SASEV Conference 44th

24 - 26 Nov 2025 • Protea Hotel, Technopark, Stellenbosch



"Navigating the challenges of sustainability in the face of climate change, precision farming, AI and consumer demands.

Abstract Book

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PREFACE

Dear Delegate

On behalf of the South African Society for Enology and Viticulture (SASEV) and the conference organizing committee, it is our pleasure to welcome you to the 44th Conference. The conference theme, *Navigating the challenges of sustainability in the face of climate change, precision farming, AI and consumer demands,* reflects the increasingly challenging environment in which grape farmers and winemakers must operate.

Wine grape growing regions in South Africa vary greatly in terms of topography, soil, climate and availability of water, therefore there is no one-size-fits-all recipe for sustainable and regenerative farming. We hope that the lectures and workshops addressing topics like irrigation, biological control of diseases, cover cropping, remote sensing, precision and digital agriculture will provide growers with knowledge and information to help navigate the challenges of sustainability.

Winemakers have to contend with ever-changing consumer preferences and demands. The market for low and no alcohol (de-alcoholized) wines is growing but producing these wines presents many obstacles. How do you cross cultural and language barriers to describe and market wine to potential new consumers? Fermentation biology, authentication of South African wines and overcoming smoke taint in wine are some of the other topics addressed in lectures reporting on research findings and in workshop discussions.

We have attracted keynote speakers that are international leaders in their fields to share their expertise and present the latest innovations and technologies developed and used globally. We hope that this conference will lead to a fruitful exchange of scientific knowledge and ideas, provide new opportunities for collaboration and networking, and making new scientific friends.

SASEV would like to thank all speakers and workshop coordinators as well as our sponsors for their contribution to the success of this conference. We trust that you will make the most of the opportunities available at the 44th SASEV conference.

Dr Elleunorah Allsopp
Chair: Conference Organizing Committee

South African Society for Enology & Viticulture

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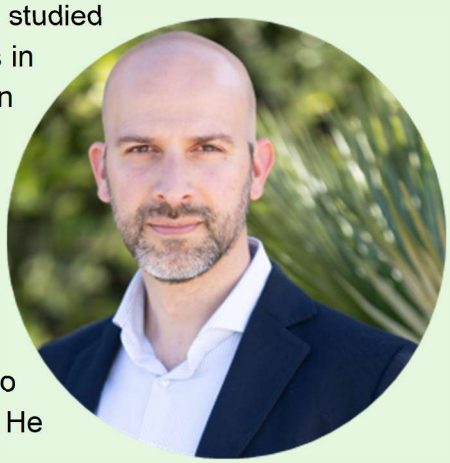
BIOGRAPHY:
KEYNOTE SPEAKERS

Carlos Poblete-Echeverria

Professor Carlos Poblete-Echeverría is an Associate Professor in Digital Viticulture and Water Management in the Dept of Viticulture and Oenology at Stellenbosch University and coordinator of the Digital Agriculture Research Group at SAGWRI. He has worked at universities in Chile, Spain, and South Africa. His research focuses on the impacts of climate change on agriculture, applications of remote and proximal sensing (including thermography, robotics, and drones), estimation of crop water requirements using models and micrometeorological techniques, and the development of computational and technological tools for agriculture and plant physiology. His keynote address, *Digital transformation in Viticulture: Sensor-based and AI-driven innovations for Agriculture 4.0,* and the workshop he is coordinating *on Artificial Intelligence (AI) in Viticulture: Opportunities and applications* aim to enlighten industry players and growers about the potential of new technologies in achieving sustainable farming.

Pietro Russo

Pietro Russo is an Italian winemaker who grew up in Sicily. He studied Viticulture and Oenology in Conegliano, followed by a Masters in Montpellier and Bordeaux. He accumulated hands-on experience by working harvests in France, Spain, New Zealand, Piedmont, and Sicily. From 2010 Pietro has held the role of the senior winemaker at Donnafugata, a successful and dynamic Italian wine brand. He crafts unique wines from the most compelling viticultural areas of Sicily; Etna, Pantelleria, Vittoria and Contessa Entellina. Technical expertise, a market and consumer-led approach and a profound commitment to preserve typicity informs his career in the wine industry. He regularly judges at international wine competitions.



BIOGRAPHY:
KEYNOTE SPEAKERS

Yvette van der Merwe

In 2024, the centenary year of the OIV, Ms Yvette van der Merwe became the first woman from the African continent to be elected as President of the OIV. She is the Executive Manager of the South African Wine Industry Information and Systems (SAWIS) and deals with wine certification under the Wine of Origin Scheme of the Liquor Products Act and management of statistical information under the auspices of the Marketing of Agricultural Products Act. Ms Van der Merwe was part of the team that developed the South African Wine Industry 2020 strategic document. She has been a member of the OIV delegation since 2000, holding several key positions at the OIV since 2013. Her involvement of almost 30 years in the South African wine industry and longstanding membership of the OIV delegation places her in an excellent position to address the topic *The economics of wine: Supply and demand trends in the context of sustainability and innovation* as our first keynote speaker.

Melané Vivier

Prof. Melané Vivier is professor in Grapevine Molecular Biology and Biotechnology at the Department of Viticulture and Oenology and the Director of the South African Grape and Wine Research Institute at Stellenbosch University. Her group focuses on grapevine biology and particularly on integrative research, where the processes under study are evaluated as a system. The methodological core of the research is molecular and metabolite profiling of the biological systems under study and applying it to the following two themes: (i) Interactome profiling of the grapevine-pathogen interaction and (ii) molecular and metabolite profiling of grapevines in vineyard settings. These two focuses have provided scope to increasingly apply these technologies to *grapevines under field conditions*. Workflows for molecular and metabolite profiling of grape berries in highly characterised "model" vineyards are providing proof-of-principle that this approach provides novel insights into grapevine biology, the genotype x environment interaction and the remarkable phenotypical plasticity of grapevine. Prof Vivier will introduce the Chenin Blanc project in her keynote address *Premium and profitable Chenin Blanc: do we start with the consumer, the vineyard, or both?*

ABSTRACTS

Although abstracts are published as received from authors, minor changes to the layout has been made. While every effort has been made to reproduce abstracts in their original form, SASEV regrets errors which may have arisen during the layout process.

Digital Transformation in Viticulture: Sensor-based and AI-driven Innovations for Agriculture 4.0

Carlos Poblete-Echeverria

South African Grape and Wine Research Institute (SAGWRI), Stellenbosch University, Private Bag X1, Matieland 7602, South Africa
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The convergence of sensor technologies and artificial intelligence (AI) is redefining viticulture through the principles of Agriculture 4.0. This presentation highlights recent advances led by the Digital Agriculture Research Group, integrating non-invasive sensing platforms, computer vision, and machine learning for data-driven vineyard management. By combining diverse imaging and sensing modalities with AI models, new solutions have been developed for yield estimation, phenology classification, water stress detection, and disease monitoring in viticulture. These technologies enable real-time decision-making, optimize resource use, and enhance sustainability while reducing dependence on manual measurements. The presentation also discusses challenges related to data annotation, infrastructure, and adoption, as well as emerging opportunities for implementation. Collectively, these innovations demonstrate how sensor-based and AI-driven systems are transforming viticulture into a more precise, resilient, and intelligent production system aligned with global sustainability goals.

The future of NoLO: Opportunities and challenges for winemakers

Pietro Russo, Master of Wine

The NoLo wine segment represents one of the fastest-growing frontiers in global beverage innovation, driven by changing consumer expectations, health awareness, and sustainability concerns. Yet, this trend also raises critical technical and conceptual challenges for winemakers.

This presentation explores the key market drivers behind the NoLo boom, the current regulatory landscape, and the physical technologies employed for alcohol removal, from membrane filtration and vacuum distillation to spinning cone systems. It highlights the environmental and qualitative implications of dealcoholisation, including energy use, production costs, and sensory balance.

Through real-case comparisons and analytical data, the discussion emphasizes how precision enology and fine-tuning, managing acidity, sweetness, mouthfeel, and aromatic recovery, are crucial to achieving quality and authenticity in NoLo wines. The future of this category depends on research, technological innovation, and the courage to think beyond traditional frameworks.

The economics of wine: Supply and demand trends in the context of sustainability and innovation

Yvette van der Merwe

SA Wine Industry Information and Systems NPC (SAWIS)
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The global wine sector faces historic challenges, with low production and consumption, climate volatility, and evolving markets. This presentation provides a global overview of supply and demand trends, highlighting key shifts in production, consumption, and international trade. It explores how innovation, sustainability, and international cooperation can help the sector adapt, while identifying opportunities for Latin American producers to strengthen competitiveness and resilience in a changing global landscape.

Premium and profitable Chenin blanc: do we start with the consumer, the vineyard, or both?

Melané A Vivier

South African Grape and Wine Research Institute (SAGWRI), Stellenbosch University, Private Bag X1, Matieland, Stellenbosch 7602, South Africa
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A multidisciplinary research project is ongoing that builds on the significant progress already made in the development of SA Chenin blanc wines. The project has a particular focus on understanding the cultivar's viticultural characteristics and how those translate into wine features and styles through the use of yeasts, nutrition and wine-making techniques. A reverse-engineering approach is simultaneously followed by using market and product intelligence to identify marketable distinctive features that can be linked to production parameters for the cultivar. Chenin blanc was chosen for the following reasons: (i) It is a widely planted cultivar with a growing reputation; (ii) It is naturally high yielding, with significant industry expertise in growing the grapes and making excellent wines from them; (iii) There is a strong focus already on developing the cultivar brand and significant work has been done in terms of typical Chenin blanc wine styles, consumer preferencing and typical Chenin blanc aromas. To facilitate optimally the different activities (and the team approach) of this project, the research work is conducted in four work streams, namely the Market and Product Intelligence-; Distinctive SA Chenin blanc wines-; Production for Profit-; and Juice to Wine workstreams. These work streams are interdependent and additive in nature and all build towards the goals of the project. An overview of these project goals, and the progress obtained in the broader project will be provided to lead in detailed presentations from three of the workstreams as part of a workshop on Chenin Blanc wine research.

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VITICULTURE ABSTRACTS BY PRESENTER

Evaluating plant growth promotion potential of biocontrol microbial consortia applied as soil inoculants in potted grapevine (*Vitis vinifera*)

Amber Justine Africa[1*], Joana Falcao Salles[2], Erna Hailey Blancquaert[1] & Mathabatha Evodia Setati[1]

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Grapevine hosts a myriad of microorganisms that are either pathogenic, neutral or beneficial. Beneficial microorganisms are applied as single species for biocontrol and plant growth promotion, but the application of consortia may improve their efficacy. This work focuses on two interkingdom consortia that have proven to be biocontrol agents against various pathogens including *Botrytis cinerea*, *Erysiphe necator* and *Plasmopara viticola*. Consortium 1 (Con1) consisted of *Wickerhamomyces anomalus* Y934, *Pantoea agglomerans* B4020 and *Bacillus nakamurai* B4022. Consortium 2 (Con2) consisted of *Hyphopichia pseudoburtonii* Y963, *Pantoea agglomerans* B4020 and *Bacillus nakamurai* B4001. We screened the consortia for *in vitro* production of ammonia (NH_3) and indole acetic acid (IAA) and solubilisation of tricalcium phosphate (Ca_3PO_4) and zinc oxide (ZnO). The consortia were inoculated in the soil of two-year old potted Chenin Blanc at flowering. Vegetative parameters such as shoot length were measured every ten days till harvest, while leaf area was measured at the end of season. We found that both consortia were able produce NH_3 and IAA, and solubilised ZnO; however, both consortia were unable to solubilise Ca_3PO_4. Con1 solubilised more ZnO than Con2, but Con2 produced higher IAA than Con1. No significant differences were observed between the consortia and the control (distilled water) for the vegetative parameters investigated. These findings highlight the differences observed in plant growth promotion experiments conducted *in vitro* compared to *in vivo*, particularly at the growth stages tested. Future studies will concentrate on evaluating growth parameters and validating the effectiveness of the consortia in disease suppression.

