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Indicate (X) client(s) to whom this final report is submitted.
Replace any of these with other relevant clients if required.

FINAL REPORT
FOR 2010

PROGRAMME & PROJECT LEADER INFORMATION

	Programme leader	Project leader
Title, initials, surname		Dr VA Carey
Present position		Extra-ordinary Senior Lecturer: Dept. Viticulture and Oenology
Address		584 Mt Moberly Place Coldstream, V1B 3Y1, B.C. Canada
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PROJECT INFORMATION

Project number	DVO VAC 04
Project title	The use of multi-source data for a site-selection model for Sauvignon blanc.
Project Keywords	Sauvignon blanc, site selection, model

Industry programme	**CFPA**	
	Deciduous	
	DFTS	
	Winetech	Cultivation (terroir)
	Other	

Fruit kind(s)	Wine grapes
Start date (dd/mm/yyyy)	01/01/2008
End date (dd/mm/yyyy)	31/12/2010

FINAL REPORT

(Completion of points 1-5 is compulsory)

1. Executive summary

Give an executive summary of the *total* project in no more than 250 words

It is well known that soil and climate, and therefore site selection, can influence grapevine vigour, production, wine style and quality. A great deal of data pertaining to the interaction of Sauvignon blanc with its growing environment in various regions of South Africa has been collected in various Winetech research projects but this information has not yet been integrated. It should therefore theoretically be possible to develop a site selection model for Sauvignon blanc by using all the available integrated terroir data.

An investigation into the relationship between phenology and climate at the vineyard-scale level, showed that other possible environmental and non-environmental parameters appeared to be the most influential factors driving the phenology up till approximately one week before the onset of a given stage. At this point, the mean temperature of the week prior to each phenological stage, was found to be the most influential parameter driving the timing of these stages

Following formulation of an intuitive model, data relating to growth, yield and production of Sauvignon blanc for three seasons, namely 2005/2006, 2006/2007 and 2007/2008 was used to predict said parameters by using forward stepwise regression as a model building tool. It appeared as if clay and silt content, as well as depth weighted soil pH and K content, were the most important soil input variables. There was greater variability of climatic input variables. However, it would seem that rainfall in the season, as well as several January climatic parameters are the most important in predicting grapevine growth, yield and quality. Models developed were not validated.

This project was ended, incomplete, at the end of 2010 due to lack of project supervision due to change in circumstances of project leader and team member. The main aims have been continued under ""Site selection for specific cultivar wine styles" by Mr Francois De Villiers and Mr Heinrich Schloms, starting 2011.

2. Problem identification and objectives

State the problem being addressed and the ultimate aim of the project.

On 13 November 2006 a meeting was held with the Winetech Terroir Program industry committee in order to discuss the Terroir Research Program. It was noted that the overarching aim of the wine grape terroir program should be to integrate all data pertaining to the interaction of different cultivars with their growing environment in a data base and GIS platform in order to be able to formulate a model to serve as a decision aid for site selection. This data must include soil and climate information and should include data from past and current research projects, wine shows, and individual cellar data management systems. The outcome should be in the form of a digital product to aid decision making.

The main objectives of this project are therefore:

AIM 1: Inventory all available viticultural measurements and associated climatic and soil data from past and current research projects and individual cellar data management systems as well as wine show results and associated climate and soil data.

AIM 2: Compile a database of data accumulated in AIM 1

AIM 3: Identify gaps in data and attempt to fill

AIM 4: Construct a statistical site selection model

3. Workplan (materials & methods)

List trial sites, treatments, experimental layout and statistical detail, sampling detail, cold storage and examination stages and parameters.

The cultivar Sauvignon blanc was used as an example.

The on-ground co-ordination of the project was expected to be performed by Ms Carolyn Howell as part of her Honours BScAgric (Viticulture) (2008) and PhD Agric (Viticulture) project (2009 and 2010).

AIM 1: Inventory all available viticultural measurements from past and current research projects and individual cellar data management systems and wine show results (particularly Veritas and Terroir) and associated climate and soil data (2008)

Milestone 1: A multi-disciplinary steering committee needs to be identified and will be responsible for:

Identifying important research stakeholders and potential data sources

Identifying input parameters for inclusion in the database

Identifying output parameters (e.g. vintage scores, wine quality scores, wine style descriptions; cultivar suitability ratings)

Milestone 2: Meetings with all research stakeholders will be necessary to clarify the type of data and format of data that is necessary for the inventory as well as any intellectual property issues.

AIM 2: Compile a database of data accumulated in AIM 1 (2009)

Milestone 1: Identify the necessary expertise and co-opt or contract for completion of the necessary tasks. This will include a data-base programmer and data-base manager.

Milestone 2: Additional hardware and software may need to be acquired depending on the data identified as being necessary for the database under AIM 1.

AIM 3: Identify gaps in data and attempt to fill (2009)

Milestone 1: Data gaps may relate to environmental or viticultural characteristics of a certain vineyard for which other data is available. It may be possible to complete the data set using anecdotal information, the SAWIS data base or modelled soil or climatic data.

