CFPA	SAAPPA / SASPA / SAT	DFTS	Winetech
Canning Fruit Producers' Assoc. Submit to: Wiehahn Victor Tel: +27 (0)21 872 1501 inmaak@mweb.co.za	Fruitgro Science Submit to: Louise Liebenberg Tel: +27 (0)21 882 8470/1 louise@fruitgro.co.za	Dried Fruit Technical Services Submit to: Dappie Smit Tel: +27 (0)21 870 2900 dappies@dtd.co.za	Submit to: Jan Booysen Tel: +27 (0)21 807 3324 booysenj@winetech.co.za

			x

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 W.J du Toit	Dr W.J du Toit
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PROJECT INFORMATION

Project number	W&W-WdT-08/01
Project title	Factors influencing SA white wines during bottle ageing
Project Keywords	White wine ageing, temperature

Industry programme	**CFPA**	
	Deciduous	
	DFTS	
	Winetech	Production technology
	Other	

Fruit kind(s)	
Start date (dd/mm/yyyy)	1-1-2008
End date (dd/mm/yyyy)	12-12-2009

Project number / researcher / research institution

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

This project investigated the effect of different anti-oxidant treatments and storage temperatures on the bottle ageing of South African white wines. In the first year of the project we found that temperature played a larger role in Sauvignon blanc and Chenin blanc wine development than anti-oxidant additions such as ascorbic acid. Changes in the sensory characteristics and some chemical changes were also observed.

The second part of this project continued the work on the temperature aspect, where Chenin blanc and Sauvignon blanc wines were again exposed to different temperatures, as well as variable temperatures during a stimulated transport trial. A sensorial trained panel were able to clearly distinguish the 37 degree C storage wines from the variable temperatures, 15 degree C and -4 degree stored wines. They were not able to clearly distinguish between the Chenin blanc (closed with screw cap) wines stored at the lower temperatures, but did pick small differences in the Sauvignon blanc wines (closed under cork). This indicates that the accumulated temperature seems to play a larger role in off odours forming than variable temperatures during shipping of wine. This project could give wine producers an idea what would happen to their white wines during shipping if they know the shipping conditions.

2. Problem identification and objectives

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

Some South African white wines show premature aging effects after relatively short bottle aging. Sauvignon blanc and Chenin blanc wines have a passion fruit, guava character, which is a positive aroma characteristic. This characteristic can be lost or altered during premature aging. The effect of varying storage temperature on white wine's ageing capacity is also not well known, especially during shipping. Recent studies (Meyer, 2002) have showed that wine can be exposed to large variation in temperatures during shipping and can reach up to 40 degree C in a shipping container. The main aim of this project was thus to investigate these temperature aspects on South African Chein blanc and Sauvignon blanc during a period which would simulate the transport by ship from SA to Europe.

3. Workplan (materials & methods)

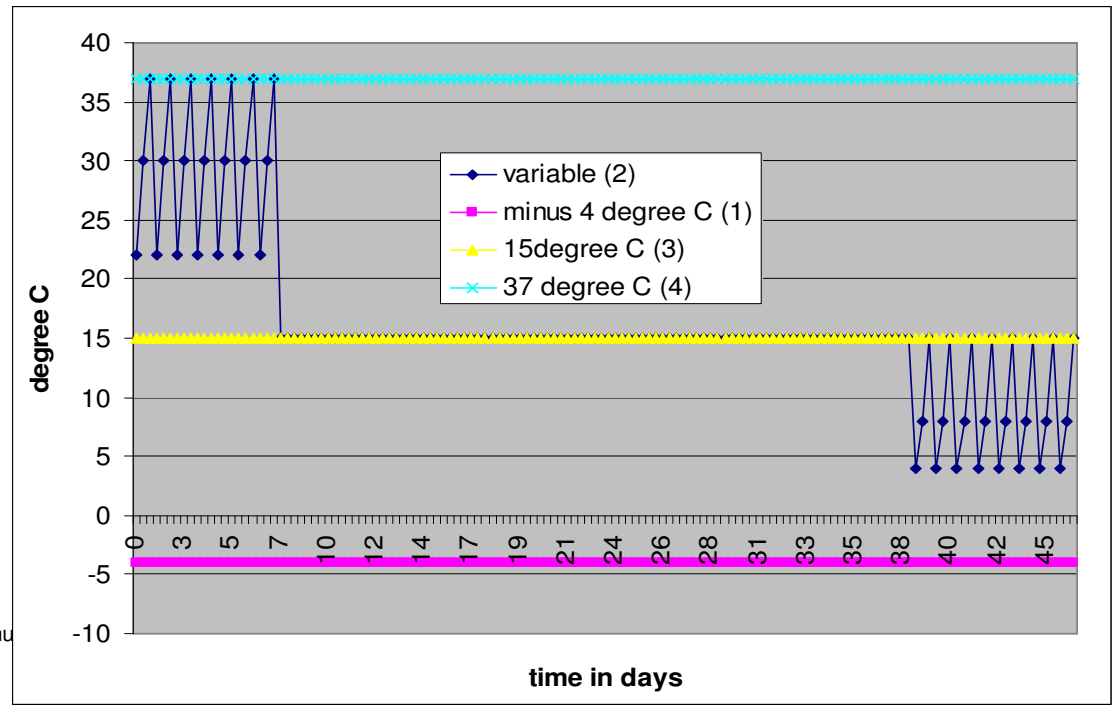
List trial sites, treatments, experimental layout and statistical detail, sampling detail, cold storage and examination stages and parameters.