Exploring Gamma Irradiation as a Tool for Intra-varietal Improvement towards Climate Resilience: Effects on Cluster, Canopy, and Grape Traits in a Pinotage Mutant population

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The wine industry relies on a limited number of grapevine cultivars, comprised of clones differing slightly in viticultural, oenological, or stress-tolerance traits. As climate change intensifies, characterising and conserving intra-varietal diversity is crucial for cultivar improvement. Induced mutagenesis, using chemical or physical mutagens, is a valuable tool to increase genetic and phenotypic variation and uncover useful traits.

Pinotage, a relatively young South African red-wine cultivar, has few registered clones compared to ancient cultivars. To increase the diversity of available Pinotage planting material, an intra-varietal improvement scheme was implemented using gamma irradiation. *In vitro* plantlets from three widely planted clones (Pi7B, Pi45R and Pi48I) were treated, targeting latent bud meristems. This generated ~1400 putatively mutated plants. A subset of 500 vines (irradiated (treatment) and unirradiated somaclonal controls) was pre-selected and field-planted in 2021. Fruiting began in 2023, enabling detailed analysis of viticultural and oenological traits.

Phenotyping (OIV descriptors and agronomic measurements) and phenological scoring (E-L scale with ripeness monitoring) revealed diverse characteristics among the putative mutants. Variation was observed in berry skin and flesh colour, seed traits and bunch compactness – a key focus due to its influence on ripening and disease susceptibility. This population also displayed wide variation in phenological timing, particularly during the véraison-to-harvest period. Such diversity supports climate adaptation, as rising temperatures may advance phenology and ripening, negatively impacting phenolic accumulation, sugar-acid balance, and grape and wine quality. This proof-of-principle study highlights the potential of gamma irradiation and induced mutagenesis to enhance intra-varietal diversity in grapevine cultivars and clones.

The quest to find biological control agents as pruning wound protectants against Grapevine Trunk Disease pathogens in rootstock mother blocks

Zubayr Daniels[1*], Matthew Webber[1], Lizel Mostert[2], Yolanda Petersen[1], Francois Halleen[2] & Minette Havenga[1]

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Grapevine trunk disease (GTD) pathogens infect and colonize the heads of rootstock mother vines through pruning wounds, resulting in infected canes being used during propagation. This compromises the phytosanitary status of propagation material and emphasizes the need for effective pruning wound protection. The aim was to screen fungal and bacterial isolates alone and in combination with fungicides as potential biocontrol agents (BCAs) against four GTD pathogens. A total of 121 fungal and 96 bacterial isolates were screened *in vitro* against *Phaeomoniella chlamydospora*, *Phaeoacremonium minimum*, *Neofusicoccum parvum* and *Diaporthe ampelina*. An elimination approach was followed. For fungal BCAs isolates, the production of diffusible antifungal compounds as biocontrol was evaluated *in vitro* using either a liquid culture or cellophane method. A total of 45 fungal isolates were selected to screen for the production of volatile organic compounds. The most effective isolates against all four pathogens were selected. For bacterial isolates, pathogen inhibition screening using competition growth assays were used. Thereafter, nine bacterial BCAs that were effective against all pathogens were selected to screen for diffusible antifungal compounds. Additionally, the EC_{50} values were determined for four pathogens against boscalid, didecyldimethylammonium chloride, fluazinam, tebuconazole, thiophanate-methyl and pyraclostrobin. The most effective fungal and bacterial BCAs were screened against the most effective fungicide actives to identify fungicides to use in combination with BCA isolate. Several BCAs and BCAs-fungicide combinations were assessed using detached shoot assays. The application of these isolates in mother blocks could provide long-term protection to safeguard pruning wounds and reduce pathogen infection.

Evaluation of non-*Saccharomyces* yeasts as biocontrol agents against *Botrytis cinerea*

Zukisani Gomomo[1,2], Morris Fanadzo[2], Maxwell Mewa-Ngongang[1,3], Boredi Chidi[3], Justin Hoff[1], Marieta van der Rijst[4], Lucky Mokwena[5], Mathabatha Setati[6] & **Heinrich du Plessis**[1,*]

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Botrytis cinerea is a fungal pathogen that causes the disease known as grey mould or rot that leads to significant yield and quality loss. Using non-*Saccharomyces* yeasts as biological control agents is a promising and environmentally friendly alternative to synthetic chemicals. This study aimed to evaluate the growth inhibition activity of four non-*Saccharomyces* yeasts against *B. cinerea*. Four non-*Saccharomyces* yeast strains (*Meyerozyma guilliermondii*, *Pichia kluyveri*, *Suhomyces pyralidae* and *Zygoascus helenicus*) were screened for growth inhibition activity against three *B. cinerea* strains (B05.10, SAGWRI-FF1, PPRI 30807) on agar plates and grapes. Mode of action included inhibition through direct contact, competition for nutrients and the production of volatile organic compounds (VOCs). Yeasts displayed varying levels of growth inhibition against the *B. cinerea* strains, indicating that inhibition effectiveness varies depending on both yeast species and *B. cinerea* strain. In the ual-culture plate assay, *S. pyralidae* inhibited *B. cinerea* B05.10, IWBT-FF1, and PPRI 30807 by 56%, 38% and 35%, respectively. In the spore germination assay, *M. guilliermondii* and *P. kluyveri* achieved 100% inhibition against all three *B. cinerea* strains. The volatile organic compounds isobutanol, isoamyl alcohol, 2-phenylethanol, isoamyl acetate, and 2-phenethyl acetate were associated with the growth inhibition of *B. cinerea*. The selected yeast species demonstrated potential as biological control agents against *B. cinerea*, but further research is needed.

The impact of regenerative practices on grapevine performance, fruit and wine quality

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Regenerative farming is growing in popularity for its contribution to sustainability (planet, profit and people). Within the South African context, little empirical data is available on the impact of these practices on grapevine performance, fruit and wine quality. The aim of this study was to evaluate the impact of cattle grazing (Dexters) in a commercial Merlot noir vineyard situated on Hartenberg Wine Estate during the 2024-2025 season. Five replicates consisting of 12 grapevines (6 vines per panel with panels being adjacent) were selected in the vineyard with control (no grazing) and treatment (grazed). The 1st, 3rd and 5th vines of each panel were used to monitor vegetative and reproductive characteristics. Fermentation kinetics were monitored in both inoculated and spontaneous fermentation wines. Canopy sizes varied between the grazed and ungrazed rows between véraison (E-L 35) and harvest (E-L 38). Overall shoot lengths were higher in the grazed rows than the ungrazed rows throughout the season from véraison (E-L 35) to harvest (E-L 38). Berry weights were significantly influenced ($p<0.0005$) by grazing which led to an increased sugar accumulation. Contrarily, the berry circumference was higher in the ungrazed rows. Alcohol (% abv.) varied significantly in the ungrazed inoculated fermentation. Spontaneously fermented wines resulted in higher volatile acidity irrespective of the absence or presence of grazing. Our data suggests that grazing had an impact on the grapevine performance (vegetative characteristics) and fruit quality characteristics. Fermentation kinetics were also impacted, and the final wine quality was impacted by these practices.

Development of Novel Spectral Indices for Estimating Anthocyanins and Colour Index in Water-Stressed *Vitis vinifera* L. (cv. Cabernet Sauvignon)

Maria Ignacia González[1], Samuel Ortega-Farias[1] & Carlos Poblete-Echeverria[2,*]

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Continuous monitoring of the chemical composition of grapes is essential to ensure optimal fruit quality and, consequently, wine quality. In the case of red cultivars, anthocyanin concentration is a key indicator of berry maturity and is directly linked to the visual quality, antioxidant capacity, and phenolic composition of the resulting wine. A quantification of anthocyanin concentration is critical for assessing grape quality, optimizing harvest timing, and ensuring desired wine characteristics such as colour stability, mouthfeel, and aging potential. Traditional methods for assessing grape composition often rely on destructive sampling and complex analytical techniques, which can be time-consuming and may not adequately capture spatial or temporal variability within the vineyard. In this context, this study aimed to develop novel spectral indices for the non-destructive assessment of anthocyanin concentration and colour index in grapevines (*Vitis vinifera* L. cv. Cabernet Sauvignon) subjected to four irrigation levels. To achieve this, we employed a contour map approach based on hyperspectral reflectance data. A field experiment was conducted over two consecutive growing seasons (2019/20 and 2020/21) to identify optimal wavelength combinations using contour maps derived from hyperspectral reflectance data (350–2500 nm) collected from grape berries under laboratory conditions. Results indicated that the optimal spectral indices (SI) were SI_{ANTH} = 1339/713 nm for anthocyanins and SI_{CI}= 1333/715 nm for colour index. In both cases, the optimal spectral index combined a near-infrared band, which is sensitive to the internal structure and water content of the berries, as well as a band near the red edge of the spectrum, where anthocyanins exhibit strong absorbance. The linear regression analysis based on SS_{ANTH} and SI_{CI} presented a coefficient of determination of 0.90 and 0.89, respectively. Model validation confirmed the stability of these spectral indices across different irrigation regimens, with index of agreement of 0.95 for anthocyanins and 0.93 for colour index. This methodology demonstrates strong potential for accurately quantifying key quality attributes in wine grapes, offering a scalable solution for vineyard management and decision-making in precision viticulture.

Epidemiology and post-harvest management of the sexual state of *Erysiphe necator*

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Powdery mildew (*Erysiphe necator*) on grapevines leads to global economic losses. Despite its impact, little is known regarding the role of the sexual state in the epidemiology of the pathogen in South Africa. In 1996-1997, only a few immature chasmothecia were detected in three vineyards and flag shoots in one vineyard in South Africa. However, in 2016, larger numbers of mature chasmothecia were detected over a wider geographical range. The aim of this study was to investigate the epidemiology of powdery mildew and determine the effect of post-harvest treatments on chasmothecia. Chasmothecia were observed from 72 vineyards in six climatic and seven grape-growing regions, suggesting that sexual reproduction is not limited to a specific growing region even in high summer temperature areas. Chasmothecia were detected on bark, leaf litter and pruning debris from the four monitored vineyards. However, the number of chasmothecia decreased between leaf fall and bud break due to ascospore release throughout winter. The premature release could result in inoculum depletion, however, viable chasmothecia were detected on bark and pruning debris at bud break. No chasmothecia were detected on leaf litter at bud break and it is likely not an important source of inoculum. No flag shoots were detected in commercial vineyards. Three haplotypes, previously reported in Europe and Western USA, all belonging to biotype B, were identified. A post-harvest fungicide application generally decreased yellow chasmothecia due to low lipid content making it more permeable but had little effect on black chasmothecia. However, seven fungicide actives and *Ampelomyces quisqualis* significantly reduced the viability of black chasmothecia in a detached leaf assay. Post-harvest treatments applied shortly after harvest could decrease the overwintering inoculum and reduce the disease pressure in the growing season.

Mechanical pruning vs hand-pruning: the effect on incidence and severity of grapevine trunk disease pathogens

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Grapevine trunk diseases (GTDs) cause severe dieback and economic losses to grapevines in all major grape-growing regions in the world. Dieback of infected grapevines results in stunted growth, leaf necrosis and, in severe cases, death. Mechanical pruning (MP) uses machinery to prune vines and has proven benefits of reduced labour costs, increased production and acceptable wine quality. However, the effect of MP on GTDs is unknown. The study, therefore, aimed to elucidate the effect of MP on the incidence and severity of GTDs compared to conventional hand pruning (HP). This was achieved by sampling a MP and HP vineyard in five economically important wine regions in South Africa; Robertson (2019), Aan de Doorns (2020), Goudini (2020), Vredendal (2021) and Upington (2022). A total of 70 vines per site were sampled. From each vine, a pruning stub with at least 4-5-year-old growth was removed from MP blocks and a distal spur with 10cm of the cordon for HP blocks. Isolations were made from all visible symptoms in the internal discoloration. Isolates were identified using morphological and molecular techniques. In all seasons, Botryosphaeriaceae, Togniniaceae, Phaeomoniellales, Diapothales, Diatrypaceae and Basidiomycete species were identified from both pruning types. However, HP vineyards had significantly higher incidence and severity of several dieback and canker pathogens compared to the MP vineyards in all wine regions. Wood rot symptoms were abundant in hand-pruned samples. This is because hand pruning results in larger and more wounds, whereas mechanically pruned vines had longer canes with smaller wounds. Mechanical pruning is a good option to use as part of an integrated management strategy to prevent inoculum build-up and reduce wound infections, thereby increasing the productive lifespan of vineyards in several wine regions in South Africa.