Milestone 2: Data gaps may relate to wine composition for wines from shows and this may be completed by means of FTIR analyses (FOSS WineScan)

AIM 4: Construct a statistical site selection model (2010)

Milestone 1: Data-mining to determine key data that can be used to model a relationship between the inputs and outputs. CART is a possible tool that can be used to construct decision trees.

Milestone 2: Establish the relationship between input and output variables. Artificial neural networks are a possible tool that can be used to establish this relationship (training process).

Milestone 3: Determine the inputs that give the desired or optimal outputs (optimization algorithm).

4. Results and discussion

State results obtained and list any benefits to the industry. Include a short discussion if applicable to your results. This final discussion must cover ALL accumulated results from the start of the project, but please limit it to *essential* information.

AIM 1: Inventory all available viticultural measurements from past and current research projects and individual cellar data management systems and wine show results (particularly Veritas and Terroir) and associated climate and soil data (2008)

Milestone	Achievement
1. A multi-disciplinary steering committee needs to be identified	Experts, listed in Addendum A, attended initial meetings
2. Meetings with all research stakeholders will be necessary to clarify data	Two meetings were held, a start-up meeting in November 2007 and a meeting to discuss the model in March 2008. In March 2008, the following outputs were identified as important, namely: Price class (on input level or output level?); Vigour (growth); Yield; Herbaceous aroma; Tropical/fruity aroma and Time of ripening (Can the required sugar and aroma compounds be achieved?). The recommendation was also made to formulate an intuitive model based on current knowledge and literature. This was done and is attached as Figure 1. Furthermore it was emphasized that the model should have the potential to display the results spatially. The quantity:quality relationship should be clearly established so as to estimate profitability. The model must be user-friendly. An additional meeting was held with Christo Spies and Francois Viljoen in connection with Wine MS in order to determine whether data from Wine MS can be used to formulate this model. It appeared that, whilst this data would not be suitable for the formulation of the model, using Wine MS may be an ideal way to validate the model.

AIM 2: Compile a database of data accumulated in AIM 1 (2009)

Milestone	Achievement
1. Obtain relevant viticultural, oenological and environmental data	The limiting factor in the use of research data is that data was restricted to that of Sauvignon blanc. The main source of data for this project came from the research done by Dr. Carey. Additional research that has been funded by Winetech has also been identified as of value. It was envisioned that researchers would be approached individually in order to gain permission to add selected data to the database. Project leaders would have been approached once the data of Dr Carey was analysed. This was to ensure that the time of other project leaders was not wasted and that specific types of data could be targeted. Some data may already be available in the public

	domain as the result of scientific publications. As an initial step, inventory of all Sauvignon blanc viticultural measurements and associated climatic and soil data of the current University of Stellenbosch terroir project of Dr. Carey, was conducted. Forty eight sites, on 14 farms were identified. Each site comprised of 10 experimental vines. Data was for three seasons, namely 2005/2006, 2006/2007 and 2007/2008. Viticultural measurements such as PDLWP, berry ripening data, yield parameters and vegetative growth parameters were analysed. Available soil analyses of the current WW1312 project were evaluated and sites were classified according to the soil texture class using the South African textural triangle. The results of this research are summarized in the two attached posters (Addendum B and Addendum C). In May 2009, a survey (Addendum D) was sent to a number of viticulturists and the Sauvignon blanc interest group in order to establish the limits of the categories within each dependent variable and the general availability of data relating to independent variables during the process of site selection. The feedback from the Cultivation committee suggested that this survey was too complicated and needed to be adjusted. Only one response was received. Based on this single response and data from WW13/02; WW13/12 and the PhD dissertation of Dr Victoria Carey, limits for low, medium and high categories of the 5 identified output variables could be identified. These were not discussed or evaluated further by the team of experts and have therefore not been included in this report.
2. Identify the necessary expertise and co-opt or contract for completion of the necessary tasks.	At the start-up meeting it was possible to identify potential expertise to assist with this project (Minutes available on request).
3. Additional hardware and software may need to be acquired depending on the data identified as being necessary for the database under AIM 1	An external hard drive and additional computer were purchased in order to facilitate data storage, transfer and analysis.

