POSTER PRESENTATIONS

THEME I – A Worldwide Perspective on Viticultural Zoning

Phenology and Bioclimate of Wine Grapes in the Tropical Region of the São Francisco Valley, Brazil

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The region of the São Francisco Valley, located at 9°S, has been increasing the production of fine wines during the last years. The region has a tropical semi-arid climate (viticultural climate with intra-annual variability according to the Geoviticultural CCM System : « very hot, with hot nights and an intense to sub-humid dryness » depending on the period of the year in which the grapes are produced). The research aims at characterizing the phenology and bioclimatology of the region's wine grapes. Four cultivars with different levels of precocity were evaluated – Syrah, Cabernet-Sauvignon, Muscat Canelli and Schönburger, grafted on IAC 572, a vineyard in its first productive cycle, using the pergola as training system. The phenological stages bud burst (b) – stage 05, flowering (f) – stage 23 and ripening (r) – stage 35 were evaluated according to the system of Eichhorn & Lorenz. The date of the harvest (h) corresponds to the commercial grape harvest. The duration of the phenological sub-periods b-f, f-r r-h and b-h has been calculated. For each sub-period 19 climatic indices have been calculated – thermic, hydric as well as the solar radiation. The results of the São Francisco Valley have been compared with the same cultivars from a temperate climate region – the Serra Gaúcha (« temperate warm, with temperate nights, humid climate » according to the Geoviticultural CCM System), located 29°S. The results have shown that the duration of the period b-h has been 124, 123, 116 and 104 days for Syrah, Cabernet Sauvignon, Muscat Canelli and Schönburger, while in the Serra Gaúcha the duration has been 158, 160, 160 and 138 days, respectively. As for the bioclimatic characteristics, the mean air temperatures in the São Francisco Valley during the period b-h have varied from 25,4 to 28,1 °C, whereas in the Serra Gaúcha the temperatures have oscillated between 15,8 and 21,8°C. The potential evapotranspiration, even when showing higher mean daily values in the Valley, was similar in both regions during the whole period b-h. The global solar radiation for the period b-h in the São Francisco Valley was lower when compared with the Serra Gaúcha. This result is related especially to the latitude (photoperiod) and the shorter duration of the b-h period under tropical conditions. The study presents the bioclimatic indices by cultivar and sub-period, comparing the region of low with that one of mean latititude. It has been concluded that the vegetative cycle of the grapevine (b-h) is significantly shorter in the the São Francisco Valley (mean duration, for the 4 evaluated cultivars, 37 days less than in the Serra Gaúcha). Such behavior is a consequence, essentially, of a shortening of the period b-f (29 days shorter in the average). It can be stated that the phenological behavior of the grapevine in the São Francisco Valley, although distinct from a temperate climate region, can be understood above all by the particular bioclimate found in the tropical zone.

THEME II – Methodological Approach to Zoning

Weather Classification for the Western Cape (February 1996-2000) and Viticultural Implications in the Stellenbosch Wine District

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A preliminary study of the daily weather situations was performed for February in South Africa (grape ripening period), similar to the synoptic classification realized for the temperate latitudes in France (Van Jones & Davis, 2000), in order to focus the study of the relationships between climate and viticulture at lower latitudes. Daily weather bulletins of the South African Weather Service (SAWS) and surface data observed at Cape Town International Airport by the SAWS were used. The synoptic weather situations were classified in four main patterns, namely: the ridging of the Atlantic Ocean High over the western parts of South Africa, the passing of a cold front over the Western Cape, the dominance of the interior trough, and the ridging of the Indian Ocean High over the eastern parts of South Africa. Of these four groups, two are predominantly occurring over the Western Cape, namely the ridging of the Atlantic Ocean High and the cold front. The Atlantic Ocean High occurs on 42% of the days in February over the five seasons (1996-2000) used for the classifications, whilst the cold front occurs on 24% of the days. The occurrence of the Atlantic Ocean High varies between 64% (1998) and 32% (1999). Comparing these occurrences with previous research on the influence of vintage and meso-climate on wine aroma (Carey *et al.*, 2000), it was found, for instance, that warmer conditions (the result of sunny skies associated with the Atlantic Ocean High situated over the Western Cape) in 1998 resulted in predominant tropical fruit aromas in the Sauvignon Blanc wines, and tree fruit aromas in Chardonnay wines. It appears as if the weather associated with dominant synoptic conditions holds significant implications for wine style. Knowledge of these conditions and their variation over the entire season will aid climatic modelling studies for application to viticulture.

The Use of Remote Sensing for Intra-Block Vineyard Management

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In vineyard management, the technical work-unit is now the block. However, considerable variability can exist inside a bock with regard to vegetative growth and fruit composition at ripeness, because of soil heterogeneity. In this research, vine characteristics were measured on 96 plots of a block of 0.3 ha. Leaf area was two times greater on the plots with the highest vigour compared to the leaf area on the plots with the lowest vigour. Berry sugar content varied from 205 to 235 g/L. Optimised vineyard management should take in account this variability. Variations in soil (depth, texture) can be surveyed by soil sampling and mapped. They can also be assessed more rapidly and more precisely by geophysics, a technique based on variations in soil resistance to electric current. Vine behaviour can be measured by means of physiological indicators: N-tester for vine nitrogen status, leaf water potential and carbon isotope discrimination ($\delta^{13}C$) for vine water status. To represent spatial variability of physiological parameters, repeated measurements are necessary on a great number of plots inside a block, making this approach very time and money consuming. Remote sensing can be considered as an interesting alternative way to map intra-block heterogeneity. In satellite pictures, one pixel represents about one square meter on the soil. Because a vine row rarely exceeds 60 cm in width, these pixels contain both information from the vine canopy and from the soil, making them difficult to interpret. In high resolution remote sensing, pictures are taken at an altitude of approximately 300 meters. Pixels represent 10 to 20 square cm on the soil. Pixels containing only information from the canopy can thus be isolated from the picture. On these photographs, vine vigour can be characterised with NDVI (Normalized Difference Vegetation Index). This approach was used in this study. Zones of variable vine vigour were identified inside a block. Monitoring of vine water and nitrogen status by means of physiological indicators allowed to conclude that low vigour was in some zones the result of vine water deficit, in some zones the result of low vine nitrogen status and in some zones the result of both low vine water and nitrogen status. The high correlation between NDVI and vigour parameters demonstrates the possibility to map the vigour with the NDVI by means of high resolution remote sensing, and consequently to explain the variations of linked quality factors.