Assessing the drought tolerance of selected grapevine scion cultivars under dryland conditions in the Swartland region of South Africa

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Grapevines depend on adequate water for sustainable yield and quality. According to climate change forecasts, rainfall in the Western Cape of South Africa could become lower. In drier regions such as the Swartland, many vineyards are grown rainfed or with limited volumes of irrigation water. During droughts, vineyards produce low yields with the possibility of poor wine quality. Drought tolerance refers to the degree to which a plant is adapted to arid or drought conditions. Therefore, risk of yield losses for rainfed, as well as irrigated vineyards could be reduced if drought tolerant scion cultivars are planted more extensively. There is no scientifically based information regarding growth, yield and quality for alternative scion cultivars in South Africa. Consequently, the project was conducted to generate this knowledge to make recommendations to the wine industry. The project was carried out in a vineyard on a Northeast facing slope at -33.461027 latitude and 18.668030 longitude near Malmesbury. Nine red and eight white cultivars were included in the study. Vegetative growth, berry development, yield and its components, as well as juice characteristics were determined for four seasons. Under the prevailing conditions, Shiraz and Assyrtiko had the strongest vegetative growth in relation to the other red and white cultivars that were evaluated. Piquepoul blanc had the poorest growth. Over four seasons, Grenache noir consistently produced the most grapes and Malbec the least for the red cultivars. Piquepoul blanc and Macabeo consistently produced the most grapes for the white cultivars whereas Chardonnay produced the lowest yield.

Response of *Vitis vinifera* L. *cv.* Pinotage to Irrigation Strategy and Trellis System in the Breede River Valley Region (South Africa): Vegetative Growth, Yield and Wine Quality

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Pinotage is a South African bred red wine cultivar and is second only to Shiraz in terms of the country's wine exports. Since rainfall in the Breede River region is low, vineyards in this region depend on irrigation. The sensitivity of Pinotage/99R to water deficits and the most suitable irrigation strategy during water restrictions were studied in a field trial. The possibility to produce more grapes with the same volume of irrigation water was also investigated. Irrigation strategies entailed combinations of 50% readily available water (RAW) depletion, 75% RAW depletion and no irrigation between various phenological stages, *viz.* budbreak, flowering, pea size berries, véraison, 17°B and harvest. Irrigation applied at 50% RAW depletion from budbreak until harvest was regarded as the control. Each experiment plot was split into a six-strand vertical hedge and a two-tier vertical trellis. The experiment layout was a split plot, randomised block design. Cane mass of grapevines on the two-tier trellis was lower compared to those on the six-strand hedge. Irrigation at 75% RAW depletion until harvest tended to reduce cane mass compared to more frequent irrigation. Drier soil conditions reduced berry mass, regardless of the trellis system. Sustained water deficits reduced yield. More Pinotage grapes were produced on the two-tier vertical trellis compared to the six-strand hedge with the same amount of irrigation, thereby reducing the blue water footprint and increasing the irrigation water use efficiency substantially. Water deficits enhanced the potential for colour and cultivar character development in Pinotage thereby improving overall wine quality.

The Role of Cover Crops in Sustainable Nematode Suppression

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Grapevines are susceptible to infestation by various plant-parasitic nematodes, which significantly reduce vine vigour and yield - estimated at approximately 15% in South Africa. While chemical control remains a conventional strategy, integrated management approaches are gaining traction due to their sustainability and environmental benefits. Among these, cover cropping has emerged as a valuable tool in perennial production systems, offering a suite of advantages such as improved soil structure, organic matter accumulation, nutrient cycling, and suppression of weeds, pests, and pathogens. However, the role of cover crops in nematode management is complex. Certain cover crops may unintentionally act as hosts, promoting nematode populations, with their susceptibility influenced by factors such as soil temperature. Understanding the interactions between nematode species, cover crop host status, and environmental conditions is critical for developing effective management strategies. This presentation will highlight findings from multiple research projects conducted since 2017, which evaluated the nematode host status of various cover crop species. The insights gained contribute to a more nuanced understanding of how to integrate cover crops into vineyard systems to reduce nematode pressure while supporting sustainable viticulture.

Evaluation of biocontrol agents through isolation, characterization, and fermentation trials for sustainable wine production

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The increasing demand for sustainable viticulture necessitates effective biological control alternatives. This study systematically identified potential biocontrol agents from diverse grapevine cultivars across South African and Italian vineyards employing biodynamic, organic, and conventional farming practices. We isolated bacterial and yeast strains from flowers, shoots, leaves, and grapes, targeting both endophytic and epiphytic microorganisms. Isolates demonstrating inhibitory activity against both hypervirulent and laboratory strains of *Botrytis cinerea* were selected through *in vivo* and *in vitro* antagonism screening assays. Promising isolates were evaluated for production of cell wall degrading enzymes, secretion of volatile compounds, biofilm formation, and iron sequestration and also screened for tolerance to commercial fungicides. Molecular identification through Sanger sequencing revealed taxonomically diverse antagonists. Among yeasts, we identified several *Metschnikowia* species, *Aureobasidium pullulans*, *Filobasidium oeirense*, *Pichia kluyveri*, *Suhomyces prunicola*, and *Hanseniaspora uvarum*. Bacterial antagonists included *Bacillus velezensis*, *Stenotrophomonas* sp., *Pantoea agglomerans*, and *Pseudomonas* species. Notably, several isolates demonstrated resistance to fungicides, with *Hanseniaspora* and *Pantoea* species exhibiting exceptional tolerance to Switch (cyprodinil and fludioxonil) and copper formulations. Selected isolates produced chitinase and glucanase when challenged with *B. cinerea*, while others deployed volatile organic compounds as their antifungal mechanism. Fermentation trials assessed four biocontrol agents applied to fresh and withered grapes, fermented with *Saccharomyces cerevisiae* under controlled conditions. Certain BCAs survived during the first 72 hours of fermentation with only minor differences in ethanol production across treatments. These findings establish a foundation for developing biocontrol strategies compatible with existing chemical control measures, offering promising solutions for sustainable grape and wine production.

Plant biostimulants evidence for protection against both biotic and abiotic stress in wine grapes – a role for the microbiome?

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Climate change projections indicate a rising frequency of drought events, which, when combined with disease outbreaks, threaten the survival of perennial fruit crops like grapevine. This combined stress of drought and disease is receiving increasing attention in grapevine research. Plant biostimulants, which are naturally derived and non-toxic, have emerged as a promising strategy. They are thought to influence the leaf (phyllosphere) microbiome in ways that could improve plant health and immune responses. This study aims to explore two key questions: (1) Can plant biostimulants alter the phyllosphere microbiome? and (2) Do these changes enhance plant health and immunity when grapevines are subjected to the combined stresses of drought and infection by *Botrytis cinerea*? One-year-old potted grafted Cabernet Sauvignon vines in glasshouse conditions were used as a model testing system. Detached leaf disc and liquid culture assays were used to evaluate the effects of glycine betaine pre-treatment on the response of potted grapevines to infection. So far, no differences in infection severity or progression have been observed between the control group and those treated with glycine betaine. ARISA analysis is currently being conducted to assess fungal and bacterial diversity in glycine betaine-treated grapevine leaves. Additional biostimulant studies are in progress, incorporating experiments involving water deficit and *Botrytis cinerea* infection.

Responses of Merlot noir to biostimulant application: grapevine performance and fruit quality

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Biostimulants are innovative and sustainable tools in viticulture that aim to improve nutrient utilisation, enhance biotic and abiotic stress tolerance, and increase fruit and wine quality. This study evaluated the response of Merlot noir to foliar application of two commercial biostimulants: Seaweed extract (Kelpak®) and Protein hydrolysate (XCELL Amino®). This study was conducted in a commercial vineyard (Hartenberg Wine Estate) in Stellenbosch, South Africa. Three foliar sprays were applied at flowering, fruit set, and véraison during the 2024-2025 growing season. The effects of the treatments on grapevine performance (vegetative growth, stomatal conductance, intrinsic water use efficiency, and chlorophyll content) and grape ripening and fruit & juice quality were evaluated. Slightly larger canopy area and leaf surface area were observed for Kelpak® treated vines compared to the Control and XCELL Amino® vines. Biostimulant-treated vines showed less water deficit and increased berry weight and diameter ($p < 0.0001$) throughout the season. XCELL Amino® showed the highest berry sugar concentration at harvest (112 DAA). The foliar applications also impacted seed number, with Kelpak® producing berries with a higher number of seeds, which may be due to improved ovule fecundation, potentially stimulated by the hormonal activity of the biostimulant. Overall, this study suggests that the use of the two foliar biostimulants was beneficial in increasing grapevine performance and fruit qualitative characteristics.

Screening table grape cultivars using rapid cell wall profiling tools for berry quality parameters

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Postharvest alterations in the cell walls of table grapes have been shown to and involve modifications in key polysaccharides such as cellulose, hemicellulose and pectin matrices. However, there is a missing link that will fill a critical gap in our understanding between plant polysaccharides and the overall firmness of table grapes. There is limited information available on the cell wall properties and differences between different table grape cultivars that contribute to the differences in firmness and overall texture. This study will evaluate whether rapid profiling tools can detect changes in berry quality parameters in commercially available table grapes obtained from grocery stores. A recently optimized ELISA protocol will be used to obtain a relative quantification of a range of polysaccharide and glycoprotein epitopes present in plant cell walls. Additionally, a standard physical analysis in combination with elemental nutrient analysis will be used to evaluate the physical and chemical structure of various table grape cultivars. The FTIR and Comprehensive microarray polymer profiling (CoMMP) analysis will be performed on cyclohexanediaminetetraacetic acid (CDTA), and sodium hydroxide (NaOH) extracts of alcohol-insoluble residue (AIR) obtained from the different berry cultivars to analyse the biochemical properties of the samples. The resulting datasets in addition to information on the physical and chemical berry parameters will be evaluated using multivariate software. It is hypothesized that an accumulation of polysaccharides in the plant cell wall will result in a greater firmness in grape berry cultivars, namely arabinan and type II arabinogalactan in firmer cultivars.

Enhancing Grapevine Phenological Monitoring with AI and Low-Cost Imaging: A Study on Automated Classification and Climatic data Integration

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Grapevine phenological stages are critical indicators for guiding viticultural practices. Traditional phenological models rely primarily on climatic data, often assuming that temperature is the main driver of phenological development. However, these models are not universally applicable and must be adapted and validated under local conditions. Phenological development is influenced by a complex interplay of factors such as cultivar, rootstock, soil type, and atmospheric conditions, which adds significant variability to predictions. In this context, the integration of artificial intelligence (AI), low-cost imaging, and basic climatic data offers promising opportunities to enhance the accuracy and scalability of phenological monitoring in viticulture. This study evaluates the effectiveness of two AI-based approaches: (i) image-only classification using RGB data and (ii) a multimodal model that combines RGB imagery with cumulative growing degree days (GDD) to assess major phenological stages of grapevines. An exploratory field study was conducted during the 2024–2025 growing season to evaluate the performance of these approaches for automated classification of vineyard canopy images into four key phenological stages. The image-only AI model demonstrated high classification accuracy across all stages analysed, exceeding 90% overall, despite the use of inexpensive, conventional RGB cameras. Confusion matrix analysis revealed high precision and recall for most classes, with minor misclassifications primarily between the flowering and fruit set stages, likely due to visual similarity during transitional periods. The inclusion of cumulative GDD as an additional input significantly enhanced model performance by providing temporal context. In the multimodal model, confusion matrix analysis showed reduced misclassification rates between adjacent phenological stages, confirming the value of integrating climatic data. These results underscore the potential of accessible, AI-powered tools to support timely and accurate phenological assessments in viticulture. By combining low-cost imaging with simple climatic metrics, this study demonstrates a scalable, cost-effective approach to developing practical decision-support systems for vineyard management.