AIM 3: Identify gaps in data and attempt to fill (2009)

Milestone	**Achievement**
1. Identify and fill data gaps in viticultural and environmental data	As always, the absence of spatial climatic data has been identified as a data gap. The research that has been admirably performed by Christien Potgieter of ARC ISCW will go a long way to filling this gap. Collaboration with Assoc. Prof. Stefan Grab, School of Geography, Arch. & Enviro. Studies at University of the Witwatersrand within their climate change programme was

	established in 2009 in terms of an honours study entitled "Influence of temperature on grapevine phenology in the Stellenbosch Wine of Origin District". The honour's report can be provided on request. This research looked at topographic influences on climatic data, the relationship between data recorded at the Agroclimatic weather stations and with the Tinytag dataloggers and at the relationship between phenology and climate. Regarding the latter, when analysed at the vineyard-scale level, other possible environmental and non-environmental parameters appear to be the most influential factors driving the phenology up till approximately one week before the onset of a given stage. At this point, the mean temperature of the week prior to each phenological stage, was found to be the most influential parameter driving the timing of these stages ($p < 0.05$).
2. identify and fill data gaps related to berry / wine characteristics	For data originating from WW13/02 and WW13/12, wine quality measurements or potential price points for wine are a gap and for other research projects, even where wine quality has been evaluated sensorially, translating this data into a commercial context may be a challenge.

AIM 4: Construct a statistical site selection model (2010)

Milestone	**Achievement**
1. Data-mining to determine key data that can be used to model a relationship between the inputs and outputs	The step-wise regression used by Ms. Howell on data from WW13/12 and the CART analyses used by Dr Carey on data from WW13/02 have identified the following key independent variables: a. Rain during growth season b. Rain during October and November c. Rain during month before harvest d. Number of rain days in January e. Huglin Index f. Mean temperature during October and November g. Maximum temperature during October and November h. Maximum temperature during January i. Number of hours with temperature above 35°C during growth season. j. Number of hours with day temperature between 20°C and 25°C during growth season. k. Number of hours with day temperature between 10°C and 25°C during growth season. l. Number of hours with night temperature between 20°C and 25°C during January. m. Mean wind speed during month before harvest n. Number of hours with wind speed greater than 4 m/s during month before harvest.

	o. Number of hours with wind speed greater than 4 m/s during October-November. p. Maximum relative humidity in January. q. Relative humidity at 15:00 during January. r. Radiation (month before harvest) s. Depth weighted sub-soil clay content (35-70 cm) t. Depth weighted clay content in soil profile. u. Depth weighted soil potassium content v. Depth weighted medium sand content in soil profile w. Depth weighted coarse sand content in soil profile x. Depth weighted sand content in soil profile y. Depth weighted silt content in soil profile z. Soil water holding capacity (estimated) aa. Depth weighted soil pH bb. Distance from sea cc. Scion clone dd. Vine density These were planned to have been refined following the survey response and further statistical analyses on the full data set.
2. Establish the relationship between input and output variables	Data was subjected to multiple linear forward stepwise regression analysis using Statistica during the BSchonours study of Ms Howell (can be provided on request). Only variables that were statistically significant were included. In addition, input variables were minimized. Essentially, if they were significant but did not contribute to an increase in R^2 of more than 5%, they were not included in the model. It was not possible to validate these results. The following prediction models for Sauvignon blanc growing in Stellenbosch Wine of Origin region were obtained. **Pruning mass (kg/m cordon) = -4.8 – 0.0180 * DW Clay content (%) + 0.25 * Maximum January temperature (°C) + 0.00076 * DW Soil K (mg/kg) - 0.014 * DW Medium sand content (%)** This model could explain almost 60% of the variation in pruning mass as quantified in kg per m cordon. Individual contributions of input variables are DW Clay content (37%); Maximum January temperature (14%); DW Soil K (4%) and DW Medium sand content (4%). Standard error of the estimate is 0.14496. **Yield (kg/m cordon) = 74.13 + 0.11 Rainday in January (Days) – 0.05 * DW Coarse sand content (%) + 0.06 * DW Silt content (%) – 0.04 * DW Clay content (%) - 0.12 * T>35°C for the season (Hours)** This model could explain almost 55% of the variation in yield as quantified in kg per m cordon. Individual contributions of input variables are Rainday in January (16%), DW Coarse sand content (12%), DW Silt content (11%), DW Clay content (10%) and T>35°C (6%). Standard error of the estimate is 0.46.

