

Industry allocated project number

PHI allocated project number

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				<b>x</b>

## FINAL REPORT (2017)

### 1. PROGRAMME AND PROJECT LEADER INFORMATION

	<b>Research Organisation Programme leader</b>	<b>ARC Research Team Manager</b>	<b>Project leader</b>
<b>Title, initials, surname</b>	Dr HH Nieuwoudt		Dr HH Nieuwoudt
<b>Present position</b>	Researcher		
<b>Organisation, department</b>	IWBT-DVO, Stellenbosch University		
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### 2. PROJECT INFORMATION

<b>Research Organisation Project number</b>	IWBT W 13-02		
<b>Project title</b>	Rapid descriptive sensory methods for wine evaluation: special focus on investigating the effects of vinification techniques on Chenin blanc wine sensory attributes		
<b>Short title</b>	Development of cost saving wine sensory tests		
<b>Fruit kind(s)</b>	Wine grapes		
<b>Start date</b> (mm/yyyy)	01/01/2013	<b>End date</b> (mm/yyyy)	31/12/2016

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**Key words**

Rapid sensory methods, sorting, pick-K attributes, rate-K attributes, CATA, Pivot profile, polarised sensory positioning, projective mapping, descriptive analysis, wine profiling, mouthfeel

Approved by Research Organisation Programme leader (tick box)

### 3. EXECUTIVE SUMMARY

#### Objectives & Rationale

The overall objective was to establish a portfolio of fit-for-purpose methods for wine sensory evaluation at DVO, IGWS, Stellenbosch University and for the industry.

Specific objectives were: (i) to optimise the tasting procedures and statistical workflow of rapid sensory methods for wine profiling, for research and the SA wine industry; and (ii) to train a panel to evaluate mouthfeel attributes of old-vine Chenin blanc wines. In order to realise these objectives, the setting up of a sensory tasting facility for the DVO was initiated through project IWBT-W 13/02. The overall infrastructure needed included the acquisition of necessary hardware, software, panel selection and training, staff skills training, testing of sensory methods and establishment of validated workflows.

#### Methods

The rapid sensory methods, Projective Mapping (PM), sorting, pick-K attributes, rate-K attributes, Pivot Profile, Polarised Sensory Positioning (PSP) and descriptive analysis (DA) were applied to commercial Chenin blanc and Sauvignon blanc wines. Comparison of the different methods was made using the statistical Rv coefficient as indicator. Randomisation of terms on pick-K attribute lists was investigated as a means to minimise panelists' biases, in their usage of lists. The strategies that panelists' used for the similarity-based rapid methods were investigated in the sorting task.

#### Key Results

The rapid methods yielded sensory profiles similar to DA. PM and rate-K attributes required the most complex data analysis and were perceived as most difficult by panelists. Sorting and pick-K attributes were rated as the easiest and data analysis was the fastest. Terms on a pick-K attributes list should be randomised judiciously, to improve data quality. The trained DA panels' performances for mouthfeel attributes body, heat, length, balance, and complexity was excellent, yielding accurate data and consistency in the use of line-scales. Panels could successfully differentiate between low, medium and high intensities of the attributes. A set of old-vine Chenin blanc wines was profiled for mouthfeel. A workflow for the evaluation of mouthfeel with a rapid method, PSP was established. The task order used by panelists in the sorting task (first group the wines then describe the attributes, versus first describe the attributes and then group the wines) influenced the outcomes of the sensory evaluation.

#### Conclusion/Discussion

A significant contribution towards the establishment of a tasting facility at DVO, IGWS was made through the outputs of project IWBT-W 13/02 and extension. Sorting and "pick K-attributes" are the most suitable for rapid in-house sensory testing methods in the wine industry. A screening method for evaluation of the intuitive/natural way that individual panelists approach the Sorting task must be developed. The ability of the trained panel to evaluate wine mouthfeel made a valuable extension to the range of tests offered at the university and to the industry.

#### 4. PROBLEM IDENTIFICATION AND OBJECTIVES

At the onset of this project in 2013, wine sensory research at IWBT-DVO was to a large extent informal and fragmented. There was an almost complete absence of infrastructure in terms of panels, software, dedicated sensory projects, and clear objectives. No sensory service or research was offered to the industry. The ultimate aim of this project was therefore to initiate the setting up of the facility with all necessary infrastructure required.