Lessons learnt about the adaptability of Chenin blanc from a trellis-system experiment

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Globally, Chenin blanc is known for being adaptable to a wide range of growing conditions. In South Africa, it is extensively cultivated across multiple wine regions and is used to produce a wide range of wine styles. Limited information is available on the metabolic responses of the cultivar to changes in microclimates. This study aims to further understand the adaptive capacity of Chenin blanc by investigating clone SN220 (grafted onto Richter 99 rootstock), planted in a 1.11 ha model vineyard in the Stellenbosch region under 19 distinct trellis systems. This unique viticultural resource allows an analysis of microclimatic differences created by the trellis systems and the associated impacts on the vines' growth, physiology, viticultural performance, and the metabolic impacts on the berries. Following from a baseline analysis of all 19 systems, a more detailed investigation was initiated on six of the trellis systems (2K2T, Lyre, High Wire Perold, 7-strand double lengthened, posted vines and bush vines). Here, the bunch microclimates in the six systems will be compared to contextualise the berry development and ripening dynamics, as well as the observed influences on berry metabolism (with a focus on sugars and organic acids). Sensors used to monitor PAR, canopy and bunch temperature, and RH showed that the microclimates of the different systems varied significantly, particularly with regard to diurnal temperature variation and light quantity in the bunch zone. In addition to detailed phenological progression analysis and ripeness monitoring, berry samples from three developmental stages namely EL stage 32, 36 and 38, were analysed for their sugar and organic acids profiles, using HPLC analysis. By combining the different datasets, the research aims to generate a detailed understanding of the metabolic plasticity of Chenin blanc grapes when facing divergent microclimates.

Characterizing functional traits of microbial communities in the root zone soil of grapevine under different irrigation levels

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Soil microbial communities are key drivers of plant health, productivity, and resilience, particularly under environmental stressors such as drought. The microbiota associated with the plant play a crucial role in the response to stress as they can enhance the uptake of water, modulate root architecture and produce osmoprotectants. This microbiota is actively recruited by the plant from bulk soil in the root zone, therefore it is important to understand the diversity and potential function within this reservoir. This study aimed to analyse the functional diversity of the soil microbial communities in the root zone of Cabernet Sauvignon, Pinotage and Shiraz each grafted onto two rootstocks (US8-7 and Richter 110). Three irrigation regimes that follows optimal (L1), moderate deficit (L2), and dryland (D) were applied from the time of planting in a model vineyard located at Stellenbosch University. The soil samples were collected during the 2023/2024 season at fruit set from a 30 cm depth using an auger. Biolog® EcoPlates™ were used to measure the ability of the microbial communities to oxidise different carbon substrates. Overall, the preliminary data suggest that the microbial community associated with Cabernet Sauvignon R110-L2 display strong metabolic activity across multiple carbon sources, Pinotage R110-L2 showed the highest average colour development (AWCD) overall, while R110-L1 had the lowest, indicating a big shift in microbial function with irrigation and in Shiraz R110-L1 performed best, particularly on amino acids and carbohydrates, whereas R110-L2 showed unexpectedly low AWCD suggesting a possible cultivar-specific response. Therefore, microbial functional activity in grapevine root zone soils is strongly influenced by irrigation and rootstock-scion combinations.

Incidence of the G143A mutation for QoI resistance in grapevine powdery mildew populations

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Grapevine powdery mildew poses a significant threat to wine and table grape production. There is an increased prevalence of the sexual stage in Western Cape vineyards over the past two decades. The G143A mutation in the *Cytochrome b* gene confers resistance to quinone outside inhibitor (QoI) fungicides. This study aimed to detect the G143A mutation in powdery mildew from 29 vineyards in the Western and Northern Cape and to determine the potential for sexual reproduction. Powdery mildew colonies were sampled, DNA extracted, *MAT1* idiomorph determined (PCR) and G143A mutation was detected using a TaqMan probe qPCR assay (distinguish wildtype (WT) and mutant type (MT) individuals). Leaves were inspected for chasmothecia. The overall population was MT dominant with 407 MT individuals and 218 WT. The MT type was found widespread throughout the Western and Northern Cape. Sixteen vineyards were MT dominant ($P < 0.05$) of which in five vineyards only had MT individuals. Either chasmothecia or both mating types were present in the MT dominant populations. Eleven populations had even WT:MT ratios ($P > 0.05$). For MT dominant and even populations, chasmothecia or both mating types were observed, confirming sexual reproduction. Only three vineyards (Botrivier, Gansbaai and Hermanus) were WT dominant of which the Chardonnay vineyard in Botrivier only had WT individuals. In this vineyard, only *MAT1-2* individuals and no chasmothecia were identified which suggest no sexual reproduction is occurring. Care must be taken not to introduce MT or *MAT1-1* fungal spores into this vineyard since sexual reproduction can lead to fungal populations that are less sensitive to fungicides.

Grapevine Bio-factories: Hairy Roots for Specialised Metabolite and Antimicrobial Compound Production

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Hairy roots (HRs) are the result of a natural genetic modification by the bacterium *Rhizobium rhizogenes*. The phytopathogen inserts a piece of transfer DNA (T-DNA) into the host plant's genome, which is subsequently expressed by the plant cell machinery, leading to the characteristic prolific highly branched root growth. The bacterial infection strategy can be hijacked to introduce genetic material of interest and establish hairy root cultures (HRCs) in tissue culture which, among other applications, can be utilised for the bioproduction of specialised metabolites or recombinant bioactive compounds. We initially established a reference methodology towards a standardised *Vitis* HRC induction, maintenance, and validation protocol for the reliable, reproducible, and routine cross-cultivar use of the HR system in grapevine research. The system's bioproduction capacity was initially evaluated by overexpressing the *VvMYBA1* transcription factor, which lead to enhanced anthocyanin accumulation in HR, exhibited as deep red pigmentation of root tissue. In the next phase of the project, we are targeting small grapevine peptides for production by the HRCs. We identified grapevine antimicrobial peptides (AMPs) with potential antifungal activity, by utilising conserved core amino acid motifs, length of peptides and their predicted tertiary structures in combination with available genomic resources, in a bioprospecting approach. Candidate AMPs were subsequently overexpressed in grapevine HRs to determine the AMP bioproduction capacity of grapevine HRCs, and to evaluate whether the system can produce antimicrobial compounds for the potential application as environmentally friendly bio-pesticides.

Deleterious effects of grapevine trunk diseases on canes sourced from infected rootstock mother vines

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Infection of rootstock mother vines with grapevine trunk disease (GTD) pathogens reduces yields and compromises the phytosanitary quality of propagation material, threatening the sustainability of the South African grapevine industry. The optimal age for replacing rootstock mother vines to reduce this risk is unknown. This study investigated how rootstock mother block age affects the physiological, morphological, and infection status of both mother vines and one-year-old canes. Thirty-nine blocks of 10 varieties, varying in age, were surveyed over three seasons. Cane morphology (length, thickness, fresh mass), physiological traits (water and starch content, macro- and micronutrients, total phenolic index), and fungal infections were assessed. Fungal isolations were made from canes and mother vine heads, and *Diplodia seriata* and *Phaeomoniella chlamydospora* quantified in canes using qPCR. Results showed variable effects of block age and season across rootstock varieties, with no consistent association with vine age. Interactions between minerals and cane morphology were synergistic or antagonistic. Botryosphaeriaceae and Celotheliaceae (*P. chlamydospora*) were the most prevalent GTD pathogens in canes (incidences up to 28% and 2%; DNA concentrations up to 3171 and 1055 ng μL^{-1}) and in mother vine heads (up to 84% and 90%). *Diplodia seriata* infections in vine heads led to cane contamination. Botryosphaeriaceae negatively affected cane morphology, while Celotheliaceae and Diaporthaceae were associated with reduced starch levels. Infections by Botryosphaeriaceae and Hymenochaetaceae increased the phenolic index. GTD pathogens infected mother blocks and canes from as young as three years old, underlining the importance of starting with clean vines and preventing early infection.

A deep learning approach to identifying GLRaV-3 symptomatic leaves in red and white grapevine cultivars using smartphone captured images

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Grapevine leafroll-associated virus type 3 (GLRaV-3) is one of the more commonly found viruses causing Grapevine Leafroll Disease (GLD). It affects both vine health and the quality and yield of wine. There is no control measure post-vine infection apart from removing infected vines. Standard molecular and biochemical testing protocols that can reliably identify the virus are time consuming and expensive. The use of smartphone captured images would allow for ease of accessibility in the future development of artificial intelligence tools. Therefore, this study aimed to develop a validated image database together with a robust method for identifying GLRaV-3 symptoms in red and white grapevine leaves using smartphone captured images and deep learning techniques. Smartphone images were collected of leafroll symptomatic and healthy leaves, and other maladies having similar symptoms for seven red and three white cultivars and configured into a database. The pre-trained InceptionV3 Deep Convolutional Neural Network (DCNN) was trained, evaluated, and optimised for symptom identification. The constructed database consisted of 28 472 images, distributed as 11 382 to the “Healthy” class, 15 577 to the “Diseased” class, and 1 513 to the “Other” class. The proposed model was able to identify GLRaV-3 leaf symptoms from healthy and other infected vines with an accuracy of 96%. The best-identified cultivar was that of Pinot Noir, with a 99.53% accuracy, while the lowest was for Chardonnay with 83.41%. This trained model managed accuracies of over 80% for both white and red cultivar leaf symptoms combined as well as against other abnormalities displaying similar symptoms. Thus, it shows great promise towards identification of leafroll symptoms that can assist farmers in diagnosis and removal of infected vines.

Image Analysis in Viticulture: Proximal Sensing Techniques, Applications, and Future Perspectives

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Precision viticulture is a field which has advanced swiftly in recent years and continues to make headway in the development of tools which can be used for more efficient and accurate vineyard monitoring and management. One important aspect of vineyard management is ripeness monitoring to ensure optimal ripeness of grapes at harvest. Chemical parameters such as total soluble solids (TSS), pH and Titratable Acidity (TA) are routinely used to determine harvest readiness and classical measurements of these parameters are destructive, laborious and time-consuming. Grapes often exhibit asynchronous ripening both within bunches and between bunches and this impacts on the accuracy of these assessments. It is this variability that complicates the matter of sampling to ensure that a representative selection of bunches is selected. It has become apparent that there is an increasing need for quick, efficient and accurate determination of harvest readiness. As a possible solution non-destructive technologies such as spectral imaging have been proposed as possible alternatives to traditional grape ripeness measurements with some promising results being reported. This review looks at the principles of spectral imaging for this application and evaluates past studies on this topic to gain a better understanding of the current achievements, potential challenges and possibilities for future improvements to facilitate further adoption of this tool in research and practice.

Demonstrating the effect of plant water potential-based deficit irrigation on grapevine (*cv.* Shiraz) in an arid climatic region

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Plant water potential is a well-established indicator of plant stress in various crops, including grapevines. This study examines the response of Shiraz vineyards to plant water potential-based deficit irrigation in an arid region (Olifants River Valley) of South Africa. Three irrigation treatments were applied at pre-determined midday stem water potentials thresholds: Treatment 1 (-1.1 MPa), Treatment 2 (-1.5 MPa), and Treatment 3 (-1.8 MPa). Irrigation was implemented from when berries reached pea-size up and until harvest over four consecutive growing seasons (2019/2020–2022/2023).

Water savings of 41% and 57% were achieved in Treatments 2 and 3, respectively, compared to Treatment 1. The only consistently significant ($p < 0.05$) vegetative difference was total leaf area per vine, which was highest in Treatment 1. Reproductive parameters showed that mean berry mass was significantly higher in Treatment 1 than in Treatment 3, while bunch number per vine did not differ significantly among Treatments. Yield (ton/ha) followed the same trend as bunch number, with Treatment 1 producing on average 3.3 ton/ha more than Treatment 2 and 5.8 ton/ha more than Treatment 3. Water use efficiency did not differ significantly over the first three seasons; however, in 2022/2023, Treatment 3 utilised water most effectively.

Overall, Treatment 2 achieved a balance between water savings and wine composition, outperforming the other Treatments in terms of irrigation efficiency and wine quality potential.

Can the incorporation of disinfectants or fungicides to the hot water treatment regime have an improved efficacy against Petri disease pathogens in nursery vines?