The workplan of the 2008 has been described in a previous 2009 report in detail, but basically entailed storing 2008 Chenin blanc and Sauvignon blanc wine at different

temperatures (-4, 20 and 37 degree C) under screw cap. Ascorbic acid and glutathione were also added to some of the wines and the wines tasted and analysed after 3 and 6 months. The largest contributor to changes observed was the different temperature regimes.

We thus decided to investigate storing wine at variable temperatures during 2010, which could happen if wine is exported from SA to Europe for 46 days (Meyer, 2002). A 2009 Sauvignon blanc (cork) and 2010 Chenin blanc (screw cap) were stored at constant temperatures (-4℃, 15℃ and 37℃) as controls as well as variable temperatures. This was supposed to simulate a summer in SA and winter in the northern hemisphere, where the wines were exposed to a few days of high variable temperatures in the beginning and a few days of variable low temperatures at the end (Fig 1). Treatments were thus constant -4 degree C (1), variable (2), constant 15 degree C (3) and constant 37 degree C (4). However, the accumulated temperature over the 46 days was the same between those exposed to constant 15 degree C and to variable temperatures. After this trail we also left more of the Chenin blanc wine at 37 degree C and 15 degree C and tasted it weekly to assess at which stage the panel could perceive differences with a triangular tasting. The panel received extensive training in Sauvignon blanc and Chenin blanc wines beforehand.

Fig 1. Temperature regimes where Chenin blanc and Sauvignon blanc wines were exposed to during 2010.



Panel members

For sensory analysis, 9 panellists experienced in descriptive analysis were chosen for their ability to assess aroma, mouthfeel and taste, as well as for their descriptive language skills. All of the panellists had prior experience in wine assessment. Their collective previous experience included *Brettanomyces* taints, Cork taint and the detection of diacetyl in red and white wines. The panel consisted of 9 females, ranging in age from 24 – 60.

Calibration of the panel using reference standards

The panel of nine judges was trained extensively to analyse specific aroma (orthonasal & retronasal), attributes of the selected wines (Lawless & Heymann, 1998). In order to achieve this, the wine aroma wheel of Noble *et al.* (1987) was used as a starting point in this study (Figure 1). The latter wine aroma wheel was used for finding and developing the most applicable descriptive terms. This wheel divides descriptors into three tiers. Judges were firstly encouraged to evaluate the first tier and to then move on to the second and third tiers. As the study progressed, an adapted wheel with the appropriate tiers was drawn up for the specific wine samples used in this study (Figure 2). For illustrating the respective aroma attributes, reference standards were prepared and used during training, mainly to calibrate the judges with a the full spectrum of Sauvignon and Chenin blanc wine aroma attributes (Biasoto *et al.,* 2010). Parameters identified and used to calibrate the panel included visually straw (yellow) colour of the wine, the aromas fruity, tropical, sulphur like, overaged and a burning sensation on the aftertaste in the Chenin blanc. For the Sauvignon blanc the same parameters were used with additional vegetative aroma and flavour included (this referred to a green vegetative character often associated with Sauvignon blanc).