#### 1. DETAILED REPORT

##### a. PERFORMANCE CHART (for the duration of the project)

Milestone	Target Date	Extension Date	Date completed
<u>1.From IWBT-W 13/02</u> a. Initiate setting up of a sensory facility at IWBT-DVO: software, hardware, panel training, establishing industry and research networks. b. Rigorous implementation of DA method for wine aroma: panel training and performance evaluation. c. Rapid methods PM, sorting, Pick-K attributes, Rate-K attributes were tested on white wine d. Implementation of rapid sensory methods to profile effects of skin contact on experimental Chenin blanc wine e. Consumer liking and preference testing experiments on experimental wines	2014		2014
<u>2.From IWBT-W 13/02 extension</u> a. Further testing and validation of rapid methods in 1 (c) on white wine b. Rapid methods, CATA, Pivot profile, were tested for white wine c. Established workflows and written protocols transferred to industry d. Profiling of commercial Chenin blanc and S. blanc wines	2014	2016	2016

<p>3. <u>From IWBT-W 13/02 extension</u>  a. Successful evaluation of wine in-mouth sensations with trained DA panel  b. Testing of rapid method PSP for wine in-mouth sensations  c. Comprehensive sensory profiling (aroma and mouthfeel) of old-vine Chenin blanc wines  d. Evaluation of Sorting method task order on panelist performance</p>	<p>2016</p>		<p>2016</p>
<p>4. <u>From IWBT-W 13/02 extension</u>  a. Large-scale data mining of research generated and publicly available sensory data on SA Chenin blanc wine  b. Start-up for updating flavour wheels for SA Chenin blanc wine</p>	<p>2016</p>		<p>2017/2018</p>
<p>5. Intended Journal publication(s) – final milestone  <u>Peer reviewed for 2017 / 2018</u>  Jeanne Brand (3)  Carla Weightman (2)  Carlo Valente (2)  Renée Crous (1)  Andiswa Mapheleba (1)  Hélène Nieuwoudt (2)   <u>Intended Semi-scientific for 2017</u>  Renée Crous (1)  Andiswa Mapheleba (1)  Hélène Nieuwoudt (1)  Valeria Panzeri (1)</p>	<p>2017/2018</p>		

**b) WORKPLAN (MATERIALS AND METHODS)**

Sensory evaluations were done in the sensory facility at DVO. Classic descriptive analysis (DA) and several rapid cost-saving methods were tested and the workflows optimised. Rapid methods applied for aroma properties were Projective Mapping (PM), pick-K attributes, rate-K attributes, sorting, Pivot profile, Polarised Sensory Positioning (PSP). Rigorous testing and statistical validation were done, mostly through comparison between results obtained with DA and rapid methods. Statistical indicators used were Rv coefficients. Softwares acquired and implemented were CompuSense, At-Hand and XLSTAT. Commercial wines and experimentally produced wines were used in testing.

Special attention was paid to industry-specific needs, for example, to evaluate the effects on the quality of data when using smaller numbers of panelists and larger sets of wines (than with the DA method) were used. The effects of randomisation of attributes in pick-K attributes, rate-K attributes were tested. The different strategies used by panelists in the sorting task was investigated. Finally, a statistical workflow to combine wines' quality ratings with sorting data to identify the sensory drivers of quality was developed for industry panels.

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## c) RESULTS AND DISCUSSION

The rapid methods yielded sensory profiles similar to DA. PM and rate-K attributes required the most complex data analysis and were perceived as most difficult by panelists. Sorting and pick-K attributes were rated as the easiest and the method's data analysis was the fastest. Terms on a pick-K attributes list should be randomised judiciously, to improve data quality. The trained DA panels' performances for mouthfeel attributes body, heat, length, balance and complexity was very good, yielding accurate data and consistency in the use of line-scales. Panels could successfully differentiate between low, medium and high intensities of the mouthfeel attributes. A workflow for the evaluation of mouthfeel with a rapid method, PSP was established. The task order used by panelists in the sorting task (first group the wines then describe the attributes, versus first describe the attributes and then group the wines) influenced the outcomes of the sensory evaluation. In total, a set of some 120 Chenin wines and 20 old-vine Chenin blanc wines were profiled for aroma, while the old-vine Chenins were also evaluated for mouthfeel. In addition to the sensory methods developed, the results generated in the research on the sensory attributes of South African Chenin blanc wines, led to a much better understanding of the sensory dimensions of this cultivar. To this end, the bolstering of the research database with information extracted from Platter's Guide to South African Wines was very valuable.

