result**	**Result**
pH_w	pH	**6.7**	**6.4**
pH_{Ca}	pH	**6.1**	**5.6**
	Comment	Moderately acidic	Moderately acidic
Phosphorus	mg/kg	**33**	**8**
	Comment	Adequate	Low
Potassium	mg/kg	**156**	**163**
	Comment	Adequate	Adequate
Sulphur	mg/kg	**6.6**	**20.1**
	Comment	Marginal to low	Adequate
Organic Carbon	%	**2.47**	**0.91**
	Comment	High	Low
Iron	mg/kg	**1698**	**1441**
	Comment		
Salinity (EC)	dS/m	**0.069**	**0.067**
Estimated ECe	dS/m	**0.449**	**0.436**
	Comment	Low salinity	Low salinity
Nitrogen: Nitrate	mg/kg	**17**	**6**
	Comment	May be acceptable	May be acceptable
Ammonium	mg/kg	**1**	**4**
CEC	meq/100g	**11.93**	**8.23**
	Comment	Acceptable	Acceptable
Calcium	%	**80**	**53**
	Comment	High	Low
Magnesium	%	**16**	**38**
	Comment	High	High
Sodium ESP	%	**1**	**4**
	Comment	Non sodic	Non sodic
Potassium	%	**3**	**5**
	Comment	Acceptable	Acceptable
Calcium:Magnesium		**5.1**	**1.4**
	Comment	Acceptable	Structural problems
Aluminium	mg/kg	**0**	**0**
	Comment	Acceptable	Acceptable
DPTA Copper	mg/kg	**0.79**	**0.65**
DPTA Zinc	mg/kg	**1.58**	**2.22**
DPTA Manganese	mg/kg	**2.8**	**1.63**
DTPA Iron	mg/kg	**111.27**	**49.16**
Boron	mg/kg	**0.5**	**0.6**
Chloride	mg/kg	**20**	**34**
	Comment	Below critical	Below critical

5.0 KUITPO SAUVIGNON BLANC SOIL

Yellow Gleyd, with quartz and iron oxides, plus compacted clay layer under a fragipan layer. Good organic layer at surface with sharp and uneven transitions in profile, down to a bleached horizon leached by sub-surface running water.

Roots grow along the clay layer with good development of fine roots but as they enter the clay layer there is minimal branching. Roots can enter cracks with they clay however as the clay becomes wet it expands and crushed the roots.

Fragipan forms via a slurry of silt moving through micro pores until it becomes lodged and the build up continues creating a compacted silt layer that is impermeable to water and roots.

The ironstone formations are created by liquid iron mobilised in water travelling through the soil across the block and re-crystallise as iron stone upon drying.

Figure A.5.0. Kuitpo Sauvignon Blanc soil pit.

KUITPO SAUVIGNON BLANC SOIL

	Depth (cm)	30 cm	50 cm
	Texture	**3.5**	**3.5**
Measurement	**Unit**	**Result**	**Result**
pH_w	pH	**6.1**	**6.4**
pH_{Ca}	pH	**5.1**	**5.5**
	Comment	Strongly acidic	Moderately acidic
Phosphorus	mg/kg	**38**	**28**
	Comment	Adequate	Low
Potassium	mg/kg	**46**	**40**
	Comment	Very low	Very low
Sulphur	mg/kg	**10.8**	**14.1**
	Comment	Adequate	Adequate
Organic Carbon	%	**2.51**	**1.54**
	Comment	High	Acceptable
Iron	mg/kg	**1874**	**1624**
	Comment		
Salinity (EC)	dS/m	**0.071**	**0.094**
Estimated ECe	dS/m	**0.462**	**0.611**
	Comment	Low salinity	Low salinity
Nitrogen: Nitrate	mg/kg	**5**	**5**
	Comment	May be acceptable	May be acceptable
Ammonium	mg/kg	**3**	**5**
CEC	meq/100g	**7.07**	**9.31**
	Comment	Acceptable	Acceptable
Calcium	%	**74**	**61**
	Comment	Acceptable	Low
Magnesium	%	**20**	**32**
	Comment	High	High
Sodium ESP	%	**4**	**6**
	Comment	Non sodic	Sodic
Potassium	%	**2**	**1**
	Comment	Low	Low
Calcium:Magnesium		**3.7**	**1.9**
	Comment	Acceptable	Structural problems
Aluminium	mg/kg	**0.01**	**0**
	Comment	Acceptable	Acceptable
DPTA Copper	mg/kg	**4.72**	**3.63**
DPTA Zinc	mg/kg	**3.67**	**2.54**
DPTA Manganese	mg/kg	**3.39**	**2.2**
DTPA Iron	mg/kg	**356.05**	**162.7**
Boron	mg/kg	**0.3**	**0.4**
Chloride	mg/kg	**37**	**78**
	Comment	Below critical	Below critical

5.1 KUITPO SHIRAZ SOIL

- Yellow Podzolic soil, silt derived from parent material, and some quartz and weathered saprolite (material in transition between soil and rock)
- Compaction in wheel tracks, evident from flattened roots and root growth at right angles.
- The side walls show the natural formation coming upwards, whereas the end shows the compaction and flatteries profile forced down from the top.
- Problems with this is it produces a reduced area for root growth, and prevention of water penetrating profile in this area on both sides equates to a large overall area. In addition water moves laterally down the row rather than into the profile.
- Most roots growing nicely accept for the compacted wheel tracks where root growth is flattened with few fine roots.