Training of the panel

Generic descriptive analysis, also known as Quantitative Descriptive Analysis (QDA), was used as a research tool for analysing the full spectrum of sensory attributes of the respective wines (Lawless & Heymann, 1998; Lattey *et al.,* 2007). For each sub-set or group of wines the judges were trained for ten consecutive sessions of approximately 1.5 h per session. During each training session the panel members were exposed to 4 or 5 white wine samples, as well as the Control samples. Descriptors were generated for the respective wine samples and discussed by the panel members until consensus was reached on the range of sensory attributes necessary to profile the respective wines; as well as on the minimum and maximum intensity value of each aroma (retro- and orthonasal).

Testing of sensory profile

The sensory attributes were profiled on unstructured line scales with 0 = *No intensity* and 100 = *Prominent intensity*. The profiling was conducted in tasting booths fitted with Compusense software (Compusense®, Canada) and artificial daylight lighting. The room temperature was controlled at 20℃ ±1℃ (ISO, 1988). The wines were analysed in standard ISO wine tasting glasses at 20℃ ±1℃ and the sample size was 20 mL (ISO, 1977). Each sample was coded with a three-digit code and the judges received all treatments in a complete randomised order; however, the Control sample was always served in the first position. Each glass was covered by a lid (Kimix, South Africa) and prior to the aroma analysis the judges were instructed to remove the lid from the glass, swirl the wine and analyse the specific aroma concentrated in the headspace area. After all aroma (*orthonasal*) attributes were analysed, the panel members were instructed to analyse the flavour or palate aroma (*retronasal*), taste and mouthfeel attributes. The analysis was replicated in six identical sessions on three consecutive days, two replications per day.

Statistical analysis of data

Multivariate statistical techniques were performed using the XLSTAT software (Version 7.5.2, Addinsoft, New York, USA). Principal Component Analysis (PCA) Partial Least Squares regression (PLS) regression was conducted in order to investigate the associations and patterns within the sensory data set(Guchu *et al*., 2006).

Basic chemical analysis were also performed on the wines performed (SO2, colour measured spectrophometrically).

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.

Milestone	**Achievement**
1. Assessing the effect of different storage temperatures and anti-oxidant additions on SA white wine bottle ageing	Completed
2. In depth sensory investigation on the effect of different shipping temperatures on SA white wines	Completed
3. Compiling an article for SASEV journal	Partly completed

In the 2009 report it was clear that temperature played a major role in the wine's ageing capacity Results revealed that the anti-oxidant treatments per se did not have such a large influence, except for ascorbic acid sometimes preventing pinking of the wines. However, differences in the storage temperature led to large differences in chemical and sensorial composition of the wines. We thus decided to investigate in more detail the temperature effect, especially fluctuating temperatures which could be expected during shipping, which will be mainly reported on in the following section. In fig 2 a biplot of the sensory data of the different treatments can be seen. It is clear that treatment 4 separated completely different from the other 3 treatments, with F1 explaining almost all the variability between the samples (96%). Treatment 4 thus associated with negative characteristics such as overaged, sulphur like and straw colour, while the other three treatments associated with tropical and fruity characteristics. We then decided to further investigate the effect of only treatments 1, 2 and 3 separately to assess if differences were not obscured by the large effect treatment 4 had in fig 2. This data is presented in fig 3 and it can be seen that no clear tendency could be observed. One way ANOVA analysis of the sensory data of treatments 1, 2 and 3 also did not show any significant differences (results not shown). This indicates that variable temperatures (treatment, as would happen during shipping) did not influence the sensory composition of the wine in this case.

In fig 4 the biplot of the Sauvignon blanc wine can be observed. We again saw treatment four separating from the other three on F1, which explained again 96% of the variance. Again treatment 4 associated with negative associated characteristics and the other three with more positive ones such as vegetative, fruity and tropical. In fig 5 the biplot for only treatments 1, 2 and 3 can be seen. Interesting enough some samples of treatments 2 and 3 associated more with negative characteristics and most of treatment 1 with the positive characteristics. In table 1 the average and standard deviations are shown for the sensory characteristics of treatments 1, 2 and 3. Small, but significant changes were observed with certain characteristics, especially tropical, fruity and overaged aroma, with the lowest temperature treatment (treatment 1) often being significant different from the other two. However, it must be kept in mind that these differences were small. It thus seems that the 2009 Sauvignon blanc (closed under cork) were more sensitive towards the slightly higher temperatures than the 2010 Chenin blanc (screw top). This could be due to different reasons or a combination of: the chemical composition of the wines, the fact that the Sauvignon blanc was one year older then the Chenin blanc and thus more sensitive to temperature increases or the fact that cork let more oxygen come into contact with the wine during bottle ageing. However, it seems that South African white wines are more sensitive towards accumulating temperatures than temperatures shifts during ageing and shipping. The above mentioned

finding also correlated with a decrease in free SO2 levels and an increase in colour at 420 and 440 nm (Table 2).