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Young vine decline is primarily caused by Petri disease pathogens including *Pleurostoma richardsiae, Phaeoacremonium* spp., and *Phaeomoniella chlamydospora*. *P. richardsiae* is considered heat-tolerant and is not effectively controlled by hot-water treatment (HWT). This study aimed to improve the efficacy of HWT (50°C for 30 min) in grapevine nurseries by adding chemicals (fungicides or disinfectants) to the HWT regime to reduce Petri disease infections. Two semi-commercial field trials were conducted by subjecting grafting material to a fungicide amended HWT bath with or without added chemicals, followed by a cooldown bath (30 min), also with or without additives, prior to grafting. Five and 12 treatments were tested in season 1 and 2, respectively. After 8 months, plant growth parameters and the percentage of certifiable vines were determined. Pathogen incidence and severity were assessed on representative vines. HWT, with or without chemical additives, had no adverse effect on vine growth. The standard HWT protocol remained effective in reducing infection by *Pa. chlamydospora* and *Phaeoacremonium* spp., but the addition of chemicals did not further enhance disease control. In contrast, the incidence and severity of heat-tolerant *P. richardsiae* were not reduced by HWT, regardless of chemical amendment. In some cases, higher infection levels were observed compared to untreated controls. These findings suggest that while HWT effectively suppresses several Petri disease pathogens in propagation material, it may not prevent *P. richardsiae* infection, which could occur later during the grafting process. The suppression of other pathogens by HWT may inadvertently create a favourable niche for *P. richardsiae* establishment.

Non-destructive Evaluation of Grape Quality: Insights from VNIR Spectroscopy and Chemometric Modelling

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Accurate and non-destructive monitoring of grape chemical maturity or quality indicators, such as total soluble solids (TSS), total acidity (TA), pH and berry pigments, is essential for optimizing grape cultivation, harvest decisions and improving grape quality. Traditional methods, while effective, are often time-consuming, destructive, and impractical for large-scale or real-time field use. Visible–Near Infrared Spectroscopy (VNIRS) has emerged as a promising alternative, offering rapid, non-invasive analysis of fruit quality. However, conventional high-end benchtop VNIR spectrometers are expensive, bulky, and confined to laboratory settings, limiting their accessibility and practical utility in dynamic vineyard environments. This study explores the feasibility and performance of low-cost handheld VNIR spectrometers for non-destructive grape quality assessment in comparison to laboratory-grade instruments at a berry and bunch level. Using multiple devices, we evaluated their ability to predict key quality parameters, across heterogeneous vineyard blocks influenced by environmental and physiological variation. The analysis involved comparing instrument accuracy, portability, usability, and predictive power using chemometric models and validation protocols. Our findings demonstrate that while benchtop VNIRS devices maintain high precision, modern handheld spectrometers have significantly closed the performance gap, offering comparable accuracy under lab and trial-field conditions. These devices can potentially enable efficient in-situ monitoring of grape quality, paving the way for site-specific harvest strategies and enhanced decision-making in viticulture. Moreover, the growing integration of low-cost VNIR tools supports the democratization of precision agriculture, especially under the increasing challenges posed by climate variability. This work contributes to the broader understanding of practical VNIR applications, highlighting lessons learned from traditional VNIR spectroscopy while charting a path toward scalable, field-ready solutions for sustainable vineyard management.

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Communicating wine style to consumers crossing language and culture barriers: aroma wheels and style indicators

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Aroma wheels, tasting notes, style indicators and wine and food pairing suggestions are intended to describe the intrinsic properties of wine. These phrases and graphical representations are used to assist consumers with purchase decisions. Currently, these descriptions mainly exist in English. Increasing the relatability and the perception of inclusiveness, creating brand and product ambassadors from a language/cultural perspective could have a positive effect on marketing of wine. A few approaches could be followed to create visual aids such as aroma wheels and style indicators. Direct translation has been shown to be ineffective since cultural aspects are lost. When aroma and flavour is perceived, the person tasting refers to smells and tastes already familiar to them. If the aroma wheel or style indicator refers to unfamiliar smells and tastes the consumer will not be able to understand or relate to the product before consuming it, irrespective of the language used.

Wine is a complex product, and large variation exists between different individuals' perception and verbalisation of aroma and flavour. To establish a "relatable" language or lexicon to communicate wine aroma and flavour, a large number of descriptors (data) is needed. Processing an acquiring these descriptors can be tedious and time consuming, consolidating these terms even more so. In the current digital era electronic, web based and AI tools emerge fast. Investigating the suitability of these tools could create a platform for the development of an optimised and continuously updating roll-out of marketing tools, including aroma and flavour wheels.

Commercial South African Chenin blanc wines profile and its distinctiveness

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Wine profiling is essential for understanding cultivar characteristics, defining wine quality, and linking aroma typicality to geographical origin, viticultural practices, and winemaking techniques. Chenin blanc is known for its adaptability and resilience to a range of growing conditions, as well as diverse viticultural and wine-making practices. This research aims to define some of the sensory and chemical key markers for the typicality and perceived quality of commercial South African Chenin blanc wines. The project forms part of a larger, multidisciplinary project titled Premiumisation and value growth of South African Chenin blancs.

The study sourced 61 non-sparkling dry commercial South African Chenin blanc wines from recent vintages, different geographical regions and wine production styles. Wine sensory evaluation was done by free description by a panel of Chenin blanc wine (industry) experts, with typicality measured on an unstructured 10 cm linear scale. In addition, quality tier ranking and overall quality scoring based on appearance, nose and pallet was included in this analysis. Chemical analyses of the aroma compounds in a subset of the wines were performed using different gas- and liquid-chromatography techniques. Multivariate data analysis showed relationships between the wine production practices and their sensory and chemical aroma attributes linked to quality and typicality. These results can contribute to a comprehensive understanding of South African Chenin blanc's aroma characteristics.

The reduction of protein haze in Sauvignon Blanc by Saccharomyces cerevisiae high chitin strains

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Cloudy or hazy white wines are undesirable to wine consumers, and wineries spend significant financial and logistical resources on haze removal and prevention strategies. The most common cause of haze is protein aggregation, and the most commonly used preventative strategy is bentonite fining. However, bentonite fining is expensive, and disposal of bentonite waste can be harmful to the environment. This practice may also impact the aromatic profile of the wine. Protein haze occurs due to complex aggregation processes primarily between grape derived pathogenesis-related proteins. These proteins are very stable and survive the wine making process, but may over time become unstable and denature, especially when storage conditions are not optimal. Chitinases have been identified as primary contributors to haze formation, and previous work has shown that grape chitinases bind efficiently to yeast cell walls, suggesting a possible strategy for the specific removal of these proteins from wine. Here, we show that live yeast strains derived from the commercial yeast strain Vin13 and selected for a high concentration of cell wall chitin can effectively remove chitinases from wine during fermentation, and that this removal results in significantly reduced wine haze formation. Wines produced by these strains also required significantly less bentonite to achieve protein stability when compared to wines produced by the parental Vin13 strain or by natural yeast when spontaneously fermented. This strategy of reducing haze formation potential can contribute towards the development of an environmentally sustainable strategy for haze reduction in white wines.

Investigating the relationships between wine sensory attributes and climatic parameters of single vineyard blocks

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This research project aimed to assess the influence that climatic parameters have on sensory properties and wine style of single vineyard wines by using a multivariate statistical approach. With increasing climate change, understanding its influence on wine style is crucial. Single vineyard wines produced from grapes originating from different regions and climatic zones were selected. Vineyard location was used to obtain climatic data from digital scientifically built models and platforms including TerraClim. Wine sensory properties were determined by industry experts, mainly winemakers, through formal sensory evaluation applying the Rate-All-That-Apply method. The relationships between climatic and sensory data were investigated by means of multivariate statistical methods and data science techniques to relate climatic and sensory data from single cultivar single vineyard wines.

Climate-related sensory trends providing insights into regional typicity could be observed. These findings can assist viticulturists and winemakers wanting to produce a certain style of wine with the changing climatic conditions allowing insight in which climatic conditions result in specific wine sensory parameters.

The changing landscape of South Africa wine grape age distribution

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The sustainability and productivity of the wine industry depend on the preservation of a healthy core of young vines. However, in South Africa, vineyard age distribution has undergone a significant transformation over the past decade. The early 2000s red wine boom drove rapid vineyard expansion, peaking at 102,146 hectares in 2006, but the 2007-2008 global recession abruptly halted further growth. Since then, vineyard establishment and vine replacement have declined, with the total vineyard area shrinking to 87,848 hectares by 2024. While projections suggest potential stabilization at approximately 80,000 hectares, uncertainty persists. Older vines, many exceeding the traditional 20-year replacement threshold, are increasingly responsible for sustaining production within a competitive global market.

An analysis of Stellenbosch and Breedekloof reveals alignment with national trends. From 2015 to 2022, the proportion of red wine vines older than 20 years doubled, yet yield levels remained relatively stable. In Stellenbosch, yield averages declined by only 5.8%, despite a substantial rise in older vines and decrease in hectares. Similarly, Breedekloof recorded slight vineyard hectare growth, with stable or increased yields across most cultivars even though the average age of vines over 20 years increased to 26%, contradicting conventional expectations. These trends challenge the long-standing industry belief that vine productivity declines sharply beyond 20 years.

Emerging research suggests that improved viticultural techniques, disease management strategies, and economic incentives contribute to enhanced vine longevity. A reassessment of the industry's definition of older vines and economic lifecycle of vineyards is necessary to optimize vineyard management, ensuring long-term sustainability while maintaining South Africa's wine industry.

Purchasing premium wine online: Exploring consumer intention in the digital era

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An online shop serves as a virtual platform for retailers to provide product information and conduct sales through online channels, becoming increasingly popular and now integral to many consumers' daily routines. The technology acceptance model is a concise and robust structural framework for investigating technology acceptance by consumers in various contexts. This research aims to understand why South African consumers choose online channels when purchasing premium wine. The study examines factors known to influence online wine consumer purchasing attitudes and intentions. Specifically, this study investigates perceived usefulness, perceived ease of use, social influence, knowledge about wine, and online purchasing experience and their effects on the online purchase of premium wine.

To measure the relationship between the variables a self-administered online questionnaire was designed. The questionnaire was distributed via Facebook and LinkedIn using judgement sampling, specifically targeting South African premium online wine consumers. Using the structural equation model, a total of 109 responses were analysed. The results showed that when consumers perceive the process of purchasing premium wine online as being easy (perceived ease of use), they most likely feel and believe that using this channel increases its perceived usefulness. The findings also suggest that if consumers have a positive attitude towards using online channels to purchase premium wine, they could have a strong intention to engage in online purchases. The consumers in this study were not, however, influenced by reference groups when deciding whether to purchase premium wine online. Furthermore, the results showed that consumers with sufficient knowledge about premium wine and a favourable online purchasing experience will most likely have an increased perceived ease of use when using the online purchasing channel.

The research results enabled the development a simplified technology acceptance model for premium wine e-commerce, highlighting the interconnected relationships among knowledge about wine, online purchasing experience, perceived ease of use, perceived usefulness, attitude towards use, and intention to purchase premium wine online. The findings from this research provide some practical implications that could be used when developing future online marketing strategies to increase online wine sales.

Studying the effect of wine type, temperature and carbon dioxide on the volumetric mass transfer coefficient (K_La) during nitrogen-induced oxygen removal in wine

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Oxygen management is critical in winemaking to prevent oxidation and preserve wine quality. Nitrogen (N_2) sparging is widely used for oxygen removal, but its efficiency depends on multiple factors affecting gas-liquid mass transfer. This study aimed to evaluate the effect of wine type, temperature, and dissolved carbon dioxide (CO_2) on the volumetric mass transfer coefficient (K_La) and determine optimal conditions for improving oxygen removal efficiency. Experiments were conducted in a 15 cm inner diameter, 90 cm high bubble column, using red, white, and rosé wines at 5°C, 10°C, and 20°C. A 14 cm diameter, 20 mm thick stone sparger (40 µm pore size) delivered N_2 at 1 L/min, while dissolved oxygen was monitored using a NomaSense optical probe positioned 5 cm below the liquid surface and 5 cm from the column wall.

This study confirmed that K_La increased with temperature across all wine types due to reduced viscosity and enhanced bubble dynamics. Surprisingly, despite red wine's higher tannin and phenolic content, it exhibited the highest K_La, followed by white wine and rosé. Based on compositional differences, it was anticipated that white wine would show the highest K_La, followed by rosé and red wine. Increased dissolved CO_2 reduced K_La, suggesting an influence on bubble coalescence and stability. Although N_2 sparging effectively removes oxygen, these results highlight the importance of optimizing process parameters for different wine styles. Wineries should consider temperature and CO_2 content when designing degassing strategies to maximize oxygen removal efficiency.