Role of Climate on Grape Characteristics of 'Moscato bianco' in Piedmont (Italy)

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The study's purpose was to realize the role of climate on phenological aspects of 'Moscato bianco' grapevine cultivar in different production zones of wine Moscato d'Asti docg in Piedmont (Italy) and his effects on vintage time. We have carried on three analysis levels: (1) geographical and topographical data collection on GIS system, climatic and bio-climatic data collection on 16 meteorological stations, phenological and grape quality data collection in 30 selected vineyards; (2) relationship between development-ripening rapidity and climatic aspects in different zones and (3) cartographic display of different bioclimatic, phenological and grape quality parameters. The vineyards of the study are in a hill area extended over 9,500 ha with a production of 50,000 kL; they altitude ranges between 200 and 250 m a.s.l., with a maximum of 710 m, and they have East exposure. Huglin's index, between 1990 and 2600°C, is the best index to express the phenological development and the ripening rapidity: a inverse relation to total acidity until 2100°C and altitude, a direct relation to colour change of grapes. The cartography display (scale 1:25.000) of different parameters of exposure, altitude, climate, bioclimatic indexes, phenological phases, grape's quality (alcohol, acidity, pH) allows to zone the Moscato d'Asti production area in three sub-zones: between an early zone and late zone there is a intermediate zone with more or less earliness.

THEME III – Practical Application of Zoning

Methodology to Assess Vine Cultivation Suitability Using Climatic Ranges for Key Physiological Processes: Results for Three South African Regions

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Climate has serious implications for proper physiological functioning of grapevines and needs to be quantified in order to determine the vine cultivation suitability of grape growing regions. Methodology is proposed that may eventually be used to predict the suitability of regions/terroirs for grapevine cultivation. Climatic ranges of temperature, wind speed and relative humidity for key physiological processes (photosynthesis of the leaves as well as sugar and potassium accumulation, organic acid formation and respiration, and colour and flavour development in the grapes) were studied in three wine producing regions of South Africa (Stellenbosch, Robertson and Upington) during the pre- and post-véraison growth periods. Both optimum and extreme climatic ranges were considered. Marked variation in the number of hours

available for optimal physiological functioning (according to the parameters studied) occurred between the regions. All factors considered, the Stellenbosch region would seem to be best suited to the studied physiological requirements for grapevine cultivation.

THEME IV – Viticulture, Landscapes and the Marketing of our Wine

Geological History and Landscapes of the Coastal Winegrowing Region of South Africa

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Geological processes shape landscapes and their associated mesoclimates, and generate soil parent materials. It is therefore evident that geology is a factor – albeit an indirect one – in terroir and terroir demarcation studies. The purpose of this investigation was to compile an account of the geology of the western Cape winelands, with particular reference to the Coastal Region, to provide a structural and temporal framework for work on terroir and terroir demarcation. Coastal Region geology testifies to a history which includes the former existence of a late Precambrian supercontinent, its fragmentation, the closure of an ocean basin between the South African and South American continental precursors (the Kalahari and Rio de la Plata cratons), the accumulation of marine sediments and limestones, and their compression during the subsequent collision between the Kalahari and Rio de la Plata cratons. This collision, which occurred over 500 million years ago, took place within the framework of the assembly of the southern supercontinent of Gondwana. Erosion during the Cambrian reduced the rugged topography of the suture zone to an alluvial plain dotted with granite hills – much as now. From Ordovician to Carboniferous times this plain intermittently subsided, forming the Agulhas Sea. Into this sea, which at times extended from Vanrhynsdorp in the north to beyond Port Elizabeth in the east, and which was bordered by mountains to the west and north, were transported considerable volumes of coarse and fine sediments. These sediments (now known as the Cape Supergroup) were uplifted and folded during the Permo-Triassic Cape Orogeny (mountain building episode). Today the ramparts of these mountain belts (the Cape Fold Belt), are composed of erosion-resistant Table Mountain Group sandstones, whilst the alternating shales and sandstones of the younger Bokkeveld Group are preserved in downfolds. In the late Jurassic or early Cretaceous, after Gondwana had rifted apart and the southern Atlantic Ocean basin had begun to spread, a remnant of the Rio de la Plata craton remained attached to South Africa. This remnant, which now underlies the vineyards of the Coastal Region, was exposed by removal of the overlying sandstones and shales of the Cape Supergroup through erosion and scarp retreat. Erosion was particularly rapid under the warm, wet conditions which prevailed throughout much of the Cretaceous. Indeed, it seems likely that the main features of the present-day topography of the Coastal Region had already been roughed out by the early Tertiary. Final shaping of the landscape in accordance with the abilities of the rock structures and materials to resist erosion took place during the Tertiary and Quaternary, a time of subaerial erosion associated with marked sea level changes and climatic variation superimposed on a trend toward increasing aridity. That hundreds of metres of rock were, indeed, removed from the coastal plain is attested by the presence of such remnants of this cover as Simonsberg, Table Mountain.and Riebeek Kasteel. The altered and locally hornfelsed Precambrian sediments and granite hills of the coastal plain, together with the granite and sandstone slopes, and the sandstone and shale-floored valleys and upland plateaux of the mountains of the Cape Fold Belt, provide the Coastal Region and its mountainous hinterland with a variety of landforms, aspects, associated mesoclimates and soil parent materials. Since the Tertiary and Quaternary were glaciation-free in the western Cape, the landscapes escaped the rounding effects of ice, and the soils remained unrejuvenated. The landforms and geological structures of the Coastal Region and its surroundings have been mapped and described, and its geological history has been documented, thereby contributing both a physical structure and a temporal framework to the study of western Cape terroirs. It remains to determine the viticultural potential of these features.