We then also decided to investigate at which accumulated temperature the panel could distinguish with a triangular tasting the differences between the Chenin blanc wine stored at 15 degree C and 37 degree C. We included quite a large tasting panel for this purpose (32 tastings at a time). For significance 16 out of 32 must correctly identified the difference according to Jackson, 2007. After week one 11/32 identified it correctly, but after two weeks 16/32 identified it correctly. In this wine, after two weeks of exposure to 37 degree C the panel were thus able to distinguish it from those left at 15 degree C. They also clearly preferred the wine left at 15 degree C.

Fig 2: Biplot of the sensory data of the Chenin blanc wines exposed to different temperatures after 46 days. constant -4 degree C (1), variable (2), constant 15 degree C (3) and constant 37 degree C (4).

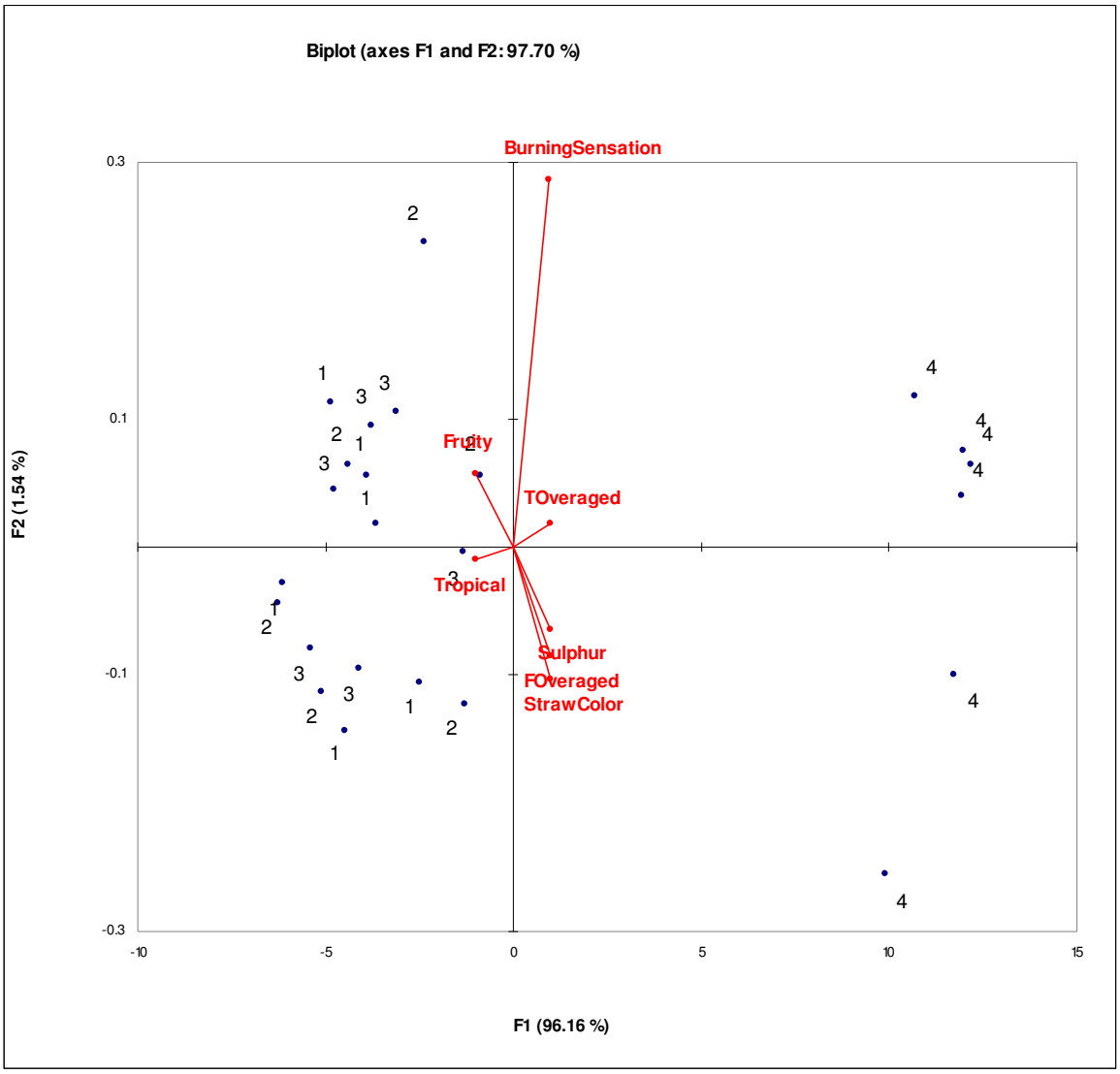


Fig 3 Biplot of the sensory data of the Chenin blanc wines exposed to different temperatures after 46 days. Constant -4 degree C (1), variable (2) and constant 15 degree C (3).