Figure A.5.1. Kuitpo Shiraz soil pit

KUITPO SHIRAZ SOIL

	Depth (cm)	30 cm	50 cm
	Texture	3.5	3.5
Measurement	**Unit**	**Result**	**Result**
pH_w	pH	**6.8**	**6.4**
pH_{Ca}	pH	**6.2**	**6**
	Comment	Moderately acidic	Moderately acidic
Phosphorus	mg/kg	**34**	**13**
	Comment	Adequate	Low
Potassium	mg/kg	**136**	**28**
	Comment	Adequate	Very low
Sulphur	mg/kg	**29.9**	**57**
	Comment	Adequate	Adequate
Organic Carbon	%	**1.5**	**0.32**
	Comment	Acceptable	Low
Iron	mg/kg	**1291**	**763**
	Comment		
Salinity (EC)	dS/m	**0.094**	**0.115**
Estimated ECe	dS/m	**0.611**	**0.748**
	Comment	Low salinity	Low salinity
Nitrogen: Nitrate	mg/kg	**2**	**1**
	Comment	May be low	May be low
Ammonium	mg/kg	**1**	**1**
CEC	meq/100g	**12.20**	**8.96**
	Comment	Acceptable	Acceptable
Calcium	%	**53**	**40**
	Comment	Low	Low
Magnesium	%	**41**	**54**
	Comment	High	High
Sodium ESP	%	**3**	**5**
	Comment	Non sodic	Non sodic
Potassium	%	**3**	**1**
	Comment	Low	Low
Calcium:Magnesium		**1.3**	**0.8**
	Comment	Structural problems	Structural problems
Aluminium	mg/kg	**0**	**0**
	Comment	Acceptable	Acceptable
DPTA Copper	mg/kg	**3.77**	**0.25**
DPTA Zinc	mg/kg	**2.87**	**0.85**
DPTA Manganese	mg/kg	**2.09**	**0.38**
DTPA Iron	mg/kg	**42.92**	**12.82**
Boron	mg/kg	**0.6**	**0.5**
Chloride	mg/kg	**54**	**80**
	Comment	Below critical	Below critical

APPENDIX 5 - CLIMATIC DATA 2005-2006 SEASON

The following tables are summaries of the climatic data obtained over the 2005-2006 growing season. Note: Lobethal site data has been excluded from all tables and is replaced by data from Charleston. (ch)

Average minimum and maximum temperatures recorded over 2005 – 2006 season by month (C°)

Site		Oct-05	Nov-05	Dec-05	Jan-06	Feb-06	Mar-06	Apr-06
Balhannah	**Max**	24.90	31.72	40.73	40.00	33.05	35.49	24.42
	Min	-0.55	3.56	5.09	6.31	4.61	3.88	0.17
Lobethal (ch)	**Max**	24.70	32.80	40.20	40.50	33.10	35.50	21.20
	Min	-0.90	2.90	5.10	6.80	4.90	3.80	1.20
Forreston	**Max**	26.40	29.70	37.60	39.10	32.00	34.40	22.80
	Min	0.00	4.50	5.40	8.30	5.50	5.90	1.40
Kuipto	**Max**	24.00	30.00	38.00	39.60	32.30	35.30	22.20
	Min	2.80	6.00	7.70	10.70	9.10	8.90	5.80
Lenswood	**Max**	25.30	31.70	39.30	39.80	33.20	36.20	
	Min	0.70	5.50	7.60	8.20	7.30	5.90	
Meadows	**Max**	24.80	29.60	38.00	39.70	34.90	35.40	24.80
	Min	2.50	5.90	7.80	10.00	8.10	8.00	2.70

Mean temperatures recorded over 2005 – 2006 season by month (C°)

Site	Oct-05	Nov-05	Dec-05	Jan-06	Feb-06	Mar-06	Apr-06	05/06 Mean
Balhannah	12.40	14.76	17.22	19.76	16.32	17.01	11.74	**15.60**
Lobethal (ch)	12.53	14.60	17.19	20.17	16.49	16.67	11.67	**15.62**
Forreston	14.60	15.46	18.14	21.25	17.71	18.73	12.49	**16.91**
Kuitpo	13.14	14.93	17.07	19.56	16.31	16.97	12.30	**15.75**
Lenswood	12.98	15.22	17.71	20.59	16.86	18.20		**16.93**
Meadows	12.71	14.94	17.58	19.41	16.08	17.93	12.38	**15.86**

Average daily BEDD values for season 2005– 2006 by month (day°)