Evolving Sensory Profiles: A Comparative Study of Spontaneous and Inoculated Fermentations in Chenin Blanc and Merlot

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Winemakers continually innovate to create wines that meet and exceed consumer expectations. This innovation includes the re-adoption of using indigenous microflora, due to their metabolic diversity, to drive fermentation instead of inoculation with *Saccharomyces cerevisiae*.

Using a sensory-driven approach, this study compares spontaneously fermented and inoculated Chenin blanc (CB) and Merlot (M) from distinct geographical regions (Stellenbosch (M and CB), Darling (M), and Philadelphia (CB), South Africa). Utilising a projective mapping sensory task, the aim was to investigate the panels' ability to differentiate between spontaneously fermented and inoculated wines over time. Additionally, panellists described each wine and rated the aroma intensity.

One year after bottling, the trained panel struggled to distinguish between inoculated and spontaneous fermentations in Chenin blanc wines. However, they could often distinguish between the inoculation treatments in the Merlot wines. By the third year, the panellists were able to distinguish between the two inoculation conditions in both Chenin blanc and Merlot wines. This suggests that the treatment effect may not be perceptible in Chenin blanc after just one year.

This supports anecdotal evidence suggesting that the sensory differences between spontaneously fermented and inoculated wines become more pronounced as the wines age. This temporal progression in sensory differentiation underscores the potential for spontaneous fermentation to impart unique and identifiable characteristics to Chenin blanc wines, which may only emerge distinctly with time.

Nutrient Deficiencies Resembling Disease: Inducing and Differentiating Leafroll-Like Symptoms

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In-field disease diagnosis using smartphones will offer grape growers a practical and cost-effective tool to detect GLRaV-3. Among the most significant grapevine pathogens in South Africa is *Grapevine leafroll-associated virus 3* (GLRaV-3), the primary agent of Grapevine Leafroll Disease (GLD). This study aimed to compile an image database of nutrient deficiencies and other diseases that can easily be confused with grapevine leafroll symptoms. Field images of vines displaying symptoms of phosphorus and magnesium deficiencies were collected in the 2024 season in the Western Cape wine regions, including Stellenbosch, Paarl and Franschhoek. Both nutrient and viral infection statuses of vines sampled were confirmed through laboratory analysis. Additionally, controlled experiments inducing potassium and phosphate deficiencies were conducted on ten wine grape cultivars grown in pots, and symptomatic leaves were photographed. Field images of vines affected by Aster Yellows and Esca were also included. A total of 2,627 high-quality images were captured across 18 wine grape cultivars. More often red cultivars were identified in the field with nutrient disorders than white cultivars. Twenty-eight vineyards had magnesium deficiency and two vineyards phosphorus deficiency. In the nutrient deficiency pot trial leaf symptoms were only observed for the cultivars Cabernet Franc, Chenin blanc, Merlot and Pinotage and Shiraz. The resulting image dataset enhances existing resources for training AI models to accurately identify leafroll-infected vines. This work contributes to broader disease management strategies aimed at reducing the impact of Grapevine Leafroll Disease on the wine industry.

Application of Yeast Cell Walls to Combat Protein Haze in White Wine

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Protein haze formation in white wine compromises both its visual clarity and commercial appeal, as turbidity is generally deemed undesirable by consumers. The formation of protein haze is primarily attributed to grape-derived pathogenesis-related (PR) proteins. Chitinases, which exhibit lower thermal stability than other PR proteins and irreversibly denature at suboptimal temperatures are considered as the primary cause of haze formation. Chitin is a major component of *Saccharomyces cerevisiae* cell walls, and grape chitinases have been shown to bind to *S. cerevisiae* cell wall chitin.

In this study, the impact of the application of yeast cell walls or hulls on protein haze formation was evaluated. For this purpose, several mutants of the wine yeast VIN 13 with high cell wall chitin concentrations were developed through chemical mutagenesis. Chitin content was quantified with Calcofluor White staining and subsequent flow cytometric analysis. Yeast hulls were produced from selected mutants. These chitin-rich hulls were applied in 5 L Sauvignon Blanc fermentations at a standard industry dosage of 30 g/hL, both at the onset and completion of alcoholic fermentation.

All treatments involving hull additions demonstrated reduced haze formation compared to untreated controls. Among the mutants, strain HCS 6 exhibited the greatest efficacy, yielding a protein-stable wine without the use of bentonite.

These findings support the application of high-chitin yeast hulls as a sustainable and environmentally friendly fining alternative, offering a promising strategy to mitigate protein haze in white wine while reducing dependency on traditional fining agents such as bentonite.

Enhancing mouthfeel aspects of de-alcoholised wines

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The removal of ethanol from wine substantially alters its sensory profile, leading to reduced body, mouthfeel, and balance. To address these challenges, this study investigated the impact of various additive combinations on the sensory properties of de-alcoholised wines. Sugar, tannins, glycerol, arabic gum, and mannoproteins were selected based on their potential to enhance mouthfeel, sweetness perception, and overall balance, with particular emphasis on additives permitted in South Africa. A full factorial experimental design was employed to assess their individual and interactive effects, aiming to identify optimal formulations that improve body and balance. Sensory evaluations with industry experts provided a comprehensive understanding of the impact of these additives on the mouthfeel of de-alcoholised wine. Results showed that certain additive combinations produced a more integrated effect than single additives, improving viscosity and reducing bitterness without compromising varietal typicity. However, responses were highly dependent on both additive ratios and wine matrix, suggesting that optimal formulations must be tailored to specific wine styles. These findings highlight the potential of additive strategies to enhance the market competitiveness of de-alcoholised wines and provide a framework for evidence-based recommendations in regulatory and industry contexts.

Lachancea thermotolerans: Shaping the future of fruit-forward and balanced wines

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Fruitier wines are increasingly sought after by consumers, and yeasts contribute significantly through their production of fermentation aroma compounds such as esters and the release of varietal aromas such as terpenes. Some may influence the overall flavour balance by improving wine acidity, a valuable trait amidst global warming, which tends to result in grape juices lacking acidity. Indeed, literature reports that the yeast *Lachancea thermotolerans* may impart fruity flavours while enhancing acidity through lactic acid production, but strain diversity is significant. In this study, 20 strains of the genus *Lachancea* from the South African Grape and Wine Research Institute's yeast collection were screened for their ability to produce wines with distinct organoleptic profiles matching current consumer demand. Microsatellite typing and SAU-PCR revealed significant genetic diversity, with strains grouping into nine clusters. Fermentations in flash-pasteurised Chenin blanc also showed variability closely associated with the genetic clusters, not only in fermentation kinetics but also in primary and secondary metabolite production. Notably, five strains produced lactic acid, two at excessively high levels (ca. 9 g/L), significantly reducing pH. Interestingly, all strains yielded less ethanol and more succinic acid than *Saccharomyces cerevisiae*, and several strains consumed over 50% of the initial malic acid. Secondary metabolite analysis identified high levels of fruity esters, terpenes, and for the first time aldehydes in some strains, with the potential to enhance wine fruitiness. Overall, these findings highlight the potential of *Lachancea* species to produce wines with desired consumer sensory characteristics, including fruity aromas, organoleptic balance and lower alcohol.

Exploring the understanding of the terminology used to describe taste and mouthfeel perception: A case study on South African Pinotage

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The aroma, taste and mouthfeel perception of wine drives the intrinsic sensory acceptability of the product, in other words, how much consumers will “like” the product. Verbalising aroma, taste and mouthfeel perceptions can be taxing and subjective, but necessary to create comprehensive sensory profiles. Tools such as aroma wheels and cultivar aroma-terms lists are often used to communicate with consumers. In addition, a mouthfeel wheel was developed by Gawel and co-workers to simplify and provide guidance during the process of mouthfeel description.

A case study was conducted on South African Pinotage wine to explore which of the terms on the Pinotage aroma wheel and mouthfeel wheel are used during wine description. The terms used and understood by a trained panel and consumers before and after a training session were studied and compared to the terms on the Pinotage aroma wheel and the mouthfeel wheel created by Gawel and co-workers. The wines were evaluated by 30 trained panellists and 30 consumers using the Rate-All-That-Apply method (RATA). The RATA lists consisted of the terms on the sensory wheels. The correlation between the most frequently used aroma and mouthfeel descriptors and quality and liking perception was determined. Univariate and multivariate statistical analyses including Chi-square, Cochran’s Q tests, Correspondence Analysis (CA) and penalty lift analyses were conducted.

Both trained panellists and consumers used fewer terms than the number of terms on the mouthfeel wheel even after the training session. This was however not the case for aroma description.

An alternative to carbocation of sparkling wine

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Sparkling wine is typically produced by carbonating wine, which involves saturating it with carbon dioxide. There is limited research on using other gases to create sparkling wines from full strength wines or dealcolized wines with unique sensory properties. This concept has successfully been explored in the beer industry and has been found to create smaller bubbles, which is often desirable in sparkling wine.

This project aimed to produce a variety of sparkling wines (full strength and dealcoholized) by saturating them with carbon dioxide, argon, and/or nitrogen, using different ratios of these gases to create multiple combinations. Additionally, we investigated the effect of wine temperature and the total pressure in the tank. The process involved sparging wine under high-pressure conditions using a custom-made tank/keg; alongside this, a traditional method of secondary bottle fermentation was used for comparison.

To assess the effect of these treatments on bubble characteristics, high-speed photography and a custom code were used to count bubbles, determine bubble size, measure mousse size, and track weight loss over 20 minutes. A sensory panel was also used for sensory evaluation of the sparkling wines, with a focus on the differences in mouthfeel between samples.

Aroma compounds in de-alcolized wines and their sensory effects

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South Africa's emerging de-alcoholised wine sector faces evident aroma and quality gaps relative to full-strength wines. This work addresses three questions: (i) How do South African (SA) de-alcoholised wines compare with international counterparts in volatile composition and aroma attributes? (ii) To what extent does the quality of the full-strength base wine affect the quality of the de-alcoholised product? (iii) Are key volatiles/aromas lost during the spinning cone column (SCC)?

We combined targeted chemical analyses of a wide range of volatiles with sensory evaluation of 18 SA wines and 22 international wines over four wine styles: white, rosé, red and sparkling. Sensory evaluations compared SA with well-known international de-alcoholised wines in terms of their sensorial composition and quality scores. Volatile and sensorial analyses of SCC fractions recombined in their original proportions were also compared with the original full strength base wines to ascertain possible losses due to the dealcoholisation process.

Differences were observed between the SA and International wines' aroma descriptors. International wines were more closely associated with sweet notes such as raisin, passion fruit, and honey, whereas SA wines leaned toward fresher descriptors like citrus and apple.

Preliminary findings suggest that the quality of the initial full-strength base wine affects the quality of the de-alcoholised product. A measurable reduction in olfactory impact in de-alcoholised wines, even after essence addition, relative to their full-strength counterparts, was also seen and show that the aromatic intensity and quality of the base wine is an important driver of de-alcoholised wine quality. However, results also indicate in general that dealcoholisation with the SCC led to rather small sensory changes when the different fractions were recombined.

Developing wine aroma descriptors in an African language/cultural context to create multicultural consumer education tools

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This project investigated the effectiveness of the development of a sensory lexicon in African languages to improve understanding, inclusivity and consumer liking/ preference of wine in general.

A free description/free listing approach was followed, where participants developed their own terms using reference standards such as food and household products. A first step similar to the language development stage of descriptive sensory analysis was followed. Participants provided the terms in both English and their native language in order to limit the analyst bias when comparing results from different language groups. Three different Generation Z consumer panels were trained, an Afrikaans/English, Xhosa/Zulu and Sotho/Tswana/Pedi panel, each consisting of 10 participants. Panellists joined six one-hour sessions, once a week for six weeks. Four one-hour sessions, where blind tastings were conducted, were used to capture data. In those sessions, both white and red wines, from different cultivars, produced in South Africa were described. Qualitative data visualisation strategies as well as statistical analyses were conducted on the descriptor data and the experiences of the panellists. The data was analysed using univariate and multivariate statistics. One of the data sets was integrated with a consumer liking data set from a previous study to create a preference map where both the consumer liking and sensory descriptions originated from tasters from the same cultural context and language.