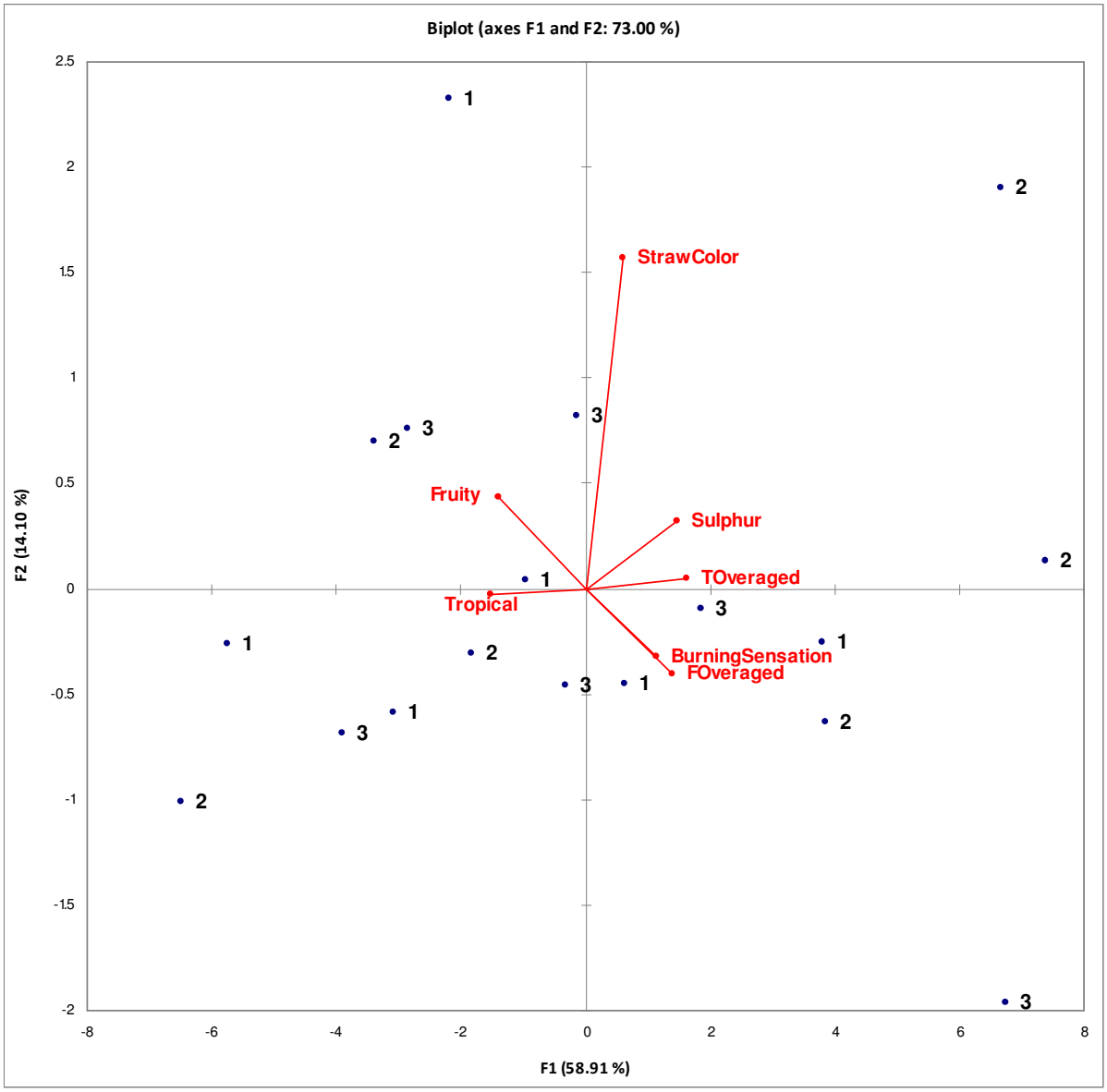


Fig 4: Biplot of the sensory data of the Sauvignon blanc wines exposed to different temperatures after 46 days. Constant -4 degree C (1), variable (2), constant 15 degree C (3) and constant 37 degree C (4).