## d) CONCLUSIONS

The outputs of projects IWBT-W 13/02 and IWBT-W 13/02 Extension made a very important contribution towards the setting up and future development and growth of the sensory facility at DVO, IGWS. The protocols developed laid a firm foundation for further innovation in methods, research projects and technology transfer to industry. A large number of students is trained in the facility, some of whom take up positions in industry in product development and innovation, while others joined the research environment to further contribute to development and innovation. An extensive international network of collaborators was established; people who will no doubt, play an important role in the future of the sensory facility.

## 6. ACCUMULATED OUTPUTS

### a) TECHNOLOGY DEVELOPED, PRODUCTS AND PATENTS

Flavour wheels for SA Chenin blanc wine styles. Technical sheets on the flavour profiles of old-vine Chenin blanc wine, sweet styles, and dry and semi-dry styles published. Sensory lexicon for flavour compounds of Chenin was created.

### b) SUGGESTIONS FOR TECHNOLOGY TRANSFER

Webpage with **Wine.co.za** was arranged and Chenin research outputs will be published here, together with the technology transfer that has been done (wheel, technical sheets and lexicon).

### c) HUMAN RESOURCES DEVELOPMENT/TRAINING

Student Name and Surname	Student Nationality	Degree (e.g. MSc Agric, MComm)	Level of studies in final year of project	Graduation date	Total cost to industry throughout the project
Honours students					

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Mikhayla Williams	RSA	BScHons (Wine Biotechnology)	Graduated	December 2015	
Masters Students					
Carla Weightman	RSA	MSc (Wine Biotechnology)	Graduated	December 2014	74,000
Carlo Valente	RSA	MSc (Wine Biotechnology)	Graduated	March 2016	40,000
Renée Crous	RSA	MSc (Wine Biotechnology)	Graduated	December 2016	72,000
Andiswa Mapheleba	RSA	MSc (Wine Biotechnology)	2	March 2018	40,000
PhD students					
Jeanne Brand	RSA	PhD (Wine Biotechnology)	4	March 2019	0
Carla Weightman	RSA	PhD (Wine Biotechnology)	3	March 2018	95,000
Postdocs					
Support Personnel (not a requirement for HORTGRO Science)					
Hugh Jumat	RSA				45,000
Valeria Panzeri	Italian				0

**PERSONS PARTICIPATING IN THE PROJECT (Excluding students)**

Initials & Surname	Highest Qualification	Degree/ Diploma registered for	Race (1)	Gender (2)	Institution & Department	Position (3)	Cost to Project R
F Bauer	PhD	NA	W	M	IWBT, SU	Coll	0
T Naes	PhD	NA	W	M	Nofima Mat, Norway	Coll	0
D Valentin	PhD	NA	W	F	University Bourgogne, France	Coll	0
V Panzeri	MSc	NA	W	F	IGWS, US	Coll	0
E Setati	PhD	NA	B	F	IWBT, US	Coll	0
A Tredoux	PhD	NA	W	M	Polymer Chemistry, US	Coll	0
N Muller	MSc	NA	W	F	Food Science, US	Coll	0

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C Pentz	PhD	NA	W	M	Business Management, US	Coll	0
I Oertle		NA	W	M	Retail Wine Specialist, Somerset West	Coll	0

<sup>(1)</sup>Race      B      =      African, Coloured or Indian  
                   W      =      White

<sup>(2)</sup>Gender     F      =      Female  
                   M      =      Male

<sup>(3)</sup>Position    Co     =      Co-worker ( other researcher at your institution)  
                   Coll   =      Collaborator ( participating researcher that does not receive funding for this project from industry)  
                   PF     =      Post-doctoral fellow  
                   PL     =      Project leader  
                   RA     =      Research assistant  
                   TA     =      Technical assistant/ technician

**d) PUBLICATIONS (POPULAR, PRESS RELEASES, SEMI-SCIENTIFIC, SCIENTIFIC)**

Semi scientific:

Crous R, Panzeri V, Nieuwoudt H. (2017) Sensory evaluation of mouthfeel in wine (*Wineland*, August 2017).