Site	Oct-05	Nov-05	Dec-05	Jan-06	Feb-06	Mar-06	Apr-06	05/06 Mean
Balhannah	3.01	4.63	6.20	7.85	6.22	6.23	1.94	**5.16**
Lobethal (ch)	2.88	4.40	6.00	7.62	6.25	5.74	2.07	**4.99**
Forreston	3.30	5.17	6.62	8.36	7.13	6.97	2.50	**5.72**
Kuitpo	3.38	4.80	6.25	7.83	6.18	6.43	2.45	**5.33**
Lenswood	3.20	4.87	6.25	7.78	6.53	6.65		**5.88**
Meadows	2.97	4.58	6.19	7.25	5.76	6.25	2.68	**5.10**

Average BEDD values by month for season 2005 – 2006 (day°)

Site	Oct-05	Nov-05	Dec-05	Jan-06	Feb-06	Mar-06	Apr-06	05/06 Total
Balhannah	93.38	139.01	192.13	243.47	174.17	193.19	58.30	**1093.65**
Lobethal (ch)	89.20	132.10	186.10	236.20	168.70	143.50	62.20	**1018.00**
Forreston	102.40	155.10	205.30	259.20	199.50	216.10	75.10	**1212.70**
Kuitpo	104.80	143.90	193.60	242.60	173.00	199.30	73.40	**1130.60**
Lenswood	99.10	146.00	193.70	241.20	182.70	199.60		**1062.30**
Meadows	92.10	137.40	191.90	224.70	161.40	193.80	80.50	**1081.80**

Recorded rainfall for 2005-2006 growing season by month (mm)

Month	Oct-05	Nov-05	Dec-05	Jan-06	Feb-06	Mar-06	Apr-06	05/06 Total
Balhannah	31	30	31	55	56	62	60	**325**
Lobethal (ch)	31	30	31	55	55	56	60	**318**
Forreston	76.3	43.6	39.4	25.7	21.6	39.7	66.6	**312.9**
Kuitpo	76.3	43.6	39.4	55	56	62	60	**392.3**
Lenswood	84.4	44.7	43	32.4	28.5	42	73	**348**
Meadows	76.3	43.6	39.4	55	56	62	60	**392.3**

APPENDIX 6 - CLIMATIC DATA 2006-2007 SEASON

The following tables are summaries of the climatic data obtained over the 2006-2007 growing season.
Note:- Due to technical problems Lobethal data has been supplemented with data from nearby Charleston.(ch)
-Also due to technical problems Meadows data for February and March does not include 2007 data.

Average minimum and maximum temperatures recorded over 2006 – 2007 season by month (C°)

Site	Data	Oct-06	Nov-06	Dec-06	Jan-07	Feb-07	Mar-07	Apr-07
Balhannah	**min**	4.85	7.39	7.66	11.78	11.90	10.04	8.50
	max	20.76	24.19	25.41	26.73	29.79	24.37	21.72
Lobethal (ch)	**min**	6.28	9.20	8.88	13.26	12.89	11.09	9.40
	max	21.05	26.58	25.49	27.06	29.37	24.45	21.41
Forreston	**min**	7.20	9.93	10.24	13.72	14.77	12.54	11.49
	max	20.83	24.45	25.79	26.87	30.22	23.90	21.65
Kuitpo	**min**	4.93	7.68	9.06	12.76	12.53	10.58	8.81
	max	19.73	22.60	23.99	25.21	27.78	24.24	21.32
Lenswood	**min**	7.02	9.37	9.65	13.71	14.03	11.61	10.71
	max	21.45	24.55	26.04	27.39	30.33	25.10	22.11
Meadows	**min**	7.73	10.22	10.77	13.89	14.69		
	max	19.19	22.18	23.26	24.65	27.15		

Mean temperatures recorded over 2006 – 2007 season by month (C°)

Site	Oct-06	Nov-06	Dec-06	Jan-07	Feb-07	Mar-07	Apr-07	06/07 mean
Balhannah	12.84	15.52	16.58	18.94	19.95	16.86	14.69	**16.48**
Lobethal (ch)	13.60	17.18	16.86	19.43	20.10	17.13	14.91	**17.03**
Forreston	13.90	16.92	17.92	20.03	21.71	18.01	15.97	**17.78**
Kuitpo	12.70	15.15	16.78	19.03	19.68	17.02	14.69	**16.44**
Lenswood	13.52	16.13	17.27	19.74	20.78	17.52	15.66	**17.23**
Meadows	13.27	15.88	16.78	18.92	20.33			**17.04**

Average daily BEDD values for season 2006 – 2007 by month (day°)

Site	Oct-06	Nov-06	Dec-06	Jan-07	Feb-07	Mar-07	Apr-07	06/07 mean
Balhannah	2.91	5.00	5.54	7.55	7.87	6.09	4.48	**5.63**
Lobethal (ch)	3.93	6.05	5.41	7.58	7.69	6.00	4.69	**5.91**
Forreston	3.87	5.63	6.09	7.92	8.22	6.72	5.47	**6.27**
Kuitpo	2.97	4.86	5.71	7.58	7.95	6.39	4.61	**5.72**
Lenswood	3.67	5.21	5.74	7.67	7.92	6.18	5.17	**5.94**
Meadows	3.26	5.00	5.30	7.31	7.58			**5.69**