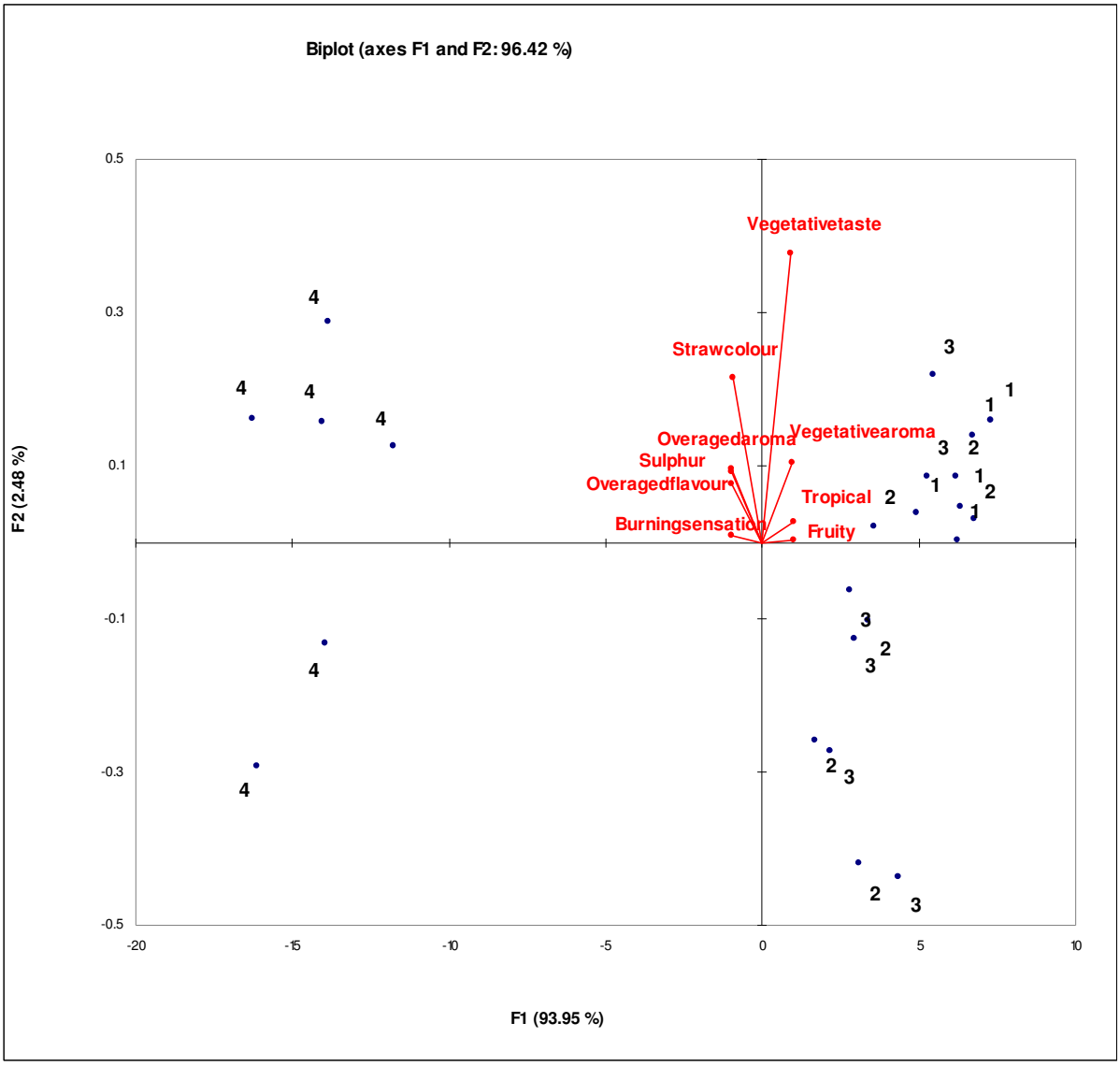


Fig 5: Biplot of the sensory data of the Sauvignon blanc wines exposed to different temperatures after 46 days. Constant -4 degree C (1), variable (2) and constant 15 degree C (3).