Crous R, Panzeri V, Nieuwoudt H. 2017 Sensoriese evaluering van wynpalet: 'n mondvoll (gepubliseer in *Wineland*, Augustus 2017).

Weightman CJ, Brand J, Nieuwoudt HH. (2016) Sensoriese Evaluering van Wyn (Deel I) 'n Kort oorsig oor handige metodes wat deur die wynindustrie gebruik kan word. *Wineland*, Februarie 2016.

Weightman CJ, Brand J, Nieuwoudt HH. (2016) Sensory Evaluation of Wine (Part I) A Short overview of useful methods for the wine industry. *Wineland*, February 2016.

Brand J, Nieuwoudt HH. (2016) Metodes vir die Sensoriese Evaluering van Wyn (Deel II) Sortering: 'n Vinnige en maklike metode om sensoriese verskille en ooreenkomste tussen wyne te beskryf. *Wineland*, April 2016.

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- Brand J, Nieuwoudt HH. (2016) Methods for Sensory Evaluation of Wine (Part II) Sorting: a fast and simple method to describe sensory differences and similarities between wines. *Wineland*, March 2016.
- Brand J, Nieuwoudt HH. (2016) Metodes vir Sensoriese Evaluering van Wyn (Deel III) Projeksiekartering and Napping®: Wat het 'n tafeldoek ("nappe") met wyn sensoriese evaluering te doen? *Wineland*, April 2016.
- Brand J, Nieuwoudt HH. (2016) Methods for Sensory Evaluation of Wine (Part III) Projective mapping and Napping®: How to use a tablecloth to profile wine. *Wineland*, April 2016.
- Brand J, Nieuwoudt HH. (2016) Metodes vir die Sensoriese Evaluering van Wyn (Deel IV) Merk-Alles-van-Toepassing (CATA): profilering van wyn met behulp van veelvuldige keusevrae. *Wineland*, Mei 2016.
- Brand J, Nieuwoudt HH. (2016) Methods for Sensory Evaluation of Wine (Part IV) Check-All-That-Apply (CATA): profiling of wine with multiple choice questions. *Wineland*, May 2016.

Scientific:

- Valente, C, Bauer, FF, Venter, F., Watson, B. and Nieuwoudt, H. (2018) Modelling the sensory space of varietal wines: Mining of large, unstructured text data and visualisation of style patterns. *Nature Scientific Reports* 8: 4987.
- Brand J, Kidd, M, van Antwerpen, L., Valentin, D, Naes, T and Nieuwoudt, H. (2018) Sorting in combination with quality scoring: a tool for wine industry professionals to identify drivers of quality rapidly. *South African Journal of Oenology & Viticulture* (In Press February, 2018).
- Weightman, CJ. (2018) Consumer attitudes and sensory perceptions of wine: A South African cross-cultural study PhD Wine Biotechnology.
- Mapheleba, A. (2018) Perceptions of South African Chenin blanc wine among Consumers and Industry professionals. MSc Wine Biotechnology.
- Carla Weightman, Florian. F. Bauer, Nic S. Terblanche, Dominique Valentin and H  l  ne H. Nieuwoudt (2018). Exploratory study of urban South African consumers' perceptions of wine and wine consumption: focus on social, emotional and functional factors. *Submitted to Journal of Wine Research*.
- Valente CC. (2016) Understanding South African Chenin blanc wine by using data mining techniques applied to published sensory data. MSc (Wine Biotechnology).
- Crous R. (2016) The sensory characterisation of old-vine Chenin blanc wine: an exploratory study of the dimensions of quality. MSc (Wine Biotechnology).
- Aleixandre-Tudo JL, Weightman C, Panzeri V, Nieuwoudt H, du Toit, W. (2015) Effect of skin contact before and during alcoholic fermentation on the chemical and sensory profile of South African Chenin blanc wines. *South African Journal of Oenology & Viticulture*, 36, 366-377.
- Williams ME. (2015) Optimisation of the sorting procedure for wine sensory evaluation. BScHons Wine Biotechnology.