	Bunch mass (g) = 1049.8 + 7.3 * Maximum RH in January (%) + 18.49 * DW pH - 3.4 * DW Clay content (%) + 0.599 * Rain in season (mm) This model could explain almost 54% of the variation in bunch mass as quantified as g per bunch. Individual contributions of input variables are Maximum RH in January (24%), DW Soil pH (13%), DW Clay content (10%) and Rain in season (9%). Standard error of the estimate is 17.092. **Number of bunches = 375.38 – 0.69 * DW Coarse sand content (%) + 0.645 * DW Silt content (%) – 1.932 * DW CEC (cmol(+) per kg)** This model could explain 34% of the variation in number of bunches per grapevine. Individual contributions of input variables are DW Coarse sand (20%), DW Silt content (9%) and DW CEC (5%). Standard error of the estimate is 6.9. **Berry mass (g per berry) = 3.04 + 0.0010 * Rain in season (mm) - 0.023 * DW Clay content (%) + 0.057 * DW pH – 0.016 * DW Sand content (%)– 0.0046 * WHC (mm per m)** This model could explain 46% of the variation in mass per berry. Individual contributions of input variables are Rain in season (22%), DW Clay content (10%), DW pH (5%), DW Sand content (%) and WHC (5%). Standard error of the estimate is 0.14. **Number of berries = 223.43 – 3.34 * Rainday in January – 0.56 * GDD in January + 6.11 * DW pH - 0.75 * DW Clay content (%)** This model could explain 46% of the variation in number of berries per bunch. Individual contributions of input variables are Rainday in January (30%), GDD in January (12%), DW pH (9%) and DW Clay content (5%). Standard error of the estimate is 9.75. **Capacity = 4.74 + 0.0065 * DW Fine sand content (%) + 0.0061 * DW Silt content (%) – 0.0083 * WHC (mm per m) – 0.0064 * NT 2025 January (hours) – 0.000002 * R_S in season (w per m^2)** This model could explain 39% of the variation in capacity of grapevines. Individual contributions of input variables are DW Fine sand content (13%), DW Silt content (6%), WHC (7%), NT 2025 January (5%) and R_S in season (8%). Standard error of the estimate is 0.156. **TSS = 72.19 + 0.005 * DT2025 for season (hours) + 0.0019 * DT1025 for season (hours) – 0.01945 * NT 2025 in January (hours) – 0.01 * DW Soil K (mg per kg)** This model could explain 34% of the variation in TSS content of grape must. Individual contributions of input variables are DT2025 for season (16%), DT1025 for season (5%), NT 2025 in January (8%) and DW Soil K (5%). Standard error of the estimate is 1.3. **TA = -28.97 + 0.0107 * Rain in season (mm) + 1.11 * Maximum January**

	temperature (°C) - 0.0208 * WHC (mm per m) + 0.1058 * RH15 January (%) This model could explain 63% of the variation in TA content of grape must. Individual contributions of input variables are Rain in season (40%), Maximum January temperature (9%), WHC (7%) and RH15 January (7%). Standard error of the estimate is 0.7719. **pH = -0.74 + 0.0198 * Mean RH in January (%) + 0.0013 * DW Soil K (mg per kg) – 0.006 * DW Sand content (%) – 0.003 * GDD for season** This model could explain 37% of the variation in pH of grape must. Individual contributions of input variables are Mean RH in January (23%), DW Soil K (4%), DW Sand content (4%) and GDD for season (4%). Standard error of the estimate is 0.098. **Maturity index = 118.95 - 0.04 * Rain in season (mm) – 3.35 * Maximum January temperature (°C) - 0.3 * DW Coarse sand content - 3.1 * DW pH** This model could explain 45% of the variation in maturity index of grapes. Individual contributions of input variables are Rain in season (22%), Maximum January temperature (9%), DW Coarse sand content (8%) and pH (5). Standard error of the estimate is 4.3. **Day of harvest = 62.8 – 0.05 * DT2025 for season (hours) + 0.16 * NT2025 for season (hours) -0.35 * DW Clay content (%) + 4.7 * WS in season (m per second)** This model could explain 54% of the variation in date of harvest. Individual contributions of input variables are DT2025 (18%), NT2025 for season (16%), DW Clay content (10%) and WS in season (10%). Standard error of the estimate is 4.4. The best model was the model that predicted TA of the must. However, a short coming of this study was that only soil and climatic input variables were considered. It is highly likely that there are other factors influencing Sauvignon blanc such as topography and management strategies. In addition, the statistical analysis assumed a linear relationship with the outputs and this is probably highly unlikely. Furthermore, models could not be validated. It is therefore recommended that more sophisticated statistical tools be used in future similar studies. In addition, validation of models should take place. Other output parameters, such as wine quality and aroma, should also be included.
3. Determine the inputs that give the desired or optimal outputs (optimization algorithm).	Not completed
4. Model	Not completed