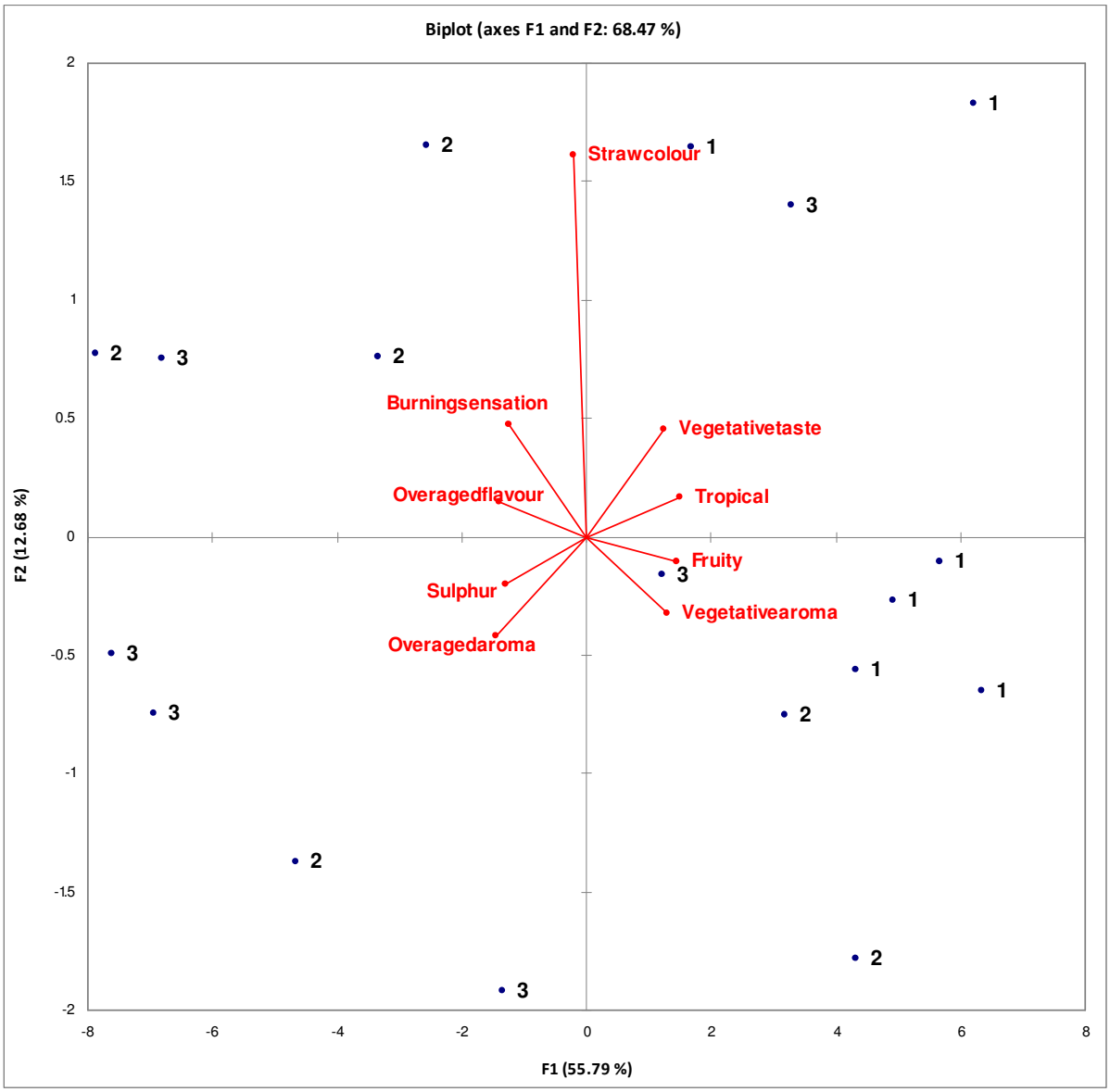


Table 1. Mean sensory scores (out of 100) for Sauvignon blanc after the variable temperature trials for treatments 1, 2 and 3. Constant -4 degree C (1), variable (2) and constant 15 degree C (3). Different letters indicate significant differences at p<0.05.