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Weightman CJ. (2014) Characterization of Chenin blanc wines produced by natural fermentation and skin contact: focus on application of rapid sensory profiling methods. MSc Wine Biotechnology.

**a) PRESENTATIONS/PAPERS DELIVERED**

BIZCOMMUNITY 6 April 2018. Study sheds light on SA consumers' attitudes towards wine.

Nieuwoudt HH. (2017) The intrigue of old-vine Chenin blanc wines. Presentation at 40<sup>th</sup> SASEV/Winetech Conference, Simondium, 29-31 August.

Nieuwoudt HH. (2017) Chenin blanc Research at Stellenbosch University. Chenin in the Spotlight Technical Seminar. Vredendal 2 November.

Brand J, Valentin D, Vivier MA, Naes T, Nieuwoudt HH. (2016) Comparing two frequency based sensory profiling methods using a trained panel: Pivot profile and frequency of attribute citation. Poster presentation at Eurosense Conference, Dijon France, 12-14 September 2016.

Brand J, Nieuwoudt HH. (2016) Novel strategy for dynamic characterisation of the sensory changes in the headspace of wine using the sorting task. Poster presentation at Eurosense Conference, Dijon France, 12-14 September 2016.

Crous R, Panzeri V, Brand J, Nieuwoudt HH. (2016) The evaluation of mouthfeel attributes in Chenin blanc wine made from old vineyards: A comparison of descriptive analysis and polarised sensory positioning. Poster presentation at Eurosense Conference, Dijon France, 12-14 September 2016.

Crous R, Panzeri V, Brand J, Nieuwoudt HH. (2016) Crafting South African Chenin blanc wines. Poster presentation at Spotlight on Chenin, Rawsonville, 28 October 2016.

Mapheleba A, Pentz C, Muller, N, Oertle I, Nieuwoudt HH. (2016) Listening to the consumer's voice: opportunities for Chenin blanc. Poster presentation at Spotlight on Chenin, Rawsonville, 28 October 2016.

Nieuwoudt HH. (2016) Chenin blanc research at Stellenbosch University. Presentation at Spotlight on Chenin, Rawsonville, 28 October 2016.

Van der Colff, N., Pentz, C.D., Nieuwoudt, H.H. (2016) Chenin blanc in the limelight: addressing South African consumers' uncertainties. Presentation at Spotlight on Chenin, Rawsonville, 28 October 2016.

Nieuwoudt HH, Krynauw S. (2016) Spotlight on Chenin blanc research data warehouse. Poster presentation at Spotlight on Chenin, Rawsonville, 28 October 2016.

Nieuwoudt HH. (2016) Chenin blanc research at Stellenbosch University. Presentation at Spotlight on Chenin, Rawsonville, 28 October 2016.

Oertle I, Nieuwoudt HH. (2016) Chenin blanc retail landscape. Presentation at Spotlight on Chenin, Rawsonville, 28 October 2016.