Developing a wood ageing protocol to mimic a barrel in experimental winemaking

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Aging wine with oak barrels is a widely used method in winemaking. It enhances the wines properties and adds value to the wine, making it a high quality product. Due to interest in oak products in general, there has been an increased interest in alternative oak products (chips and staves) which produces an economically feasible and sustainable alternative to traditional barrels.

This study aims to assess the effectiveness of oak staves as an alternative aging method for Chenin blanc wine by applying different dosage levels corresponding to 20%, 40%, and 100% of a barrel's surface area. The objective is to establish a standardized wood aging protocol for experimental cellars to replicate barrel aging conditions as accurately as possible.

The oak staves and barrels used in this study were sourced from the same cooperage to ensure consistency in wood quality and manufacturing standards. Both underwent identical medium toasting treatments to eliminate variability in thermal modification. The staves were composed of the same oak quality as the barrels, ensuring comparable extraction of volatile compounds during the aging process.

To evaluate the sensory impact of stave treatments, a different oak stave additions were compared to that of the same Chenin blanc wine matured in a new oak barrel. Sensory analyses were conducted with a trained panel at three different time intervals. The sensory data will be used to determine differences or similarities between the treatments, facilitating the identification of the optimal stave dosage for experimental cellars to mimic an oak barrel.

WINEPLUS: A Data-Driven Approach to Precision Fermentation

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The wine industry faces significant challenges arising from traditional, labour-intensive methods of monitoring fermentation. These manual practices are prone to human error, time-consuming and ultimately lack predictive analysis capabilities. This forces winemakers to make costly and reactive adjustments, resulting in substantial wine losses and inconsistent product quality. A particularly critical problem is the occurrence of stuck fermentation, which can increase to a staggering 20% in adverse years, leading to significant waste and a significant decrease in the overall quality of the wine. The absence of real-time information and proactive control mechanisms increases these issues even further, contributing to higher operating costs and a negative environmental impact.

WINEPLUS offers an innovative and comprehensive solution, seamlessly integrating advanced algorithms and state-of-the-art IoT technology for remote, real-time monitoring. This integrated system, developed by WINEGRID, uses precision technology to continuously monitor key fermentation parameters, including density, temperature and liquid level. The data collected is transmitted via LoRa protocol to a cloud-based system for in-depth analysis. The processed information is then displayed on the intuitive Dashboard, a digital platform that empowers winemakers with predictive analysis capabilities and facilitates real-time adjustments to winemaking conditions. By effectively eliminating human error and enabling significant time savings, WINEPLUS enables a decisive shift from reactive to proactive management. In addition, it improves traceability by providing a comprehensive record of fermentation data. This data-driven approach minimizes wine losses, reduces operating costs and mitigates the environmental impacts associated with waste, ultimately enabling wine producers to achieve consistent quality and efficiency.

Optimising Yeast Nutrition Strategies to Enhance the Premiumisation of South African Chenin blanc Wines

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With more than 18% of all vineyard plantings in the country and a major contributor to the domestic and international wine markets, South African Chenin blanc has great cultural and economic significance. As global demand shifts toward premium products and there being an increase in tax duties, improving wine quality through precise fermentation interventions offers a strategic path to economic benefit. This study investigates the impact of yeast nutrition strategies on fermentation performance, aromatic complexity, and wine quality in Chenin blanc, with the broader aim of informing practices that support premiumisation and economic value retention within the industry.

Two commercial yeast strains—VIN 13 and Exotics Novello—were inoculated into Chenin blanc musts from 6 trellis systems, supplemented with a targeted commercial nutrient formulation designed for this cultivar. (Lallemand, Stimula Chenin Blanc). Fermentations were monitored for kinetics and yeast population dynamics. Analysis includes standard juice and wine parameters, HPLC for sugars, organic acids and amino acids, GC-FID for volatile compounds. Sensory evaluation to follow in the second season.

Fermentation kinetics varied by yeast and trellis system. Exotics Novello showed shorter lag phases but slower completion, while VIN 13 had longer lag phases and faster finishes. Bush and posted vine fermentations completed most rapidly across treatments, suggesting trellis design may influence fermentation efficiency through differences in juice composition or nutrient availability.

This research supports a science-driven approach to enhancing South African Chenin blanc profitability by correlating specific fermentation interventions to wine quality and marketability, supporting value-driven, premium productions.

Training Detection Dogs to Identify 2,4,6-Trichloroanisole (TCA) in Wine Environments: A Preliminary Investigation

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Cork taint, primarily caused by the formation of 2,4,6-Trichloroanisole (TCA), poses a persistent quality assurance challenge in the wine industry. Even at concentrations in the low ng/L litre range, TCA can impart musty and mouldy aromas, suppressing desirable aromas and lead to consumer rejection. Given the compound's low detection threshold and the limitations of current quality control methods, alternative detection approaches should be explored. This study aimed to develop and evaluate a scientifically validated training protocol for the use of detection dogs in identifying the source of TCA contamination in wine environments. Dogs possess a highly developed olfactory system that has resulted in a canine's capacity for odour detection to be as much as 10,000–100,000 times that of the average human. Coupled with their ability to learn through operant conditioning, dogs' ability to discriminate between chemically similar molecules makes them valuable biosensors for compounds like TCA. Preliminary training was carried out with two pet dogs in collaboration with a qualified search and rescue dog trainer over a six-week period. Training focused on odour imprinting and foundational search tasks. Subsequent phases included more advanced search exercises and evaluation of detection accuracy, specificity, sensitivity, and reliability in both controlled and practical settings. Findings from this research informed the feasibility of implementing trained detection dogs as a supplementary quality assurance measure in the wine industry.

Unveiling the potential of wine yeasts as lipid supplements

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Climate change brings about various challenges to the wine industry, including higher sugar content, lower acidity, and imbalances in yeast nutrients. Winemaking practices such as low fermentation temperature fermentations and excessive clarification of white grape to produce fruitier wines in response to consumer demand may create conditions leading to sluggish or stuck fermentations. The latter conditions are typically overcome by the yeast *Saccharomyces cerevisiae* by altering its membrane composition in fatty acids and ergosterol. Nevertheless, in the absence of oxygen, the yeast cannot produce the necessary lipids and therefore relies on those occurring in grape must. In this work, a wide selection of non-*Saccharomyces* yeasts isolated from the broader wine environment was screened for their lipid content, after which six strains were selected based on the amount of lipids produced and diversity of lipid composition. Inactivated dry yeasts were produced from these yeasts and tested as lipid supplements in over-clarified Chenin blanc juice. The addition of the inactivated yeasts enhanced fermentation performance compared to the reintroduction of fine lees and no addition. Furthermore, experiments with the addition of pure analytical standard lipids in the same concentrations yielded similar results, correlating the change in fermentation kinetics to lipid addition. Overall, the data showed that the wine yeast microbiota may serve as a sustainable source of nutrients to improve fermentation under challenging environmental conditions and paves the way for further research on the availability and utilisation of lipids for wine yeasts.

Critical analyses for monitoring authenticity - investigating ATR-FT-IR as a tool for the authentication of South African wines

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Food safety remains a global concern due to the frequent adulteration of consumable products. Among these, wine is one of the most commonly adulterated beverages, prompting significant industry focus on wine authenticity. The European Union (EU) and other countries have extensively studied wine authentication and developed authenticity databases. However, these databases lack adequate representation of South African wines, which could potentially lead to export complications regarding authenticity verification.

Wine authentication typically relies on advanced chemical analytical methods approved by the International Organization of Vine and Wine (OIV), which can be expensive and inaccessible for widespread use in many countries. Therefore, this research aims to identify a cost-effective chemical analytical screening method suitable for authenticating South African wines.

The proposed method to be investigated is Attenuated Total Reflectance Fourier Transform Infrared Spectroscopy (ATR-FT-IR). Intentionally adulterated red wines (through dilution and chaptalization) will be analyzed using ATR-FT-IR to determine detection thresholds. Additionally, microvinified wines from various South African wine-producing regions and terroirs will undergo comparative chemical analysis against commercial counterparts using the ALPHA II FT-IR ATR Wine Analyzer. This will assess potential adulteration at a commercial level.

The resulting spectral and quantifiable data will help identify chemical similarities and differences among samples. Patterns related to geographical origin, grape varietals, and vintage will be explored. Chemometric techniques will then be applied to the data to develop models for effective, cost-efficient authentication of South African wines.

Zygosaccharomyces: is there a crisis looming in low alcohol wines?

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The introduction of low- and no-alcohol wine has struck the consumer market with unprecedented potential for growth. The popularity of these products has led to a drastic increase in their production which has unveiled a looming threat. Due to the lack of ethanol as a preserving agent, coupled with the stepwise production of these products, the low-/no-alcohol wine industry has reported multiple cases of refermentation in their finished products which threatens the prosperity of the industry. This study aims to identify the causative yeast responsible for refermentation of low- and no-alcohol wine, as well as identify potential chemical and/or physical interventions that can be used as preventative measures. Industry surveys have shown that the low- and no-alcohol wine industry have identified *Zygosaccharomyces bailii* in their refermenting products. Selective media have been utilized for the isolation of *Z. bailii* from refermenting products with high selectivity. The yeasts isolated from refermenting products have been identified as *Saccharomyces cerevisiae* and *Zygosaccharomyces bailii*. These isolates have been tested for resistance with dimethyl decarbonate (DMDC), SO_2, chitosan, sorbic acid and pimaricin at varying ethanol concentrations. At zero percent alcohol the antimicrobial action of natamycin and DMDC are strong. Trends in increasing efficacy of SO_2, sorbic acid and chitosan have been observed with an increase in ethanol concentration with little to no inhibition at zero percent ethanol. These results will inform the preservation strategy(ies) going forward to ensure there is no crisis looming.

Evaluating the effectiveness of fractional distillation and stable $\delta^{13}C$ Isotope Ratio Mass Spectrometry (IRMS) as tool for the geographical and botanical authentication of South African wines

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Wine is not just a beverage; it is a reflection of its origin and terroir. The authenticity of wine is an important topic, particularly in a market where counterfeit products can undermine consumer trust.

Various chemical markers can be used to evaluate the quality and authenticity of wine, however in this study our aim is to quantify stable isotope ratios, targeting $^{13}C/^{12}C$ by means of Fractional distillation and IRMS. Carbon Isotope Ratio Mass Spectrometry ($\delta^{13}C$-IRMS) is one of the official methods adopted by the European Union (EU) and by the International Organisation of Vine and Wine (OIV) to detect the addition of foreign sugar to grape products (botanical origin) and geographical origin. Five hundred wine samples, consisting of 50% microvinified and 50% commercial wines, will be collected from different wine regions in the country. Various cultivars ranging over a period of 3 vintage years will aid in constructing an analytical library to be used for future reference in wine authentication.

IRMS analysis can be costly when outsourcing to laboratories abroad, and therefore this project also aims to set up this method locally to provide the service timeously, accurately and reproducibly. Sample preparation plays a crucial part in the analysis; hence method optimisation will form a big part of the objectives of the study.

The analytical data will be evaluated to prove the effectiveness of fractional distillation and stable $\delta^{13}C$-IRMS analysis as tool for the geographical and botanical authentication of South African wines.

Evaluating the impacts of different trellis systems and yeast strains on fermentation kinetics and wine quality impact factors of Chenin blanc

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This study focuses on Chenin blanc, a highly adaptable and economically important white wine cultivar in South Africa. This study forms part of a multidisciplinary research programme ultimately aimed to elevate the premium quality and market value of South African Chenin blanc wines. This study used grapes from a model vineyard at Welgevallen experimental farm, Stellenbosch, where Chenin blanc has been trained on 19 different grapevine trellising systems. These diverse trellising systems have been shown to deliver variation in berry and juice characteristics that could be useful to evaluate winemaking strategies for Chenin blanc wine production, particularly with regards to wine yeast dynamics and fermentation performance. In the 2023/2024 season, wines were made from all 19 different trellis systems, using a single yeast strain (*Saccharomyces cerevisiae* VIN 13) and only a non-complex nutrient (Diammonium phosphate - DAP) addition in a standardised white winemaking protocol. Juice chemical analysis confirmed significant differences in pH and particularly Yeast Assimilable Nitrogen (YAN) levels between the different trellis systems, with the latter correlating to the fermentation rates observed. Chemical profiles of the resulting wines varied in major volatiles, and organic acid and sugar profiles, confirming that the trellis systems impacted on the fermentation outcomes in the wines. In the 2024/2025 season, the information from all the workstreams of the bigger programme was used to select six of the trellis systems (2K2T, Lyre, High Wire Perold, 7-Strand Double Lengthened, Posted vines, Bush vines) to make wines, now also contrasting two yeast strains—Anchor VIN 13 (low nutrient requirement) and Anchor Exotics Novello (Moderate Nutrient requirement)—together with DAP as a nutrient supplement. The fermentation kinetics revealed significant differences in fermentation speeds of the same juices for the two yeast species, as well as from the juices obtained from the different trellis systems. VIN 13 consistently outperformed Exotics Novello in fermentation speed across all trellising systems; the fastest fermentations were in juices obtained from the Posted vines and Bush vines, whereas the slowest fermentations were observed in the 2K2T system. Comprehensive wine chemical and sensory analysis are underway to contextualise the combined impacts of the trellis system and yeast strain/fermentation kinetics on quality impact factors in the Chenin blanc wines.