	Treatment		
Characteristic	**1**	**2**	**3**
Straw colour	21.5 ±2.9a	21.4 ±2.2a	21.3 ±2.5a
Sulphur off odour	0.7 2.1b	3.1 ±5.7ab	3.3 7.2a
Tropical	34.9 ±6.3a	31.1 ±7.0b	31.4 ±6.4b
Fruity	33.7 6.6a	29.7 ±6.9b	30.1 ±8.3b
Overaged aroma	0.2 ±1.2b	2.1 ±3.8ab	3.8 ±8.0a
Vegetative aroma	29.3 ±8.3a	26.2 ±9.7ab	25.5 ±8.8b
Burning sensation	4.9 ±6.6a	5.7 ±6.1a	7.4 ±6.7a
Vegetative taste	23.2 ±7.7a	20.9 ±7.1a	21.1 ±7.5a
Overaged flavour	0.9 ±3.1a	2.5 ±6.1a	2.6 ±7.2a

Different letters indicate indicates significance at p<0.05

Table 2. Average SO2 and colour measurement of the wines exposed to different temperatures after 46 days. Constant -4 degree C (1), variable (2), constant 15 degree C (3) and constant 37 degree C (4). Different letters indicate indicates significance at p<0.05.

	Characteristic			
Treatment	**Total SO2 (mg/L)**	**Free SO2 (mg/L)**	**420nm (AU)**	**440nm (AU)**
Chenin blanc				
1	99.0a	22.6a	0.054c	0.037b
2	98.7a	20.3b	0.058b	0.040b
3	99.0a	20.0b	0.056cb	0.039b
4	93.0b	16.3c	0.081a	0.056a
Sauvignon blanc				
1	121.3a	25.7a	0.076a	0.052a
2	118.0b	24.3ab	0.079b	0.055b
3	118.3b	23.3b	0.078b	0.054b
4	115.0c	21.0c	0.096c	0.067c

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)).

This project can give practical indications to winemakers regarding the storage and shipping of their wines during bottle ageing, on which very little information currently exists. If winemakers can thus know before hand to which accumulated temperatures their wines will be exposed to during shipping they would have an idea in which condition it would arrive in overseas markets.

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.

One honors student graduated form this project and one technical officer also worked on it.

Bezuidenhout M. Bottling ageing of South African white wines 2008

	Student level (BSc, MSc, PhD, Post doc)	Cost to project (R)
1.	Honors	R18 000 (bursary only)
2.		
3.		
4.		
5.		

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

We planning to submit the results to the SASEV journal for possible publication

Presentations/papers delivered

Bezuidenhout, M., McKay, M. and Du Toit, W.J. (2008). Effect of glutathione, ascorbic acid and yeast extract additions on bottled Chenin blanc and Sauvignon blanc wines stored at different storage temperatures. 31st Conference of the South African Society for Enology and Viticulture Somerset-West, South Africa.

Du Toit, W.J. & C. Piquet. 2010. Effect of different transport temperatures on South African white wine composition. Thirty Second Conference of the South African Society for Enology and Viticulture, Lord Charles Hotel, Somerset West. (**POSTER**) (17-19 November)

Wessel du Toit, Carien Coetzee, Engela Kritzinger, Daniela Fracassetti and Clement Piquet Recent Research Findings on Oxygen and Preservation of Aroma in Sauvignon blanc. Sauvignon blanc association technical seminar, Durbanville, 2010.

4. Total cost summary of project

	Year	CFPA	Deciduous	DFTS	Winetech	THRIP	Other	TOTAL
Total cost in real terms for year 1	2008				R 70 000	R 35 000		**R 105 000**
Total cost in real terms for year 2	2009				R 78 000	R 40 000		**R 118 000**
Total cost in real terms for year 3								
Total cost in real terms for year 4								
Total cost in real terms for year 5								
TOTAL					**R 148 000**	**R 75 000**		**R 223 000**