Average BEDD values by month for season 2006 – 2007 (day°)

Site	Oct-06	Nov-06	Dec-06	Jan-07	Feb-07	Mar-07	Apr-07	06/07 mean
Balhannah	90.25	150.00	171.77	234.20	220.23	188.75	134.48	**169.95**
Lobethal (ch)	177.00	96.80	167.80	234.90	215.30	186.00	140.80	**174.09**
Forreston	120.00	168.80	188.80	245.60	230.20	208.20	164.10	**189.39**
Kuitpo	92.00	145.70	177.10	235.10	222.70	198.00	138.20	**172.69**
Lenswood	113.80	156.30	177.80	237.80	221.70	191.50	155.20	**179.16**
Meadows	101.20	149.90	164.20	226.70	212.20			**170.84**

Recorded rainfall for 2006 – 2007 growing season by month (mm)

Site	Oct-06	Nov-06	Dec-06	Jan-07	Feb-07	Mar-07	Apr-07	06/07 GS total
Balhannah	3.60	20.40	31.60	46.80	7.20	30.40	114.60	**254.60**
Lobethal (ch)	0.40	2.00	27.80	38.40	2.20	18.80	87.40	**177.00**
Forreston*	0.00	32.00	37.80	72.40	3.20	29.60	141.60	**316.60**
Kuitpo	3.40	23.60	31.40	58.00	1.60	55.80	167.80	**341.60**
Lenswood	0.40	23.20	27.00	49.40	1.60	20.60	115.80	**238.00**
Meadows**	3.20	16.80	21.00	66.60	1.00	41.60	117.60	**267.80**

APPENDIX 7 - CLIMATIC DATA LONG TERM AVERAGES COLLECTED OVER PROJECT PERIOD

Average BEDD values by month recorded over project period (day^o)

	October	November	December	January	February	March	April
Balhannah	149.32	176.08	711.94	236.17	186.51	177.94	111.32
Meadows	148.44	172.31	703.34	227.72	177.90	177.67	120.05
Lobethal (ch)	154.26	171.24	700.84	232.86	182.30	171.21	114.47
Forreston	167.35	190.69	823.82	250.45	207.63	222.13	143.60
Kuitpo	149.63	179.37	722.23	235.17	188.97	185.33	112.77
Lenswood	156.19	179.76	785.10	236.14	194.90	195.91	158.15
Project mean	**154.20**	**178.24**	**741.21**	**236.42**	**189.70**	**188.37**	**126.72**

Average daily BEDD values by month over project period (day^o)

Site	October	November	December	January	February	March	April
Balhannah	2.96	4.82	5.87	7.62	6.66	5.74	3.71
Bingfield	3.12	4.79	5.74	7.35	6.35	5.73	4.00
Lobethal (ch)	3.50	4.98	5.71	7.51	6.51	5.52	3.82
Forreston	3.59	5.40	6.36	8.08	7.42	7.17	4.79
Kuitpo	3.17	4.83	5.98	7.59	6.75	5.98	3.76
Lenswood	3.43	5.04	5.99	7.62	6.96	6.32	5.27
Project mean	**3.30**	**4.97**	**5.94**	**7.63**	**6.78**	**6.08**	**4.22**

Average rainfall by month during growing season over project period (mm)

Site	**Oct-06**	**Nov-06**	**Dec-06**	**Jan-07**	**Feb-07**	**Mar-07**	**Apr-07**	**05/07 GS total**
Balhannah	29.3	38.2	46.8	53.4	19.1	30.2	72.8	**289.8**
Lobethal (ch)	27.7	28.5	41.9	49.2	16.6	24.4	59.2	**247.5**
Forreston*	12.9	26.8	38.8	69.5	39.8	36.6	90.5	**314.8**
Kuitpo	29.2	39.8	46.7	59.0	39.0	49.7	103.6	**367.0**
Lenswood	16.4	25.9	34.5	61.2	43.0	32.7	79.4	**293.0**
Meadows**	29.1	36.4	41.5	63.3	38.7	42.6	78.5	**330.1**

Average daily maximum and minimum temperatures by month over project period (C^o)

Site	Data	October	November	December	January	February	March	April
Balhannah	max	19.47	23.02	25.19	27.90	26.07	24.85	21.20
	min	6.33	7.81	8.69	11.45	10.51	9.18	7.62
Meadows	max	18.30	21.16	23.32	25.47	23.67	23.03	19.10
	min	8.38	10.34	11.39	14.08	12.95	12.60	10.60
Lobethal (ch)	max	19.78	23.51	25.23	27.98	25.95	24.19	20.67
	min	6.98	9.02	9.74	12.93	11.31	9.83	8.34
Forreston	max	19.44	23.10	25.14	28.13	26.98	24.51	21.07
	min	8.07	9.90	10.86	13.81	12.67	13.81	10.92
Kuitpo	max	18.94	21.66	23.57	25.96	24.39	23.85	20.32
	min	6.66	8.58	9.90	12.52	11.30	10.01	7.84
Lenswood	max	19.85	23.41	25.39	28.35	26.39	25.47	23.40
	min	7.93	9.56	10.71	13.38	11.87	10.96	10.42
Project ave	**max**	**16.54**	**19.41**	**21.12**	**23.40**	**21.92**	**20.84**	**17.97**
Project ave	**min**	**6.34**	**7.89**	**8.76**	**11.17**	**10.09**	**9.49**	**7.96**