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- Crous R, Panzeri V, Nieuwoudt HH. (2016) Shedding light on old-vine Chenin sensory. Presentation at Spotlight on Chenin, Rawsonville, 28 October 2016.
- Crous R, Panzeri V, Brand J, Nieuwoudt HH. (2016) Traditional Descriptive Analysis versus an alternative rapid method for the analysis of in-mouth sensations in wine. Presentation at SASEV Conference, Somerset West, 23-25 August 2016.
- Daniels, A.J., Opara, U.L., and Nieuwoudt, H.H.
- Crous R., Panzeri V., Nieuwoudt HH. (2016) Crafting South African old-vine Chenin blanc wine. Poster presentation at SASEV Conference, Somerset West, 23-25 August 2016.
- Nieuwoudt HH, Krynauw S. (2016) From lab to industry: the journey of South African Chenin blanc wine research data. Presentation at SASEV Conference, Somerset West, 23-25 August 2016.
- Mapheleba A, Pentz C, Muller N, Oertle I, Nieuwoudt, HH. (2016) Sensory perceptions of South African Chenin blanc wine. Perspectives of sommeliers, winemakers and retail experts. Presentation at SASEV Conference, Somerset West, 23-25 August 2016.
- Williams ME, Nieuwoudt HH. (2016) Sensory evaluation of wine: new insights into strategies used by panellists for the sorting task. Presentation at SASEV Conference, Somerset West, 23-25 August 2016.
- Brand J, Van Antwerpen L., Nieuwoudt HH. (2015) Investigating the suitability of sorting in combination with quality scoring to identify drivers of quality using wine industry professionals as sensory judges. Presentation at AfroSense 2015 Conference, Stellenbosch, 23-26 November 2015.
- Nieuwoudt H. (2015) What does sensory science offer? Insights gained from Chenin blanc research. Presentation at Pinotage Association AGM, 18 June, Stellenbosch University, Stellenbosch
- Brand J, Valentin D, Vivier MA, Naes T, Nieuwoudt HH. (2015) Pivot profiling applied to wine sensory evaluation. Presentation at AfroSense 2015 Conference, Stellenbosch, 23-26 November 2015.
- Brand J, Valentin D, Vivier MA, Naes T, Nieuwoudt HH. (2015) Comparison of rapid sensory techniques for white wine profiling using experts as panellists. Presentation at AfroSense 2015 Conference, Stellenbosch, 23-26 November 2015
- Brand J, Valentin D, Vivier MA, Naes T, Nieuwoudt HH. (2015) Testing the effect of ballot term randomisation on "Pick-K-attributes" using white wine profiling with an expert panel as case study. Poster presentation at AfroSense 2015 Conference, Stellenbosch, 23-26 November 2015.
- Crous R, Panzeri V, Nieuwoudt HH. (2015) Framework for Training a Descriptive Analysis Sensory Panel to Evaluate Mouth-Feel Attributes in Wine: special focus on a Product Category Unfamiliar to panellists. Presentation at AfroSense 2015 Conference, Stellenbosch, 23-26 November 2015.
- Weightman C, Nieuwoudt, H (2014) Sensory evaluation and consumer acceptance testing of Chenin blanc wines produced by skin contact and natural fermentation. Presentation at SASEV conference, 14 November 2014.

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Brand J, Valentin D, Vivier MA, Naes T, Nieuwoudt HH. (2014) Sustainable sensory profiling of wine: pros and cons of rapid methods. Presentation at SASEV Conference, 14 November 2014.

Kruger van Eck M, Nieuwoudt HH. (2014) Sensory analysis and chemical profiling of naturally fermented Sauvignon blanc wine. Presentation at SASEV Conference, 14 November 2014.

Brand J, Valentin D, Vivier MA, Naes T, Nieuwoudt HH. (2013) Rapid descriptive sensory methods for wine evaluation. Presentation at SASEV Conference, 14 November 2013.

## 7. BUDGET

### TOTAL COST SUMMARY OF THE PROJECT

YEAR	CFPA	DFTS	Deciduous	SATI	Winetech	THRIP	OTHER	TOTAL
2013	0	0	0	0	270,000	90,000	0	360,000
2014	0	0	0	0	217,800	72,600	0	290,000
2015	0	0	0	0	267,000	89,000	0	356,000
2016	0	0	0	0	261,660		0	261,600

**EVALUATION BY INDUSTRY**

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Project number	
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Project name	
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Name of Sub-Committee*	
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Comments on project

Committee's recommendation (Review panel in the case of PHI)
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- Accepted.
  
- Accepted provisionally if the sub-committee's comments are also addressed.  
Resubmit this final report by \_\_\_\_\_
  
- Unacceptable. Must resubmit final report.

Chairperson \_\_\_\_\_ Date \_\_\_\_\_

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**\*SUB-COMMITTEES**

**Winetech**

Viticulture: Cultivation; Soil Science; Plant Biotechnology; Plant Protection; Plant Improvement;

Oenology: Vinification Technology; Bottling, Packaging and Distribution; Environmental Impact; Brandy and Distilling; Microbiology

**Deciduous Fruit**

Technical Advisory Committees: Post-Harvest; Crop Production; Crop Protection; Technology Transfer

Peer Work Groups: Post-Harvest; Horticulture; Soil Science; Breeding and Evaluation; Pathology; Entomology

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