validation	

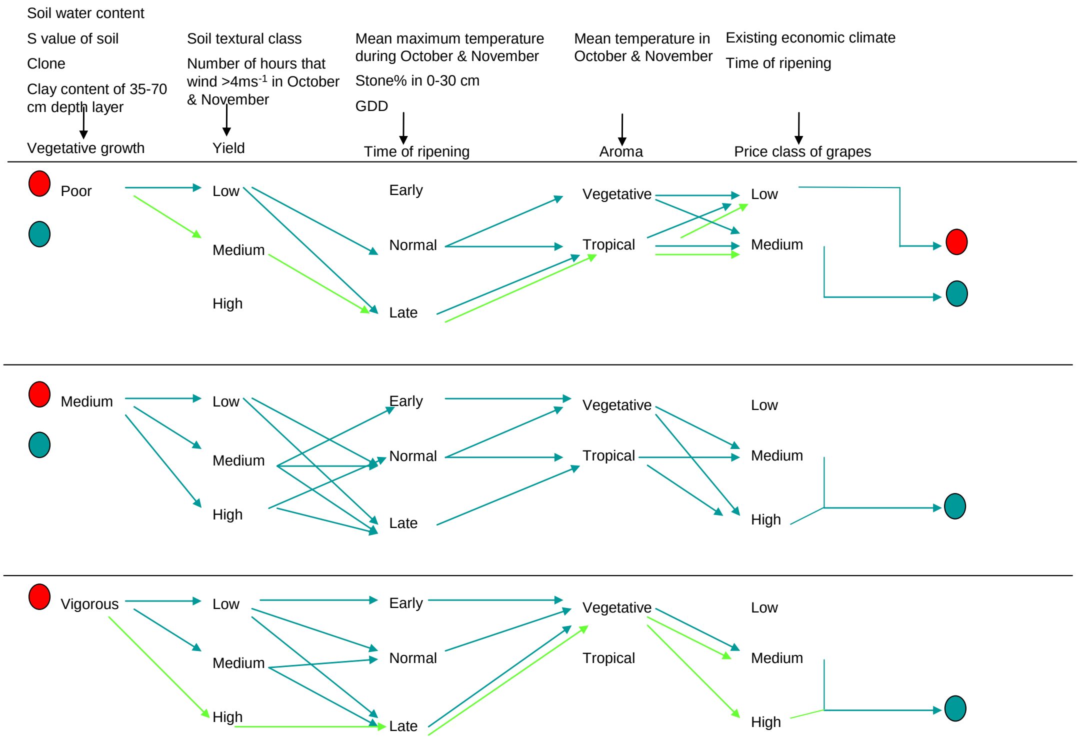

Figure 1. **Intuitive model for site selection for Sauvignon blanc in the Stellenbosch region**

Ms Carolyn Howell did not continue with her initially envisaged PhD studies on this project and Dr Victoria Carey relocated to Canada in 2009. This meant that DVO VAC04 was not able to continue optimally and it was decided in consultation with Mr Jan Booysen, CEO of Winetech, in October 2010 that the initial aims of this project could best be achieved with a new project team. Thus, after providing all written documentation relating to this project to Mr Francois de Villiers and Mr Heinrich Schloms, the project entitled “Site selection for specific cultivar wine styles” was submitted to Winetech at the beginning of 2011. Unused funds relating to project DVO VAC04 were reimbursed to Winetech in 2011.

5. Accumulated outputs

List ALL the outputs from the start of the project.
The year of each output must also be indicated.

Technology development, products and patents

Indicate the commercial potential of this project (intellectual property rights or a commercial product(s)).

Human resources development/training

Indicate the number and level (e.g. MSc, PhD, post doc) of students/support personnel that were trained as well as their cost to industry through this project. Add in more lines if necessary.

	Student level (BSc, MSc, PhD, Post doc)	Cost to project (R)
1.	Ms Carolyn Howell - HonsBScAgric (Viticulture)	R35 000 (Winetech); R20 000 (THRIP)

2.		
3.		
4.		
5.		

Publications (popular, press releases, semi-scientific, scientific)

Presentations/papers delivered

Howell, C.L., Z.A. Coetzee, C.R. van Zyl & V.A. Carey. 2008. Effect of duplex soil on growth, ripening and yield of Sauvignon blanc in the Stellenbosch wine of origin district. Thirty First Conference of the South African Society for Enology and Viticulture, Somerset West. (11-14 Nov) (**POSTER**)

Howell, C.L., Z.A. Coetzee & V.A. Carey. 2009. Identification of key soil and climatic input variables for quantification of Sauvignon blanc growth, yield and berry parameters in the Stellenbosch region. Fourth International Viticultural and Oenology Conference, Cape Town International Convention Centre, Cape Town, South Africa. (28 – 30 July) (**POSTER**)

4. Total cost summary of project

	Year	CFPA	Deciduous	DFTS	Winetech	THRIP	Other	TOTAL
Total cost in real terms for year 1	2008				R150 000	R46 500		**R196 500**
Total cost in real terms for year 2	2009				R150 000	R75 000		**R225 000**
Total cost in real terms for year 3	2010				R150 000	R75 000		**R225 000**
Total cost in real terms for year 4	2011				-R			
Total cost in real terms for year 5								
TOTAL								

Addendum A

Names of people who took part in start-up meetings held by Victoria Carey and Carolyn Howell for the project: *Use of multi-source data for a site-selection model for Sauvignon blanc for the South African wine industry*

Name	**Institution and Department**	**Expertise**
Dawid Saayman	Formerly Distell, Current status: private	Soil Science, Viticulture (Research and Industry)
Eben Archer	LUSAN	Soil Science, Viticulture (Research and Industry)
Francois Viljoen	Vinpro	Viticulture (Industry)
Briaan Stipp	Robertson Cellars	Viticulture, Soil Science (Industry)
Willem Botha	Netafim	Viticulture, Irrigation (Industry)
Dirk Bosman	Distell	Viticulture (Industry)
Cobus van Graan	KWV	Viticulture (Industry)
Hennie Visser	Vinpro	Viticulture (Industry)
Christo Spies	WineMS	Information technology (Industry)
Mike Wallace	Department of Agriculture:Western Cape	GIS
Heinrich Schloms	Department of Agriculture:Western Cape	Natural Resources, GIS
Johann Booysen	Department of Agriculture:Western Cape	Natural Resources, GIS
Hein Beukes	ARC Institute of Soil, Climate and Water	GIS (Research)
Freddie Ellis	University of Stellenbosch	Soil Science (Industry and Research)
Martin Kidd	University of Stellenbosch	Statistical analysis
Helene Niewoudt	University of Stellenbosch	Wine analysis
Anel Andrag	Winetech	Industry, research