Temperature range between maximum and minimum averages over project period 2005 – 2007 (C^o)

		January	February	March	April
Balhannah	D.F	6.55	5.44	4.72	6.42
Meadows	D.F	8.1	6.1	9.5	9.3
Lobethal (ch)	D.F	9.7	12.2	5.8	6.2
Forreston	D.F	9.2	9.1	6.9	10.8
Kuitpo	D.F	5.2	6.8	6.4	3.1
Lenswood	D.F	10.8	12.5	7.2	7.4
Project ave		**8.26**	**8.69**	**6.75**	**7.20**

APPENDIX 8 – SENSORY ASSESSMENTS BY PROVISOR PTY LTD, VINATGES 2006 AND 2007

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Report No.:	PR07004
Name:	Informal Sensory Assessment of Sauvignon Blanc and Shiraz Wines
Author:	Briony Liebich
Date:	25/01/2007
Report Type:	Sensory Analysis
Client:	Davidson Viticultural Services

Approved by,

Dr. Darren Oemcke
CEO

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1 INTRODUCTION

Davidson Viticultural Services engaged Provisor to assist with sensory evaluation of the key sensory properties of Sauvignon Blanc and Shiraz wines made during the 2006 vintage.

The wines were made and bottled at the Hickinbotham-Roseworthy Wine Science Laboratory. There were 11 wines in total, consisting of fruit from six different vineyards of Sauvignon Blanc and five vineyards of Shiraz. The sample wine codes referred to in this report are shown in Table 1.1.

The following reports were issued by Provisor after the wines were bottled and provide the basic wine chemical composition data:

- 2006 Adelaide Hills Wine Small Scale Winemaking Trial - Sauvignon Blanc (22 June, 2006); and
- 2006 Adelaide Hills Wine Small Scale Winemaking Trial - Shiraz (12 September, 2006).

This report summarises only the sensory evaluation of the wines as obtained by Provisor.

2 MATERIALS AND METHODS

2.1 Trial Summary

Treatment labels, and not the specific treatment details for each trial were known by Provisor through the grape and wine analysis. The treatments were identified by the labelling shown in Table 2.1.

Table 2.1: 2006 Trial Details – Sauvignon Blanc and Shiraz trials

Sauvignon Blanc trial	Shiraz trial
Battunga	Battunga
Bingfield	Bingfield
Setanta	Setanta
Junction Creek	Junction Creek
Yarx	Yarx
Lenswood	

2.2 Informal Assessment

Sensory analysis was conducted using Provisor's sensory panel and consisted of an Informal Assessment.

An initial Informal Assessment of the wines was performed to obtain a preliminary evaluation of all wines and to indicate any sensory differences and the presence of any off-flavours perceived. In the assessment, a panel of six experienced assessors evaluated all nine wines independently in blind tasting conditions, followed by panel discussion. Panellists were informed of the wine variety and vintage prior to tasting. Samples were

presented in identical order in coded ISO standard tasting glasses (30ml) and assessed at room temperature under white fluorescent lighting. A taint or off-note was recorded only if it was perceived at a detectable level by a minimum of two assessors.

3 RESULTS

The tasting notes for each wine are summarised in Table 3.1 and 3.2. The outcomes are presented in the following sections to separate each sensory modality assessed:

1. Appearance;
2. Aroma; and
3. By mouth characteristics.

3.1 Informal Assessment – Sauvignon Blanc Trial

When comparing the sensory properties of the white wines, the following was noted.

- Overall aroma intensity was medium to high in all six wines with the Bingfield perceived most intense in fresh, varietal characteristics;
- The majority of differences in aroma were shown in the degree of citrus, ripe tropical, floral and herbaceous notes;
- The wine flavours varied from medium to high intensity and showed differences in acidity, ripeness, citrus, tropical flavours, and grassy flavours;
- All wines had very little drying with some phenolic characters in the Setanta, Junction Creek and Lenswood wines;
- Bingfield, Junction Creek and Yarx wines were higher in body and showed some warmth from alcohol; and
- There was no taint/off-note recorded for any wine, however, the Yarx wine was perceived as dull with low level bruised apple aroma.

3.2 Informal Assessment – Shiraz Trial

When comparing the sensory properties of the red wines, the following was noted.