An Overview of Geological Influences on South African Vineyards

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The role of soils and bedrock geology has long been acknowledged as a fundamental component of terroir. In South Africa the influence of geology is misunderstood and some important geological components will be highlighted in this paper. In South Africa's Coastal Region the oldest rocks comprise the Late Proterozoic shaley sediments of the Malmesbury Group, and the Late Proterozoic– Early Cambrian granitic intrusives of the Cape Granite Suite. Locally these are overlain by Ordovician sediments of the Klipheuwel Group. These units are unconformably overlain the Middle Ordovician–Early Carboniferous Cape Supergroup, whose basal portion comprises the sandstones of the Table Mountain Group which produce the dramatic mountain scenery of the area. The Breede River Region covers the valley of the Breede River, to the east of the Coastal Region. The Worcester fault is the major feature defining the geology of this area. To the east of the fault the geology is essentially similar to the Coastal Region. To the west the upper portions of the Cape Supergroup, the Bokkeveld and Witteberg Groups, are present comprising sandstone and shaley sediments. Late Carboniferous–Permian age sediments of the Karoo Supergroup overly the Cape Supergroup and Upper Jurassic-Early Cretaceous sediments of the Uitenhage Group are preserved locally as unconformable remnants. The following geological features are important for the Coastal Regions vineyards. Soils are often acidic and potassium rich, whilst granites weather to produce both saprolites and kaolin, which are possibly unique in terms of vineyard soils.

River gravels are noted in two scenarios, firstly vineyards are planted in river floodplains and secondly fossil gravel terraces exist above the current river level. In the Breede River Region river gravels are important whilst a significant portion of vineyards are planted on loam soils containing calcareous layers. These calcareous layers are formed as a result of excess evaporation over precipitation in this low rainfall region. A geological control may exist for the formation of these calcareous layers above specific bedrock strata. These soils are unique in the South African context, as they are naturally alkaline. In addition topography resulting from differential weathering of the geological units is significant in the local terroir. Factors such as warm or cool slope orientation and the effects of altitude on mean temperatures and rainfall are important.

THEME VI – Role of Climate/Soil of Different Zones/Terroirs on Grape Characteristics

The Relationship Between Wind Exposure and Viticultural Performance of *Vitis vinifera* L. cv. Merlot in a Coastal Vineyard (South Africa)

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The South Western Cape of South Africa is exposed to strong southerly and south easterly synoptic winds during the growth period of the grapevine. The development of sea breezes in the afternoon is also a phenomenon associated with the ripening period of grapes cultivated in this coastal area. Wind is one of the environmental variables having the greatest spatial variation but the implications of regular exposure to wind for the performance of the grapevine has not yet been determined for vineyards in the South Western Cape. This study was initiated to meet this need. The study was conducted in a hedge-trellised vineyard of *Vitis vinifera* L. cv Merlot with north east – south west row direction. Thirty experimental sites, each consisting of 14 vines, were identified as being exposed to wind or sheltered based on hand-held anemometer readings during the 2001/2002 season. Four stationary anemometers were strategically positioned between the thirty sites. Stomatal conductance and leaf temperature were measured with a PP systems porometer. Vegetative and yield measurements were performed during the 2002/2003 season. The t-test of equal variance was used to determine significant differences in measured parameters between exposed and sheltered grapevines. Stomatal conductance and leaf area were significantly reduced by exposure to wind. This was associated with a significant reduction in the leaf area of primary shoots, related to shorter shoots, but a significant augmentation of secondary shoot leaf number and area. The number of bunches per vine and yield were also reduced for exposed vines. The berry potassium content was significantly increased for exposed grapevines. This demonstrates that exposure to wind can result in significant within-vineyard, and potentially between-vineyard, variability in grapevine physiology, vegetative growth, yield and berry composition, with implications for wine style and quality.

«Terroir» and Grape and Wine Quality of Native Grape Variety of Istrian Malvasia

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Viticulture and wine production are a historical tradition in Istria. First written document of vine cultivation in this area date since antiquity. The most wide spread vine variety in Istria is Istrian Malvasia (white variety), and it captures about 60% of total vineyard surface in Istria today. The Istrian Malvasia, a native grape variety, is one of the best in a huge family of Malvasian varieties from Mediterranean basin. The Istrian Malvasia gives quality grapes for high quality wine production. Except the variety, on high quality of wine, a location of vineyard – «terroir» also has a very strong impact. An objective of this research was to establish how different locations of vineyards influenced grape and wine quality of Istrian Malvasia. Four specific locations are chosen for this research. Those are: Medulin – southern part of Istiran peninsula, with shallow red soils and low amount of rain in vegetation, Zenodragi – western part of peninsula, with characteristic deep red soils with good physical and chemical properties, Motovun – central part of peninsula, with gray («flish») soils, rich with clay, and bad physical and chemical properties and cold winter period and Buje – northwestern part of peninsula, with brown soils, good physical and chemical properties and good rain distribution through year. On all locations a growing form was Guyot – single or double branched. Grapes and wine were analyzed from each location for harvest 2002. The content of acetate and ethyl esters, fatty acids and free monoterpenes was analyzed from wine extracts (Solid Phase Extractions). The content of higher alcohols was analyzed from wine distillates. All aromatic compounds were analyzed on a gas chromatograph (Lopez R., Aznar M., Cocho J. and Ferreira V., 2002). Wine from Buje location contains higher level of volatile esters, particularly iso-amyl acetate (average 2,04 mg/L), significantly higher then on the other locations. The wine from Buje location also contains significantly higher amount of free monoterpenes, especially linalool (average 27 µg/L) and geraniool (average 49 µg/L). The wine from Motovun location contains higher amount of higher alcohols, especially 2-phenyl ethanol (average 26,42 mg/L), significantly higher then on the other location. Summarized, all results show how not only the variety but also location of vineyard – «terroir» has a strong impact on the quality of grape and wine.

THEME VII – Role of Trellising System and Canopy Size/Exposure in Zone/Terroir Expression

Influence of Spraying of Copper Fungicides on Physiological Parameters of *Vitis vinifera* L. cv. 'Merlot'