Addendum B

Effect of duplex soil on growth, ripening and yield of Sauvignon blanc in the Stellenbosch wine of origin district.

C. L. Howell[1]*, Z. A. Coetzee[1], C. R. van Zyl[1] and V. A. Carey[1]
[1]Department of Viticulture and Oenology, University of Stellenbosch, Private Bag X1, Matieland (Stellenbosch) 7602, South Africa
*Email: carolyn@sun.ac.za

Introduction

- According to previous research, yield and growth of grapevines are significantly influenced by soil type.
- In South Africa, Saayman (1977) showed that Cinsaut wine characteristics varied according to soil type, even when meso-climatic conditions were the same.
- Soil type should be considered in conjunction with climate, cultural practices and cultivar requirements.
- Soil type is associated with soil characteristics such as soil depth, colour, temperature, texture and structure and water holding capacity.
- No scientific information is currently available on reaction of Sauvignon grapevines to an abrupt textural change in the subsoil.

Aims of study

- The aim of this study was to determine the effect of duplex soil on Sauvignon blanc grapevine growth, yield and ripening in the Stellenbosch Wine of Origin district.

Materials and methods

- Two experimental sites, within the same vineyard in the Bottelary hills, were identified as suitable.
- Both sites were classified as Tukulu soils. Soil 1 had 6.6% clay in the topsoil and 10.6% clay from 20 to 70 cm. In contrast, soil 2 had 9.8% clay in the top 20 cm and 25% clay in the subsoil. Soil 2 could therefore be considered as representative of a duplex-type soil.
- Growth of grapevines was quantified by measuring cane mass at pruning. Shoots were counted prior to pruning. Measurements were taken for 3 seasons, namely 2005/2006, 2006/2007 and 2007/2008.
- One hundred berries were sampled at bunch closure, veraison, intermediate Brix and harvest and their mass and volume determined. Berry ripening was quantified by determining total soluble solids (TSS), titratable acidity (TA) and pH of grape juice. Measurements were taken for 3 seasons, namely 2005/2006, 2006/2007 and 2007/2008.
- At harvest, bunches were counted and weighed. Measurements were taken for 3 seasons, namely 2005/2006, 2006/2007 and 2007/2008.
- Predawn leaf water potential measurements were taken at four main phenological stages for each site for two seasons, namely 2005/2006 and 2006/2007. No measurements were taken in 2007/2008 due to leopard spoor in the vineyard.
- Data was analysed by means of Statistica (Release 8).

Results

- Although not significant, pruning mass of grapevines on soil 1 tended to be higher than that of soil 2 (Table 1). The number of shoots for both soils were the same but canes from soil 1 tended to be heavier.

Table 1. Cane mass, number of shoots and mass per shoot of Sauvignon blanc grapevines (data are means for three seasons, means followed by the same letter do not differ significantly).

Site	*Pruning mass (t/ha)*	*Number of shoots*	*Mass per cane (g/shoot)*
Soil 1	2.53a	17.8a	42.59a
Soil 2	1.90a	17.6a	32.12a

Results continued...

- The progression of grape ripening on both soils was similar (data not shown).
- Mass of berries from the duplex soil tended to be lower (data not shown).
- Number of bunches per vine were similar but yield was lower on the duplex soil (Fig. 2). This can be attributed to smaller bunches.

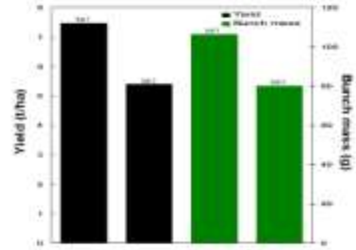

Figure 1. Yield and bunch mass of Sauvignon blanc grapevines growing in the Stellenbosch wine of origin district (data are means for three seasons).

- Pre-dawn leaf water potentials (Fig. 2) of Sauvignon blanc grapevines tended to be higher for grapevines growing on soil 1. Plant water deficits were therefore higher for grapevines growing on the duplex-type soil. For the 2005/2006 growing season, pre-dawn leaf water potential was only statistically lower ($p \leq 0.05$) for grapevines growing in soil 2 at intermediate ripening.