- Appearance of the wines ranged from medium to deep ruby red;
- Overall aroma intensity varied from low to high with the Battunga wine lowest and the Bingfield and Setanta wines highest in berry fruit aroma;
- The majority of differences in aroma were shown in the degree of red and black fruit, stewed fruit, confection and vegetal characteristics;
- The flavours varied from low to medium intensity and showed differences in ripeness, red and black fruit, spiciness, and stalky flavours;
- The Battunga, Bingfield and Yarx wines showed medium body with medium level drying and shorter length of fruit flavours than the other two wines;
- The Setanta and Junction Creek wines were more full-bodied with more persistent drying tannins; and
- The only taint/off-note recorded was a low reductive aroma in the Battunga wine.

Table 3.1: Summary of informal tasting notes for 2006 Sauvignon Blanc wines; six vineyard treatments tasted by six assessors.

Wine Code	Battunga	Bingfield	Setanta	Junction Creek	Yarx	Lenswood
Appearance						
Colour & Intensity	Pale Straw	Pale Straw	Pale Straw	Pale-Medium Straw	Pale Straw	Pale Straw
Aroma						
Overall Fruit Intensity	Medium	High	Medium-High	High	Medium	Medium-High
Odours	Citrus, Lime, Tropical, Pineapple, Floral, Confection, Vegetal, Green Pea, Grassy, Herbaceous, Sulphur Dioxide	Citrus, Tropical, Ripe Pineapple, Passionfruit, Floral, Confection, Vegetal, Capsicum, Grassy	Citrus, Grapefruit, Tropical, Green Apple, Pineapple, Floral, Confection, Vegetal, Grassy, Flint	Citrus, Lime, Tropical, Melon, Pineapple, Floral, Herbaceous, Vegetal, Sulphur Dioxide	Citrus, Grapefruit Pith, Tropical, Melon, Confection, Floral, Grassy, Herbaceous, Bruised Apple, Sulphur Dioxide	Citrus, Grapefruit Pith, Lychee, Ripe Tropical, Floral, Rose, Musk, Confection
Taint/Off-note	Nil	Nil	Nil	Nil	Nil	Nil
Other Comment	-	Fresh, Varietal	-	-	Dull Fruit	-
By Mouth						
Acidity	High	Medium-High	High	Medium	Medium-High	Medium-High
Flavours	Medium Citrus, Tropical, Grassy, Stalky, Green	Medium-High Citrus, Tropical, Confection	Medium Citrus, Tropical, Green Apple, Confection	Medium Citrus, Ripe Tropical, Melon, Confection	Medium Citrus, Ripe Tropical, Confection, Grapefruit Pith	Medium Citrus, Tropical, Grassy, Vegetal, Watery, Green
Mouthfeel	Light Body, Low Drying	Medium Body, Low Drying	Light Body, Low Drying, Some Phenolics	Medium Body, Low Drying, Some Phenolics	Medium Body, Low Drying	Light Body, Low Drying, Some Phenolics
Finish	Medium Fruit Length, Balanced Alcohol	Medium Fruit Length, Slight Alcohol Warmth	Medium Fruit Length, Balanced Alcohol	Medium Fruit Length, Slight Alcohol Warmth	Low-Medium Fruit Length, Slight Alcohol Warmth	Low-Medium Fruit Length, Balanced Alcohol
Other Comment	Coarse, Persistent Acid	High Tropical Flavour	High Citrus Flavour	Balanced Acid, Ripe Fruit	Spritzy, Not Fresh	Persistent Acid
Taint/Off-note	Nil	Nil	Nil	Nil	Nil	Nil

1. Taint/Off-notes are recorded if they were recognised and detected by a minimum of two assessors.

Table 3.2: Summary of informal tasting notes for 2006 Shiraz wines; five vineyard treatments tasted by six assessors.

Wine Code	Battunga	Bingfield	Setanta	Junction Creek	Yarx
Appearance					
Colour & Intensity	Medium-Deep Ruby Red	Deep Ruby Red	Deep Ruby Red	Deep Ruby Red	Medium Ruby Red
Aroma					
Overall Fruit Intensity	Low-Medium	Medium-High	Medium-High	Medium	Medium
Odours	Red Berry, Black Fruit, Stewed Rhubarb, Sweet Spice, Vegetal Confection, Sweaty	Red Berry, Black Fruit, Pepper, Mocha, Sweet Spice, Chocolate, Stalky, Mint	Red Berry, Black Fruit, White Pepper, Mocha, Sweet Spice, Smoky, Confection, Dusty	Red Berry, Black Fruit, Stewed Plum, White Pepper, Mocha, Sweet Spice, Smoky, Vegetal, Black Olive	Red Berry, Raspberry Lolly, Confection, Caramel, White Pepper
Taint/Off-note	Low Reductive	Nil	Nil	Nil	Nil
Other Comment	-	-	-	-	-
By Mouth					
Acidity	Medium	Medium	Medium-High	Medium	Medium
Flavours	Low Black Fruit, Sour Cherry, Sweet Spice, Savoury, Pepper, Liquorice	Medium Black Fruit, Mocha, Stalky, Vegetal, Pepper	Medium Red Fruit, Ripe, Jammy, Sweet Spice, Pepper, Leafy, Herbaceous	Medium Black Fruit, Ripe, Sweet Spice, Chocolate, Liquorice, Savoury, Low Bitter	Low-Medium Red Fruit, Sour Cherry, Herbaceous, Stalky, Sweet Spice
Mouthfeel	Medium Body, Medium Drying, Medium Viscosity	Medium Body, Medium Drying, Medium Viscosity	Medium-Full Body, High Drying, Medium Viscosity	Medium-Full Body, High Drying, Medium Viscosity	Medium Body, Medium Drying, Low Viscosity
Finish	Low-Medium Fruit Length, Slight Alcohol Warmth	Low-Medium Fruit Length, Slight Alcohol Warmth	Medium Fruit Length, Slight Alcohol Warmth	Medium Fruit Length, Slight Alcohol Warmth	Low-Medium Fruit Length, Balanced Alcohol
Taint/Off-note	Nil	Nil	Nil	Nil	Nil
Other Comment	Persistent Acid	Concentrated, Ripe	Persistent Tannins	Persistent Tannins	Fresh Primary Fruit