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Vine downy mildew is one of the most frequent diseases in intensive vineyards. Bordeaux mixture (B.m.), in order to control the disease has been applied onto vineyards since the end of the 19th century. The intensive use of Cu-fungicides could influence the physiology of grapevine. It is also possible that high amounts of foliar Cu sprays trigger stress responses in vine leaves. We tried to estimate the possible effect of the foliar applied copper on leaf photosynthesis (P), transpiration (F), stomatal conduction (g) and chlorophyll (Chl a+b) content in vine cv.'Merlot' grown in Slovenia, where copper fungicides are commonly used in vineyards' management. The measurements were carried out on eight years old vine cv. 'Merlot', grafted onto SO4. Vines were sprayed with Bordeaux mixture, at two intensities: conventional 'K' (12 kg B.m. ha^{-1}) and integrated pest 'I' (3 kg B.m. ha^{-1}) management and the control 'C' vines were sprayed with non-copper fungicides. The photosynthetic and transpiration activities of the fully developed leaves were measured with a portable measuring system Li-6400 (Licor), at PFD of 1000 mmol m^{-2} s^{-1}, at 360 (A_{360}) ad 2000 (A_{2000}) mmol CO_2 m^{-2} s^{-1} and at controlled temperature and relative humidity. The seasonal decrease of photosynthetic and transpiration activities was observed. The highest P activity 9,82 mmol CO_2 m^{-2} s-1 was obtained on I vines, and the lowest P 9,04 mmol CO_2 m^{-2} s^{-1} on C vines. The highest transpiration 2,59 mmol H_2O m^{-2} s^{-1} was measured on C vines, and the lowest 2,31 mmol H_2O m^{-2} s^{-1} on K vines. The highest stomatal conduction 0,141 mol CO_2 m^{-2} s^{-1} was measured on C vines, and lowest 0,130 mol CO_2 m^{-2} s^{-1} on K vines. The lowest Chl a+b content 3,33 mg g^{-1} dw was determined in C leaves and highest 4,77 mg g^{-1} dw in I leaves. The Cu-fungicide influenced physiological parameters of vine leaves (difference not statistical significant).

Phototropic and Geotropic Shoot Orientation: Effect on Physiological, Vegetative and Reproductive Parameters

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The effect of shoot orientation during two growth seasons (2002/2003 and 2003/2004) on physiological, vegetative and reproductive parameters was investigated in the Stellenbosch area in a Merlot/R99 vineyard with a vertical trellising system. Vines were spaced 2.7 X 1.5 m in north-south orientated rows. Micro-sprinkler irrigation was applied at pea size berry and at vèraison stages. Observations were done in vines with a natural distribution and orientation of phototropically (upward) and geotropically (downward) shoots on the same cordon. Soil water typically varied according to the progress in the season and with soil depth, decreasing towards the end of the season and increasing with depth. Geotropic orientation reduced the primary and lateral shoot length as well as the primary and secondary shoot leaf area. With phototropic shoot position, secondary shoots were more evenly distributed along the primary shoots. Basal and apical stem and leaf water potential was lower with geotropic orientation than with phototropic orientation. This was particularly pronounced during the ripening period. In spite of this, basal and apical leaf photosynthetic activity of the phototropically orientated shoots was higher than that of the geotropically orientated shoots, most probably because of more favourable microclimatic conditions experienced by the former. Bunch mass and volume and length of bunches were not significantly influenced by shoot orientation. Phototropic orientation of shoots noticeably increased glucose and tartaric acid contents of the berries, whereas sucrose, malic acid and citric acid contents were virtually unaffected. In phototropically orientated shoots, less water was lost by the skins, favouring skin colour intensity. The results have important implications for bunch and berry composition uniformity and for trellising system selection on different terroirs.

Shoot Positioning: Effect on Physiological, Vegetative and Reproductive Parameters

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The effect of vertical shoot positioning and topping at different times during two growth seasons (2002/03 and 2003/04) on physiological, vegetative and reproductive parameters was investigated in a vertically trellised Merlot/R99 vineyard located in the Stellenbosch area. Vines were spaced 2.7 x 1.5 m in north-south orientated rows. Micro-sprinkler irrigation was applied at pea size berry and at vèraison stages. Shoots were positioned at berry set, pea size, véraison and post-véraison stages (3 weeks after vèraison). After being positioned, they were immediately topped. Before positioning the canopy was in a "natural" condition with shoots hanging freely. Soil water typically varied according to the progress in the season and with soil depth, decreasing towards the end of the season and increasing with depth. The primary shoot length of the positioned shoots was at the end of growth on average approximately 100 – 115 cm, being restricted by the relatively low trellising system. Shoot positioning and topping had no marked effect on the growth of secondary shoots, but they had a noticeable effect on the position of secondary shoots along the length of the primary shoots. Pea-size shoot positioning induced slightly lower light conditions in the bunch zone, because of the low position of secondary shoot development on primary shoots. In spite of this, pre-vèraison shoot positioning treatments allowed good all-round light distribution, which would promote uniform bunch ripening

and grape quality. The basal and apical stem and leaf water potential and photosynthetic activity decreased during the season as the leaves aged and the plants lost water. A significant correlation was found for apical leaves between stem and leaf water potential. Earlier shoot positioning and topping (up to vèraison) significantly increased the °Brix level of the must, malic acid and sucrose contents, whereas tartaric acid contents were slightly reduced and glucose contents were higher in pea size and vèraison treatments. No significant differences between treatments were found for must pH. The earlier shoots were positioned, the more water was lost by the skins, resulting in a concentration of skin contents. Pre-vèraison shoot positioning and topping improved the colour of the skins. No practical difficulty was experienced when shoots were positioned early in the season, i.e. at berry set and pea size stages, whereas at and after véraison proper vertical positioning was primarily restricted by shoot lignification and the tightness of the tendrils on the wires. Bunches were also very sensitive to damage, which led to bunch rot and a reduction in yield. These are important considerations in terroirs where timely management is difficult.

Influence of Vine Spacing on Water Status, Productivity, Yield and Must Composition in Tempranillo Grapevine under Duero Valley Zone Conditions

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The purpose of the study is to evaluate the effect of vine spacing on plant water status, productivity, yield and fruit quality of Tempranillo grapevine at the A.O. Cigales, in the Valley of Duero river. Vine spacing treatments applied were: 2645 vines per ha (2.70 x 1.4 m) and 3953 vines per ha (2.20 x 1.15 m). Leaf water potencial, dry matter production, yield, berry weight and must composition (°Brix, pH, titratable acidity, phenolic compounds) were measured. The experimental trial was located in the province of Valladolid (Castilla y Leon, Spain). The 12-year-old vines grafted onto 110 Richter rootstock were vertically trellised, through a bilateral cordon, and spur pruned. The experimental vineyard was dripper irrigated by means of doses of 20% ETo from July to September. The increase of the number of plants per hectare has not affected leaf water potential significantly, but dry matter production and yield were reduced. The reduction of plant spacing correspondant to the higher plant density has provoked a significant reduction of the berry weight and an increase of the values of °Brix, pH, titratable acidity and phenolic concentration. The increase of the number of plants per hectare has affected the production and the quality of Temparnillo grapevine in the conditions of the zone (Valley of the Duero river) and the soil of the experimental trial. The main effects of the increase have been the reduction of the yield and a light improvement of the fruit quality.