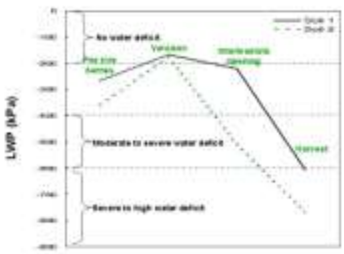

Figure 2. Leaf water potential of Sauvignon blanc grapevines growing in the Stellenbosch wine of origin district for 2005/2006 growing season.

Conclusions

- These results clearly illustrate that duplex-type soils are associated with increased plant water deficits which have the potential to manifest in lower vegetative growth and production. More dramatic differences are expected where the textural gradient between top and sub-soil is greater than in this trial.

Acknowledgments

- Staff at University of Stellenbosch for technical assistance.
- Winetech and THRIP for partial funding of this project.
- Producers on whose farms trial sites are located.

Addendum C

Identification of key soil and climatic input variables for quantification of Sauvignon blanc growth, yield and berry parameters in the Stellenbosch region.

C. L. Howell[1]*, Z. A. Coetzee[1] and V. A. Carey[1]
[1]Department of Viticulture and Oenology, University of Stellenbosch, Private Bag X1, Matieland (Stellenbosch) 7602, South Africa
*Email: carolyn@sun.ac.za

Introduction

- It is well known that soil and climate, and therefore site selection, can influence grapevine growth, yield, berry parameters and ultimately wine style and quality.
- The development of a site selection model for Sauvignon blanc from existing data from research, has, to date, not yet been attempted.

Aims of study

- The aim of this study was to identify key soil and climatic input variables for quantification of Sauvignon blanc growth, yield and berry parameters.
- These input variables could then possibly be used to develop a site selection model for Sauvignon blanc in the Stellenbosch region of South Africa using all available integrated research data.

Materials and methods

- Forty eight sites, on 14 farms in the Stellenbosch region, were identified.
- Each site consisted of 10 experimental vines.
- Soil profile studies were conducted at these sites.
- Climatic data was obtained from the closest automatic weather stations.
- Data relating to growth, yield and berry ripening of Sauvignon blanc for three seasons, namely 2005/2006, 2006/2007 and 2007/2008, was used to predict growth, yield and berry parameters by using forward stepwise regression as a model building tool.
- Data was subjected to multiple linear forward stepwise regression using Statistica. Only variables that were statistically significant were included.
- In addition, input variables were minimised. Essentially, if they were significant but did not contribute to an increase in R^2 of more than 5%, they were not included in the model.

Results

Pruning mass (kg/m cordon) = -4.8 – 0.0180 * Depth weighted (DW) Clay content (%) + 0.25 *Maximum January temperature (°C) + 0.00076 * DW Soil K (mg/kg) - 0.014 * DW Medium sand content (%) (R^2 = 0.6)

- Soils with higher clay content have higher bulk densities that limit root penetration of grapevines and vegetative growth will be reduced.
- Higher water deficits are associated with reduced vegetative growth of grapevines. Soils with a lower medium sand content have a lower water holding capacity and therefore growth of grapevines is reduced.
- Soil K increases root density and this facilitates water uptake. Higher K implies a higher nutritional status therefore having a positive impact on grapevine growth.

Yield (kg/m cordon) = 74.13 + 0.11 Rainday in January (Days) – 0.05 * DW Coarse sand content (%) + 0.06 * DW Silt content (%) – 0.04 * DW Clay content (%) - 0.12 * T>35°C for the season (Hours) (R^2 = 0.55)

- Silt content would increase available water therefore increasing yield.
- Nematodes or increased water deficits associated with sandy soil could cause poorer yield.
- Temperatures above 35° can reduce photosynthesis, decreasing yield.

Results…

Bunch mass (g) = 1049.8 + 7.3 * Maximum Relative Humidity (RH) in January (%) + 18.49 * DW pH - 3.4 * DW Clay content (%) + 0.599 * Rain in season (mm) (R^2 = 0.54)

- Higher maximum RH implies a lower vapour pressure deficit. Grapevines are therefore less stressed and bunches will be bigger.
- Root development is restricted in acidic soils. As pH increases, there will be a more favourable soil environment and thus bigger bunches.
- Addition of water will increase bunch mass.

Berry mass (g per berry) = 3.04 + 0.0010 * Rain in season (mm) - 0.023 * DW Clay content (%) + 0.057 * DW pH – 0.016 * DW Sand content (%) – 0.0046 * Water Holding Capacity (WHC) (mm per m) (R^2 = 0.45)

- Addition of water to soil will increase berry mass.
- Soils with high water holding capacity would be expected to have a positive contribution to berry mass. It may be that in this case, the soils are shallow, with a limited potential rooting depth.
- Grapevines growing on sandy soils will experience higher water deficits. This will therefore lead to smaller berries.

TSS (Total Soluble solids) = 72.18 + 0.005 * Day Temperature between 20 and 25 °C (DT2025) for season (hours) + 0.0019 * DT1025 for season (hours) – 0.01945 * NT 2025 in January (hours) – 0.01 * DW Soil K (mg per kg) (R^2 = 0.34)

- Temperatures of 23°C to 25°C are optimal for photosynthesis.
- Presumably the effect of soil K is through the preferential transport of K in the phloem after veraison. This will decrease sugar content in grape must.