1. Taint/Off-notes are recorded if they were recognised and detected by a minimum of two assessors.

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Report No.:	PR07 029
Name:	Informal Sensory Assessment of Sauvignon Blanc and Shiraz Wines
Author:	Briony Liebich
Date:	3rd September, 2007

Approved by,

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1 INTRODUCTION

Davidson Viticultural Services engaged Provisor to assist with sensory evaluation of the key sensory properties of Sauvignon Blanc and Shiraz wines made during the 2007 vintage.

The wines were made and bottled at the Hickinbotham-Roseworthy Wine Science Laboratory. There were 11 wines in total, consisting of fruit from six different vineyards of Sauvignon Blanc and five vineyards of Shiraz in the Adelaide Hills region.

The following reports were issued by Provisor after the wines were bottled and provide the basic wine chemical composition data:

- 2007 Adelaide Hills Winemaking Trial - Sauvignon Blanc (29 June, 2007); and
- 2007 Adelaide Hills Winemaking Trial - Shiraz (8 August, 2007).

This report summarises only the preliminary sensory evaluation of the wines as obtained by Provisor.

2 MATERIALS AND METHODS

2.1 Trial Summary

Treatment labels, and not the specific treatment details for each trial were known by Provisor through the grape and wine analysis. The treatments were identified by the labelling shown in Table 2.1.

Table 2.1: 2007 Trial Details

Sauvignon Blanc trial	Shiraz trial
Bingfield	Bingfield
Balhannah	Junction Creek Balhannah
Forreston	Forreston
Kuipto	Kuitpo
Lobethal	Woodside Ridge Lobethal
Lenswood	

2.2 Informal Assessment

Sensory analysis was conducted using Provisor's trained panel and consisted of an Informal Assessment. This assessment was performed to obtain a preliminary evaluation of all wines to indicate key sensory differences and the presence of any off-flavours perceived. A panel of five experienced assessors evaluated all 11 wines independently in blind tasting conditions. The six white wines were assessed first followed by panel discussion, and then the five red wines were assessed and discussed. Panellists were informed of the wine variety and vintage prior to tasting. Samples were presented in identical order in coded ISO standard tasting glasses (30ml) and assessed at room temperature under white fluorescent lighting. A taint or off-note was recorded only if it was perceived at a detectable level by a minimum of two assessors.

3 RESULTS

The tasting notes for each wine are summarised in Table 3.1 and 3.2. The outcomes are presented in the following sections to separate each sensory modality assessed:

1. Appearance;
2. Aroma; and
3. By mouth characteristics.

3.1 Informal Assessment – Sauvignon Blanc Trial

When comparing the sensory properties of the white wines, the following was noted.

- Overall aroma intensity ranged from low to high in the wines with the Bingfield wine perceived most intense in fresh, varietal characteristics and the Lobethal wine least intense;
- The majority of differences in aroma were shown in the degree of citrus, tropical and floral notes;
- The wine flavours varied from low to high intensity and showed differences in acidity, citrus and tropical fruit, floral and grassy flavours;
- All wines were light in body with a smooth mouthfeel and slight astringency was perceived in the wines from Kuitpo and Lobethal vineyards;
- The Bingfield and Lenswood wines showed greater fruit flavour intensity and more balanced acidity; and
- There was no taint/off-note recorded for any wine.

3.2 Informal Assessment – Shiraz Trial

When comparing the sensory properties of the red wines, the following was noted.

- Appearance of the wines ranged from medium to deep purple red with the Bingfield wine the lightest shade;
- Overall aroma intensity varied from low to medium with the wines from Forreston and Lobethal the least intense overall;
- The majority of differences in aroma were shown in the degree of red and black fruit, confection, spice and leafy characteristics;
- The flavours varied from low to medium intensity and showed differences in ripeness, spiciness, and stalky flavours;
- The Bingfield and Balhannah wines were perceived as highest in body with more astringency and riper fruit flavours than the other wines;
- There was no taint/off-note recorded for any wine, however, the wine from Balhannah showed a slightly burnt note.

Table 3.1: Summary of informal tasting notes for 2007 Sauvignon Blanc wines; six vineyard treatments tasted by five assessors.