THEME VIII – The Role of Soil Water Holding Capacity and Plant Water Relations in Zone/Terroir Expression

Canopy Photosynthetic Activity and Water Relations of Syrah/R99 as Affected by Row Orientation on a Particular Terroir

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The photosynthetic activity and water relations of a Syrah/R99 vineyard, situated in the Stellenbosch region, were investigated approximately one month after véraison. Vines were vertically trained and spaced 2.75 x 1.5 m in north-south orientated rows on a terroir with Glenrosa soil and a west-facing slope. Microsprinkler-irrigation was applied at pea berry size and at vèraison stages. The 1.4 m high canopies were suckered, shoot-positioned and topped and accommodated by means of three sets of double wires. Photosynthetic activity and water potential were measured on leaves in apical, middle and basal positions on both primary and secondary shoots. Lateral shoots in apical, middle and basal positions were measured. Both East and West sides of the canopy were measured in the morning and in the afternoon. In addition, photosynthesis and water potential of interior and exterior leaves on primary (apical, middle and basal leaves in apical, middle and basal positions) and secondary (middle leaves in apical, middle and basal positions) shoots were compared. The canopy typically increased in number of leaf layers from top to bottom. Light penetration decreased in tandem. On primary shoots, photosynthetic activity of leaves on sunny and shaded sides of the canopy was higher in the morning than in the afternoon. Photosynthesis of sun-exposed leaves decreased from the apical to basal position. On the shaded part of the canopy, photosynthesis of middle leaves was reduced compared to apical and basal leaves. The photosynthetic capacity of the canopy was therefore higher in the morning than in the afternoon. Water potential of leaves on the sunny side of the canopy was also consistently lower than that of leaves on the shaded side. Although the sunny side is expected to display lower water potential, the differences were, however, not in line with the large differences found for photosynthetic activity. The sun-exposed side of the canopy had slightly lower water potential in the morning than in the afternoon. Basally positioned secondary shoots on the sunny side of the canopy had higher photosynthetic activity in the morning than in the afternoon; that of secondary shoots in apical and middle positions was, however, similar in the morning than in the afternoon. Photosynthetic patterns of leaves on the sunny side of the canopy *versus* the shaded side of the canopy were similar to those on the primary shoot. Water potential patterns of leaves on secondary shoots (morning *versus* afternoon and sunny side *versus* shaded side) were similar to those of leaves on primary shoots. Comparing the photosynthetic activity and water potential of exterior and interior leaves in different positions on either pri-

mary or secondary shoots, similar patterns than those found for sunny and shaded sides of the canopy occurred. In the morning, large differences between the exterior and interior leaves occurred when measured from the sunny side. However, when measured from the shaded side, values were similar to those of interior leaves measured from the sunny side and no marked differences between exterior and interior leaves were found. Similar patterns were found for leaf water potential on primary and secondary shoots. The results are useful for application to terroirs forcing different row orientations. It provides an indication of the photosynthetic performance and water relations that can be expected with a particular row orientation.

The Application of Soil Biological Indicators to Support Soil Conservation Practices and Landscape Quality in Viticulture

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The soil has important regulatory functions in viticulture and in the landscape seen as a whole. At vineyard level e.g. the soil supports the growth of vines and influences the oenological potential of the grapes. At landscape level the soil has important functions e.g. as buffer to keep groundwater clean. The capacity of a soil to fulfill its functions in the environment is described as soil quality. This is the same for the landscape. Beside the natural functions, landscape quality also concerns with the appearance of the environment. In the context of viticultural zoning, where a landscape representing a typical region is a carrier of emotions and culture, functions like image formation or esthetical aspects have to be attributed. Soil conservation techniques protect the environment. It is widely accepted that post-emergence herbicides can be better for soil conservation than pre-emergence herbicides or mechanical soil cultivation. On the other hand, the use of herbicides is discussed negatively in the context of environmental and esthetical aspects. Therefore, the aim of our work was to investigate the influence of different soil management systems in viticulture on soil biological parameters because they are useful indicators to assess the suitability of soil management practices for soil conservation. Soil organic matter and soil microbial biomass were analyzed in soil samples from vineyards with different soil management systems. Our results showed that post-emergence herbicides, used in a reasonable way, did not lead to negative impacts on soil biology but were able to maintain soil organic carbon and soil microbial biomass. Further, the soil structure, built up by plant roots and soil biota, will not be disturbed by mechanical cultivation and the soil surface is protected by the residues of the treated weeds. Permanent green cover had the most favorable effects on soil biological parameters. In the frame of environmental friendly viticulture, herbicides were banished from vineyards because of environmental arguments. Further, the visible effect of the herbicide use (damaged and dried-out weeds) was discussed as a reason for negative image formation in the public. Because of this conflicting situation, the post-emergence herbicides should be used carefully e.g. only under the line of vines and not at the field margins. On the other hand, landscape quality might be endangered if economical and technical efficient systems like post-emergence herbicide application are refused: e.g. giving up of vineyards at terraces or steep slopes because of high production costs and difficulties to get to with machines for soil cultivation. Increasing parts of fallow land within typical viticultural land can be the consequence and have a high potential to damage the originality and the quality of a landscape.

THEME IX – Role of Harvesting Time/Optimal Ripeness (Evolution of Ripening) in Zone/Terroir Expression

Sugar Loading and Phenolic Accumulation as Affected by Ripeness Level of Syrah/R99 Grapes

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Sugar loading and phenolic accumulation in Syrah grapes were investigated as part of an elaborate study to determine parameters that would indicate high grape quality and different grape and wine styles on a particular terroir. The relationship between the dynamics of sugar loading and phenolic accumulation in the berries of a Syrah/R99 vineyard, situated in the Stellenbosch region, was investigated from pea size stage (green berry) to late maturity. Vines were vertically trained and spaced 2.75 m x 1.5 m in north-south orientated rows on a terroir with Glenrosa soil and a west-facing slope. Microsprinkler-irrigation was applied at pea berry size and at vèraison stages. The 1.4 m high canopies were suckered, shoot-positioned and topped and accommodated by means of three sets of double wires. The dynamics of berry sugar loading as well as berry phenolic composition (total tannins and polymerisation, proanthocyanidins, anthocyanins) were analysed. Sugar was used as physiological indicator of the plant-berry (source-sink) relationship. The total tannin (TT) component in the berry was synthesised from anthesis to véraison. The TT concentration increased during the green berry growth stages and decreased during ripening as the berry increased in volume. The TT per berry also increased during the green berry growth stages, but kept stable during ripening. When sugar content per berry is used as physiological indicator, it is clear that anthocyanin biosynthesis occurred until a specific berry sugar content, i.e. 20 – 21°Brix, is reached. After this point, anthocyanin evolution per berry seemed independent of berry sugar evolution. Thus, although berry sugar loading is dependent on photosynthetic activity of the leaves, the regulation of sugar loading in the berry sink seemed to be affected by the microclimate that the berry experienced. Berry sugar loading was not directly correlated with berry volume.