TA (Titratable acidity) = -28.97 + 0.0107 * Rain in season (mm) + 1.11 * Maximum January temperature (°C) - 0.0208 * WHC (mm per m) + 0.1058 * RH15 January (%) (R^2 = 0.63)

- Irrigation frequency and levels increase TA content. Likewise, rain in season would also increase TA content of must.
- RH in early afternoon affects grapevine production and wine quality. Increase in RH would imply a lower VPD and therefore less grapevine stress. Acids would therefore be maintained leading to higher TA values.

Conclusions

- The best model was the model that predicted TA of the must.
- General soil and climatic data can be used to predict parameters for Sauvignon blanc growth, yield and berry parameters.
- However, a shortcoming of this study is that only soil and climatic input variables were considered.
- It is highly likely that there are other factors influencing Sauvignon blanc such as topography and management strategies.
- In addition, the statistical analysis assumed a linear relationship with the outputs and this is probably highly unlikely.

Acknowledgments

- Staff at University of Stellenbosch for technical assistance.
- Winetech and THRIP for partial funding of this project.
- Producers on whose farms trial sites are located.

Addendum C
Input and output variables for a site selection model of Sauvignon blanc

On 13 November 2006 a meeting was held with the Winetech Terroir Program industry committee in order to discuss the Terroir Research Program. It was noted that the overarching aim of the wine grape terroir program should be to integrate all data pertaining to the interaction of different cultivars with their growing environment in a data base and GIS platform in order to be able to formulate a model to serve as a decision aid for site selection. As a starting cultivar, Sauvignon blanc was chosen.

This project has been funded by Winetech and commenced in 2008.

Following a number of meetings the following output variables for such a model have been identified: Price class; Vigour; Yield; Herbaceous aroma; Tropical/fruity aroma and Time of ripening. In order to compile a model it is necessary to identify thresholds in order to categorise the model outputs. Your assistance is sought in this regard.

Price class:

The aim of this output variable is to include a degree of economic viability in the output of the model as well as to identify the level of quality of the expected product.

1. **Should the price class be determined as price per ton of grapes or as price per bottle of wine?**

2. **What price thresholds do you associate with the following categories of price class?**

Price class	Price threshold (minimum)	Price threshold (maximum)
Low		
Medium		
High		

3. **How do you make decisions as to the specific wine aim of the load of grapes as they arrive at the cellar?**

Price class	°Brix thresholds	TTA thresholds	pH thresholds	Thresholds of other variables (please use additional paper if necessary)
Low				
Medium				
High				

4. **What is the minimum price below which planting Sauvignon blanc at this site would no longer be economically viable?**

Vigour:
The aim of this output variable is to quantify the expected growth potential of Sauvignon blanc at a particular site.

5. **What pruning mass thresholds do you associate with the following categories of vigour?**

Vigour class	Pruning mass (minimum)	Pruning mass (maximum)
Low		
Medium		
High		

6. **What other measurements do you use to quantify vigour? Please provide in the table below and provide thresholds that you consider to be associated with low, medium and high vigour respectively.**

Vigour class	Variable:	Variable:	Variable	Comments
Low				
Medium				
High				

Yield:
The aim of this output variable is to include a degree of economic viability in the output of the model by estimating the yield potential of Sauvignon blanc at a site.

7. **What thresholds (tons/ha) do you associate with the following categories of yield?**

Yield class	**tons/ha (minimum)**	**tons/ha (maximum)**
Low		
Medium		
High		

8. **What other measurements do you use to quantify yield? Please provide in the table below and provide thresholds that you consider to be associated with low, medium and high vigour respectively.**

Yield class	**Variable:**	**Variable:**	**Variable**	**Comments**
Low				
Medium				
High				

9. **Below what yield would you consider it was no longer economically viable to plant Sauvignon blanc at a particular site?**

Time of ripening:
The aim of this output variable is to ensure that the site has the capacity to ripen the grapes.

10. What weeks do you associate with the following periods of harvest?

Harvest period	week of year (earliest)	week of year (latest)
Low		
Medium		
High		

11. At what point would you consider that a site was unable to ripen Sauvignon blanc? i.e. what thresholds would have to be met by what time in order to say that Sauvignon blanc grapes were ripe at a particular site?

Variable	Threshold for ripeness:	Time threshold (week of year):	Comments

Input variables:

Please list all the environmental and viticultural variables that you feel should be included in the decision making process to determine suitability of a site for Sauvignon blanc and rank them in order of importance for each output variable.

Output variable	**List of variables (environmental and viticultural) that are considered when investigating the suitability of a particular site for Sauvignon blanc.**
Price class	
Vigour	
Herbaceous aroma	
Tropical/fruity aroma	
Ripening of Sauvignon blanc	