Wine Code	Bingfield	Balhannah	Forreston	Kuitpo	Lobethal	Lenswood
Appearance						
Colour & Intensity	Pale Straw	Pale Straw	Pale Straw	Pale Straw	Pale Straw	Pale Straw
Aroma						
Overall Intensity	Medium-High	Medium-High	Medium-High	Medium	Low-Medium	Medium
Odours	Lemon, Lime, Tropical, Pineapple, Low Passionfruit, Floral - Blossom, Sulphur Dioxide	Lemon, Lime, Tropical, Melon, Low Passionfruit, Pear, High Floral – Blossom, Green	Lemon, Lime, Tropical, Melon, Low Passionfruit, Peach, Floral – Blossom, Green	Lemon, Lime, Tropical, Lychee, Pineapple, Ripe Pear, Honey, Medium Floral - Blossom	Lemon, Lime, Tropical, Mango, Melon, Low Pear, Floral – Blossom, Straw	Lemon, Lime, Tropical, Lychee, Pineapple, Ripe Pear, Medium Floral - Blossom
Taint/Off-note	Nil	Nil	Nil	Nil	Nil	Nil
Comment	Fresh, Varietal	Clean, Fresh	Clean, Fresh	Clean, Fresh	Slightly Dull	Clean, Fresh
By Mouth						
Acidity	High	Medium	Medium	High	High	Medium-High
Flavours	Medium Citrus & Tropical, Grassy	Low Citrus & Tropical, Floral, Melon	Medium Citrus & Tropical, Floral, Melon	High Citrus & Grassy, Low Tropical	Low Citrus & Tropical, Grassy	Medium Citrus, Low Tropical & Floral
Mouthfeel	Light-Medium Body, Smooth	Light-Medium Body, Smooth	Light Body, Smooth	Light Body, Smooth, Slight Astringency	Light Body, Slight Astringency, Chalky	Light Body, Smooth
Finish	Medium Fruit Length, Fresh Citrus, Balanced Alcohol	Short Fruit Length, Alcohol Warmth	Short Fruit Length, Slight Alcohol Warmth	Short Fruit Length, Balanced Alcohol	Short Fruit Length, Balanced Alcohol, Acid Persistence	Medium Fruit Length, Slight Alcohol Warmth
Comment	Balanced Acidity	Flat Acidity	Flat Acidity	Sharp Acidity	Sharp Acidity	Balanced Acidity
Taint/Off-note	Nil	Nil	Nil	Nil	Nil	Nil

Table 3.2: Summary of informal tasting notes for 2007 Shiraz wines; five vineyard treatments tasted by five assessors.

Wine Code	Bingfield	Junction Creek Balhannah	Forreston	Kuipto	Woodside Ridge Lobethal
Appearance					
Colour & Intensity	Deep Purple Red	Deepest Purple Red	Deep Purple Red	Deep Purple Red	Medium-Deep Purple Red
Aroma					
Overall Intensity	Medium	Medium	Low-Medium	Medium	Low-Medium
Odours	Ripe Dark Berry, Low Confection, Low Sweet Spice, Low Leafy	Ripe Dark Berry, Low Confection, Sweet Spice, Burnt Match, Low Rubbery	Red & Dark Berry, Low Confection, Low Sweet Spice, Chocolate, Dusty, Musty, Low Rubbery	Red & Dark Berry, Low Confection, Low Sweet Spice Low Leafy & Menthol	Red Berry, Raspberry Cordial, Low Sweet Spice, Low Leafy & Herbaceous
Taint/Off-note	Nil	Nil	Nil	Nil	Nil
Comment	Ripe Fruit	Slightly Burnt	Slightly Dull	Fresh Primary Fruit	Fresh Primary Fruit
By Mouth					
Acidity	Medium-High	Medium	Medium-High	Medium-High	Medium-High
Flavours	Ripe Berry, Low Pepper & Spice, Low Stalky	Ripe Dark Berry, Low Pepper & Spice	Low Red Berry, Low Confection & Stalky, Unripe	Low Red Berry, Herbaceous, Slightly Unripe	Medium Red Berry, Low Confection & Stalky
Mouthfeel	Medium-Full Body & Viscosity, Medium Astringency, Chalky	Medium-Full Body & Viscosity, Medium Astringency, Chalky	Light-Medium Body, Thin, Medium Astringency, Chalky	Light-Medium Body, Thin, Medium Astringency, Chalky	Light Body, Thin, Low Astringency, Smooth
Finish	Low-Medium Fruit Length, Acidic Finish, Balanced Alcohol	Low-Medium Fruit Length, Slight Alcohol Warmth	Low-Medium Fruit Length, Acidic Finish	Low-Medium Fruit Length, Acidic Finish	Medium Fruit Length, Slight Alcohol Warmth
Taint/Off-note	Nil	Nil	Nil	Nil	Nil
Comment	Reasonable Balance	Ripe Fruit	Slightly Unripe	Reasonable Balance	Fresh & Balanced

LIST OF FIGURES

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