Effects of Soil and Climate on Wine Style in Stellenbosch: Sauvignon blanc

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A nine-year study was carried out in two non-irrigated, commercial Sauvignon blanc vineyards, grown at different localities (A and B) in the district of Stellenbosch. Two experimental plots, representing different soil forms, were identified within each vineyard. At both localities one of the soil forms showed signs of wetness with depth, while the other one was relatively dry. Despite their geographic proximity (9 km), meso-climate differed between the two localities, largely on account of A being situated at higher altitude (413 m) than B (148 m). Maximum temperature for February was 1.9°C lower for A than for B, while night temperature was also lowest at A. Grapes at the cooler locality (A) were generally harvested two weeks later than those at the warmer one (B). At the cooler locality ripening was also affected by soil form, with grapevines on the drier soil being harvested approximately one week earlier than those on the wetter soil. Ripening was not affected by soil form at the warmer locality. At the cooler locality, wine from the wetter soil generally exhibited a prominent fresh vegetative character (grass, green pepper, eucalyptus, mint), in comparison to cooked vegetative (green beans, asparagus, olive, artichoke) and fruity characteristics for the one from the drier soil. Wine style was not affected by soil form at the warmer locality, with tropical fruit character being dominant. Results suggested that the style of Sauvignon blanc wines from Stellenbosch is not only affected by climate, but also by soil form.

THEME XII – Tools for Optimizing Grape and Wine Quality

The Effect of Grapevine Rootstocks on the Performance of *Vitis vinifera* L. (cv. Sultanina) on a Silty Soil in the Lower Orange River Region

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In the Lower Orange River region, Sultanina is the major raisin cultivar. This region is characterised by a relatively low annual rainfall (169 mm), occurring mainly in summer, from September to March. Mean temperature throughout the growing season is 19,4°C, which makes the region particularly suitable for the production of quality raisins. Sultanina vineyards for the production of raisin grapes are traditionally planted on the lower river terrasses very fertile, alluvial soils. These vines are mainly planted on their own roots or 143 B Mgt, based on results obtained with screening trials and grower experience that fruit quantity is superior on ungrafted vines. The purpose of the trial was to identify rootstocks that are compatible with Sultanina and also to identify which rootstocks performed best on the silty soil in the Lower Orange River region. The performance of Sultanina H5 grafted onto the 14 rootstock cultivars, at Upington experiment farm of the Department of Agriculture Northern Cape near Upington (28°27'South; 21°15'East and 793 m above sea level in the Northern Cape Province), was investigated over a period of 18 years. Soil in the experimental site is a very fertile alluvial type (silty soil). The vines in the experiment, planted 3,0 x 2,0 m apart, were developed with one crown per vine on one side of a gable trellis. The vines were pruned with 8 canes (14 buds per cane) per vine. The experimental layout was a simple random design with seven replications and five vines per plot for each graft combination. Only the three vines in the centre of each plot were used as data vines. The results, which will be presented, are based on data recorded annually over the last five years of the trial, including the fresh mass of grapes, cane mass, as well as berry mass for each individual rootstock. Data were tested statistically with Genstat 5 release 3.2. for normal distribution, whereafter an analysis of variance was done on each variable. Tukey's LSD at a 5% level of significance was used to place treatment averages for rootstocks into three groups, namely best, intermediate and weakest.

Relationship Between Chilling Exposure and Vine Response to Dormancy Management Practices in the Northern Summer Rainfall Region of South Africa

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Various areas in the summer rainfall region of South Africa possess the climate that allows the unique advantage of early fruit maturation. The possibility to further advance the earliness of the crop by using various pruning times and/or application of dormancy breaking substances such as cyanamide, was studied. The relationship between chilling exposure and vine response to dormancy management practices was also investigated, in an attempt to quantify vine-chilling status, predict potential response to dormancy breaking treatments and develop guidelines for selection of optimum dormancy breaking treatments. The effect of pruning date, combined with date of cyanamide application, was investigated over three consecutive seasons on *Vitis vinifera* L. cv. Erlihane grafted onto Jacquez. A six year old vineyard on the experiment farm at Roodeplaat was used. The farm is situated about 30 km north-east of Pretoria (25°35' South; 28°21' East) and 1164m above sea level. Vines were planted (3,0 x 1,8m spacing), with rows running east-west, on a Hutton soil and trained onto a Trentina trellis with hail netting (20% shade) and pruned to 10 and 8 spurs respectively on the lower and upper split cordons. The trial was laid out as a randomised block design, with four replications. An experimental unit consist of a single vine. The treatment design was a 5 x 4 factorial. The factors were five pruning dates (May, June, July, August and September) and four cyanamide treatments dates (no cyanamide, cyanamide applica-

tion immediately after pruning, cyanamide application at 6 weeks before normal budbreak and cyanamide application at 4 weeks before normal budbreak). Normal viticultural practices were applied during the growing season. Results depicting the effect of pruning date on vine chilling exposure will be presented. Results regarding budbreak and fertility, as affected by the interaction between chilling exposure and dormancy management practices (pruning, cyanamide treatment), will also be discussed. Guidelines for selection of optimum dormancy breaking treatments will be given.