Do Wine and Food Pairing Rules Still Rule? Food for Thought, Wine for Debate: The Relevance of Pairing Rules Today

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"The perfect marriage of food and wine is often viewed as the quintessential vinous experience. Wine becomes a liquid salve for the soul" (Jackson, 2009). This statement captures the allure of wine–food pairings and the influence such combinations have on consumers' sensory and emotional experiences. Although traditional pairing principles have developed over time, limited research has explored whether the preferences of everyday consumers align with these conventions. This study examines consumers' awareness of pairing principles, the extent to which they follow them, and how their preferences correspond with these traditional guidelines.

A two-phase design was employed: a sensory experiment followed by a questionnaire. The experiment assessed the well-known principle that red wines complement red meat dishes and white wines pair best with white meat dishes. Sixty adult participants in Stellenbosch, South Africa, tasted four wines (Chenin Blanc, Sauvignon Blanc, Pinotage and a Red Blend) both on their own and with two local dishes—Bobotie (red meat) and Chicken Pie (white meat)—using a 7-point hedonic scale.

A Linear Mixed-Effects Model (LMM) was used to analyse the data, with wine type, food type and their interaction included as fixed effects, and participant as a random effect. Significant main effects for both wine and food were identified, along with a strong wine × food interaction. Matched pairings—Red Blend with Bobotie and Chenin Blanc with Chicken Pie—received significantly higher ratings than mismatched combinations.

These findings offer empirical support for traditional pairing principles and demonstrate that consumer enjoyment is context-dependent, shaped by the sensory synergy created when wine and food are experienced together.

Metabolic and transcriptomic responses of *Oenococcus oeni* in co-culture fermentations when in direct or indirect contact with *Saccharomyces cerevisiae*

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Co-inoculation fermentations are increasingly utilised in industry, due to the inoculation regime resulting in more fruit-driven wines and shorter total fermentation times. However, limited literature is available that focuses solely on the transcriptomic responses and metabolic outputs of *Oenococcus oeni* when co-inoculated with *Saccharomyces cerevisiae*. The wine environment allows continuous contact between different microbial cells, highlighting the importance of understanding the effects of direct (cell-to-cell) contact between *S. cerevisiae and O.oeni* in wine, rather than only focusing on indirect (metabolic) contact. This study aims to optimise *O. oeni* RNA extraction from the aforementioned co-inoculated fermentations, to allow for analysis of the transcriptomic responses of *O. oeni* when in direct and indirect contact with *S. cerevisiae*. A Percoll density gradient was used to successfully separate and concentrate *O. oeni* cells in direct contact with *S. cerevisiae* to focus on the lactic acid bacteria's transcriptomic response. The 40% gradient (with a density of 1.06 g/ml) has been chosen to work with further for RNA analyses. Indirect contact fermentation will be brought through using an optimised membrane bioreactor system. The transcriptomic analysis will be complemented by metabolomic analyses of the wines, to allow for investigation into the metabolic response of *O. oeni*.

The results will provide valuable insight and a better understanding of how *S. cerevisiae* influences the metabolism and transcriptome of *O. oeni* during co-inoculation fermentations.

Calcium tartrate instability in South African wines

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Calcium tartrate instability is an increasing issue in South African wines, primarily due to elevated levels of calcium, pH, and tartaric acid. This results in the erratic and gradual precipitation of calcium tartrate crystals post-bottling, which adversely affects wine clarity and market appeal. In contrast to potassium bitartrate, calcium tartrate precipitation is largely unaffected by temperature, rendering cold stabilization methods ineffective. This study sought to evaluate potential viticultural risk factors, with a specific emphasis on water stress. For this purpose, a water stress adaptation block was utilized, where various red cultivars were established on different rootstocks and cultivated under either well-irrigated or dryland conditions. Berries were collected at harvest and analyzed using ICP-AES to determine the concentrations of Na, Mg, K, Ca, Mn, and Fe. In addition, the effects of varying juice calcium levels and pH on calcium concentrations during fermentation were evaluated. Juice sourced from grapes from a characterized Chenin blanc vineyard at Stellenbosch University underwent adjustments in pH and calcium content to ascertain calcium evolution during fermentation. The resulting wines were then subjected to calcium tartrate (CaT) stability testing to assess the influence of these factors on CaT instability.

Characterising the microbiome of spontaneously fermented Chenin blanc grape juice from six different trellis systems

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Chenin blanc, South Africa's white flagship varietal, is the country's most widely planted cultivar. As with most cultivars, vine growth is managed by applying different trellising systems, which can alter yield and fruit composition. Furthermore, the alterations in microclimatic conditions may influence the microbial community on grape bunches. Spontaneous fermentations — fermentations without the addition of yeasts — are gaining popularity in the wine industry. However, limited research has been conducted on the microbial communities involved in these fermentations, particularly in Chenin blanc. Few studies have examined how trellising affects the grape microbiome and how these changes would impact wine fermentations. Therefore, this investigation aims to assess the impact of trellising on the microbiome of spontaneously fermented Chenin blanc grape juice. Yeast and bacterial populations in Chenin blanc grape juice from six trellis systems at a single vineyard, Welgevallen Experimental Farm, Stellenbosch, were identified, characterised, and compared. The general viticultural practices in this vineyard were consistent across all trellising systems. The data show that trellising systems significantly impacted the microbial community of grape juice and fermentation kinetics. Chemical analyses of the final wines using HPLC and GC-FID indeed show significant trellis-system dependent variation. Individual species and strains in these juices have been identified and are undergoing oenological characterisation. Lastly, a sensory analysis will be performed on the final wines of the 2026 season. This study will provide novel insights regarding the impact of trellising systems on wine microbial communities and the link between these communities, fermentation outcomes, and wine character. In the long term, such studies will guide viticulturalists to optimise local microbial communities for improved fermentation outcomes.

Determining cross-cultural wine quality drivers: a chemical, sensorial and data fusion approach

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With the ever-changing markets, various food and beverage trends and a country rich in diversity of cultures, finding out and understanding what the South African wine consumer prefers in terms of South African wine styles is not as easy.

Consumer perception of Chenin blanc, as the most planted wine grape variety in South-African, has been studied. However, limited consumer studies have been conducted on other cultivars, especially red wine cultivars. For this study Shiraz and Sauvignon blanc, both cultivars with easily recognizable aromas for the consumers, were chosen. This study investigates the relationship between cross-cultural consumer perception, producers' quality perception and chemosensory profiles of the chosen wines. Chemical analyses of the wines included the quantification of wood phenols, major volatiles, organic acids, malic and lactic acid, thiols, methoxypyrazines, phenolics as well as routine analysis, which included pH, titratable acidity, residual sugar and alcohol. Sensory evaluation of the wines was conducted using expert wine tasters and consumers from different language/cultural groups. Wine producers participated in profiling of wines through free descriptive, trained panellists conducted quality scoring through a 7-point RATA (Rate All That Apply) scale and consumers rated preference. A data fusion approach was used to investigate the correlations between product description, quality, liking and the cultural context of the consumers by using univariate and multivariate techniques. It was clear that the biggest consumer liking differences could be observed between consumers from different genders. In addition, differences between consumers from different language/cultural groups could also be seen.

Results obtained could lead to more consumer centric wine styles and potential positive economic growth.

Evaluating Lactic Acid Bacteria for Volatile Phenol Release in Smoke-Tainted Pinotage Must

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The increased frequency of wildfires near vineyards, partly due to climate change, poses a significant threat to viticulture and wine production. The undesirable sensory characteristics associated with smoke taint results from the liberation of volatile phenols (VPs) from glycosylated precursors during fermentation. Previous research has identified wine lactic acid bacteria (LAB) with high glycosidase activity, but their ability to release free VPs under realistic winemaking conditions remains unclear. This study aimed to identify LAB strains with high glycosidase activity against smoke-derived VPs under winemaking conditions as a primary step towards their elimination via downstream remediation techniques. After screening a large panel of forty-two LAB strains, five strains belonging to different species were selected based on their higher release of free VPs for further investigation. Three inoculation scenarios were then assessed to identify the one yielding the best outcome in terms of free VP release. Additionally, malolactic fermentation performance was also evaluated. Results showed that the release of free VPs in wine was strain-dependent, and that inoculation timing significantly affected fermentation kinetics and the free VP concentrations. Moreover, while some LAB strains resulted in stuck malolactic fermentations, other strains were able to enhance VP release while also completing malolactic fermentation. These findings highlight a promising strategy for mitigating smoke taint in wine. Incorporating selected LAB strains into traditional cellar practices may offer a sustainable approach to maintain wine quality and economic resilience in the face of climate-driven challenges.

Harnessing Non-*Saccharomyces* Yeast to Combat Smoke Taint in Red Wine

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The increased frequency of wildfires due to global warming in winemaking countries, including South Africa, elevates the risk of producing smoke-tainted wines. The off-flavours associated with smoke taint originate from volatile phenols, which are progressively liberated from their glycosylated precursors during winemaking. Current strategies to mitigate the smoke taint in wine are not fully effective because the removal of glycosylated volatile phenols is sub-optimal. One ill-explored avenue could involve utilising wine yeasts with strong extracellular glycosidase activities to liberate free volatile phenols followed by downstream remediation processes, such as charcoal addition. In this work, three non-*Saccharomyces* yeast strains pre-selected for their strong glycosidase activities on volatile phenols were sequentially inoculated alongside a commercial strain of *Saccharomyces cerevisiae* into smoke-exposed Pinotage juice. Wines were further split into two treatments after alcoholic fermentation where addition of activated charcoal vs. no addition was evaluated. The free and bound volatile phenols were quantified at various stages of winemaking, while aroma compounds and wine colour were also analysed to investigate potential effects on wine quality. The study revealed significant differences in the liberation of volatile phenols depending on the yeast strain employed. Subsequent treatment with activated charcoal demonstrated improved efficacy in removing volatile phenols for some yeast combinations. This research demonstrates the potential of yeast application as an improved approach for managing smoke taint, contributing valuable insights to current mitigation strategies in the wine industry.

Beyond Sugar: Yeast Vitamin Requirements in Wine Fermentation

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Yeast growth, fermentation efficiency, and metabolite production are directly affected by the availability of nutrients within grape must. The management of nutrients is therefore an important aspect of winemaking influencing the final wine organoleptic profile. Non-*Saccharomyces* yeasts are also regarded as levers to diversify this profile, but their utilisation may increase nutrient deficiencies within musts. Therefore, it is crucial to understand the specific nutrient requirements of these wine yeast species. For instance, vitamins play a significant role in modulating yeast metabolism. Despite grape musts containing B vitamins, deficiencies may cause sluggish fermentations and the accumulation of undesirable compounds. Although vitamin deficiency has been linked to poor fermentation performance, few studies have focused on the vitamin requirements of oenological yeasts, specifically non-*Saccharomyces* yeasts. This study aimed to assess the B vitamin requirements of various yeast species and strains and monitor vitamin uptake and potential release in simulated oenological conditions to shed light on variances in uptake and vitamin biosynthesis. Overall, the results showed that growth response and fermentation performance varied with the absence, increase or decrease of B vitamins within synthetic must, subsequently affecting the metabolite and aroma profiles. Nevertheless, differences in vitamin requirements were observed. With wine yeast species having varying vitamin requirements at different concentrations, optimising vitamin availability could aid in enhancing non-*Saccharomyces* yeast's survival and contribution to wine and ultimately better respond to consumer demand.