Validation of a Protocol to Quantify Spray Coverage on Susceptible Grapevine Bunch Parts

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Control failure of fruit and foliar diseases in vineyards is attributed to inappropriate timing of fungicide applications and/or insufficient coverage of susceptible tissue. Suitable technology to determine spray coverage on susceptible bunch parts is, however, not available. A protocol was developed to determine spray coverage on the pedicels, rachises, laterals and berry bases by means of fluorescence and image technology. Previous studies revealed that these bunch parts, and not the berry skins as previously understood, are most susceptible to *Botrytis cinerea*, the causal pathogen of Botrytis bunch rot. The aim of this study was to validate the developed protocol on grape bunches at different phenological stages. Grape bunches from the table grape cultivar Dauphine were selected at pea size and bunch closure. Bunches were sprayed with a gravity feed mist spray gun in a spray tent [800 x 1410 x 660 mm (h/l/w)] from two opposite sides with a mixture of a fluorescent pigment and the fungicide fenhexamid. Five spray volumes ranged from 1 mL to 15 mL. Sprayed parts from bunches were illuminated under black light (UV-A light in the 365 nm region) and visualised under a stereo microscope at 20x magnification. Photos of the berry skin, pedicel and rachis were taken with a digital camera (Nikon DMX 1200). Image analysis of photos was done with Image-Pro Discovery version 4.5 for Windows (Media Cybernetics) software. The sum of objects and total area of deposited pigment in selected areas of interest (AOI) were calculated. The percentage area covered was subsequently calculated for each AOI. The data were subjected to a factorial analyses of variance and variance component analyses. Linear regressions over volume for part x stage combinations were fitted and compared. Good correlation was evident between the parameters sum of objects and percentage area covered. Bunch parts at pea size generally had higher coverage values than at bunch closure. Spray applications earlier in the season would therefore result in higher and more effective spray coverage of the susceptible bunch parts. Similar deposition trends were observed on the inner bunch parts (pedicel and rachis). These were, however, significantly different from berry skins, which had significantly higher levels of spray deposits than the inner bunch parts. The variance component analyses indicated that the highest variance was observed for berries and bunches, and substantially less for image readings. For the same accuracy, means for percentage coverage values, of at least 10 bunches per treatment (1 part per bunch and 3 readings per part) will be sufficient.

Molecular Detection of Grapevine Trunk Disease Pathogens in Nursery and Vineyard Soils in South Africa

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Grapevine trunk diseases are destructive dieback and decline diseases and threaten the sustainability of grapevine industries worldwide. These include Petri disease, mainly caused by *Phaeomoniella chlamydospora* and *Phaeoacremonium aleophilum*, and black foot disease, which is caused by *Cylindrocarpon destructans* and *C. obtusisporum*. Management of these diseases is difficult, especially because their disease cycles are currently poorly understood. Contaminated soil is a potential source of inoculum, especially in nurseries at the susceptible stages after grafting. The aim of this study was therefore to determine whether South African nursery and vineyard soils are contaminated with these pathogens. A preliminary survey was conducted in 27 nursery, 16 rootstock mother blocks and 7 vineyard soils in the Western Cape province. In order to detect these pathogens, DNA was extracted from the soils and tested for *Pa. chlamydospora, Pm. aleophilum* and *C. destructans / obtusisporum* by means of PCR reactions with specific primer pairs Pch1 + Pch2, Pal1N + Pal2, and Dest1 + Dest2, respectively. PCR products were analysed by gel electrophoresis and visualised under UV light. *Pa. chlamydospora* and *C. destructans / obtusisporum* were frequently detected in the tested soils. *Pa. chlamydospora* occurred often (66%) in homogenously low amounts in soils, independent of the locality and the history of grapevine cultivation. While the overall incidence of *C. destructans / obtusisporum* was similar (66%), results suggest these pathogens might be more prevalent in certain areas, but further research needs to be conducted to substantiate these findings. *Pm. aleophilum* was not detected in any of the tested soils. Soils should therefore be regarded as potential inoculum sources of grapevine trunk disease pathogens. Therefore, crop rotation, soil fumigation, composting or the use of antagonistic microorganisms should be considered as means to reduce inoculum levels in soils. This is the first time *Pa. chlamydospora* was detected in soils in South Africa.

The Effect of Ethanol on the Taste of *Vitis v Vinifera* L. cv. Regal Seedless

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Regal Seedless is currently one of the major new table grape cultivars in South Africa. However, the acceptability of the cultivar on local and international markets is affected by a sporadic, unacceptable, astringent taste. Astringency is seen as a negative taste in table grapes and is caused by phenolic compounds. A correlation between levels of phenolic compounds, environment, cultivation and postharvest practices was suspected, which led to this investigation.

The objective of this study was to determine the effect of an ethanol dip treatment on the taste and cold storage ability of Regal Seedless grapes. The grapes used for this postharvest trial came from the ARC Hex River Valley Experiment Farm in the Western Cape Province. The vineyard consists of a rootstock trial with Regal Seedless as scion cultivar on a sandy soil. Grapes for the trial were only sampled from vines grafted on Ramsey. The experimental vines were planted 3.0 x 2.0 m apart and trained onto a gable trellis system. The experimental design was completely randomized with 10 treatments and four replications. An experimental unit consists of a single carton. The treatment design was a 5 x 2 factorial. The factors were five ethanol concentrations (0%, 10%, 20%, 40% and 80%) and two SO_2 pad treatments (present or absent). The bunches were dipped for ten seconds in ethanol solutions at the above mentioned concentrations at ambient temperature. The bunches were then dried in the shade for 60-90min, packed into 2 kg cartons (with or without SO_2 pads) and placed in cold storage for four weeks at –0.5°C followed by one week at 15°C. Results from this trial will be presented and discussed in the context of the stated objective.

The Influence of Commercial Tannins on Wine Composition and Quality

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Different commercial tannins are available on the market containing hydrolysable tannins, condensed tannins or mixtures of these two. Tannin additions to must it against oxidation enzymes, promote colour stability, increase polymerization of phenolic compounds and contribute to the taste of the resulting wine, according to their suppliers. Five commercial tannins and one commercial enzyme where tested on three different grape cultivars namely Merlot (from Vredendal), Shiraz (from Stellenbosch) and Cabernet Sauvignon (from Robertson). Vineyard blocks with less colour and phenolics were used. The different tannins and enzyme were compared at different dosages according to the suppliers' recommendations. The phenolic development was monitored during the course of the fermentation and during aging of the wine. Analysis included colour intensity, total phenolics, SO_2 resistant pigments, total anthocyanins, total tannins, modified colour density, HCl index, gelatine index etc. There were differences observed between the different commercial tannins, depending on the phenolic composition at the beginning of fermentation. The influence of the different commercial tannin additions on the polymerisation reactions, oxidation enzymes and sensorial characteristics are also under investigation. The results thus far suggest that the addition of some commercial tannins to must with less colour can improve the phenolic composition of the wine.

The Effect of Wine Aeration During Different Stages of the Red Winemaking Process

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The effect of controlled must and wine aeration was evaluated during different stages of the winemaking process. Different quantities of oxygen i.e. Macro-oxygenation during fermentation (Merlot), after fermentation during extended skin contact (Cabernet Sauvignon) and Micro-oxygenation (Shiraz) during aging of wine were evaluated. Analysis was done on both experimental winemaking and monitoring of external cellars. The effect that oxygen treatment had on phenolics, flavour derived from fermentation and wood, and microbial state of the wine was evaluated. Phenolic analysis included total tannins, colour intensity, modified colour intensity, total anthocyanins, HCl index and gelatine index. Initial experiments proved that treated wine was different from non-treated wine, and that oxygen treatment does affect the overall quality of the wine and the above mentioned parameters in certain cases. In the Merlot oxygen led to reduced tannins, total anthocyanins and a higher HCl index. The colour intensity was however not drastically affected. Cabernet Sauvignon did not show a drastic affect initially regarding the colour intensity, but total tannins were lower. The oxygen addition also did not increase the acetic or lactic acid bacteria numbers during fermentation. Treated Shiraz had reduced total anthocyanins and total tannins. After about 4 months of micro-oxygenation treatment a wine tasting panel was also able to statistically distinguish between the treated and untreated wines. This treatment holds vast implications for the winemaking process in terms of financial, quality and efficiency of winemaking.

Chemometrics Can Improve your Calibration: Glycerol in Wine as Model System

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Fourier transform infrared (FT-IR) spectroscopy is a powerful multi-component analytical tool that is increasingly being used in modern wine chemistry laboratories. The concept of calibration that is widely used in analytical chemistry, also applies to FT-IR spectroscopy and in order to predict the concentration of a component of interest, a predetermined calibration for the component, in the matrix in which it will be assayed, is required. Several factors, including the chemical composition, process technology, style, wine grape cultivar and geographic origin, introduce variation in the FT-IR spectra, which can affect the accuracy of the analytical data generated with this technology. The aims of this study were: (i) to identify the main sources of variation in the FT-IR spectra of wines of various styles; and (ii) to evaluate the implications of this variation for the design of calibration models with accurate predictive abilities, using glycerol calibration in wine as a model system. FT-IR spectra of 329 wines that included commercial wines and experimental wines close to the end of fermentation but not yet bottled, were generated on a Winescan FT120 spectrometer in the wavenumber range 5011 – 929 cm^{-1}. Principal Component Analysis (PCA) of the spectra showed that reducing sugar (RS,) alcohol content, fermentation stage and maturation period of the wines were major sources of variation in the FT-IR spectra. Based on the clustering of wine samples in PCA

score plots, the original sample set was divided into appropriate subsets with the aim to keep the number of glycerol calibrations required as low as possible, but at the same time attaining the best possible accuracy of prediction. A glycerol calibration for red and white wine (RS content <30 g/L, alcohol >8% v/v) with a standard error of prediction of 0.40 g/L and a RPD value (ratio of the standard deviation of the data to the standard error of prediction) of 5.6 was established. A calibration for glycerol in special late harvest and noble late harvest wines (RS 31 – 50 g/L and 51 – 130 g/L, respectively, alcohol >11.6% v/v) with a standard error of cross validation of 0.65 g/L was also established. Six wines in the sample set had atypical FT-IR spectra and were considered to be outlier samples. The Soft Independent Modeling of Class Analogy (SIMCA) approach was used to establish a calibration that facilitated the identification and classification of the outlier samples. This study shows that the successful implementation of FT-IR spectroscopy in the wine chemistry laboratory requires the careful design of calibration sets to establish calibration models with good prediction accuracies, as well as quality control measures that allow for the early detection and interpretation of poorly predicted samples and outlier samples in a sample set.

Molecular Diagnostics of Grapevine Trunk Diseases

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Grapevine trunk diseases cause decline and premature dieback of grapevines. Disease management relies on prevention as well as early diagnosis in order to ensure timely remedial management strategies. Pathogen detection and accurate diagnosis are currently based on fungal isolation onto artificial growth media. However, some of these pathogens are extremely slow-growing and morphological identification is only possible after a 2- to 4-week incubation period. Furthermore, morphological species identification of these pathogens is extremely difficult due to close similarities to related fungi that are frequently isolated or co-isolated from grapevine material. Molecular detection by means of species-specific PCR provides a fast, extremely sensitive and highly specific alternative. A protocol for molecular detection of trunk disease pathogens from grapevine wood was consequently developed and validated. DNA was extracted from grapevine wood and as little as 1 pg genomic DNA of *Phaeomoniella chlamydospora*, causal pathogen of Petri disease ("black goo"), was subsequently detected with a classical species-specific PCR. This protocol was validated with grafted grapevines from different nurseries, as well as nursery grapevines that had been hot water treated. Isolations were made from the basal end of the rootstock and this same section of grapevine was used for molecular detection. DNA of *Pa. chlamydospora* was detected in all the samples from which the pathogen was isolated. Molecular detection furthermore proved substantially more sensitive (and time-efficient (results within 1 day) than isolation. *Phaeomoniella chlamydospora* could not be isolated from the hot water treated plants, but DNA of the pathogen was nonetheless detected in most of these samples. Molecular detection, as described here, can therefore not distinguish between DNA from dead or living pathogen tissue. However, in combination with conventional diagnostic procedures, molecular detection will greatly increase the speed, sensitivity and specificity of diagnostic services. The applicability of this technology will furthermore depend on the development of species-specific PCR primers for the other grapevine trunk disease pathogens, such as *Eutypa lata*, *Botryosphaeria* spp., *Phomopsis viticola* and *Cylindrocarpon* spp.

Stir Bar Sorptive Extraction Combined with Chemometrics for the Classification of South African Wines

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A recently developed extraction technique named Stir Bar Sorptive Extraction (SBSE) was used for analysis of volatile compounds occurring in 60 South African wines. A magnetic stir bar coated with polydimethylsiloxane (PDMS), which acts an extraction phase, is placed in an aliquot of wine and stirred for a predetermined time. Afterwards the volatiles are thermally desorbed from the stir bar and analysed by Gas Chromatography – Mass Spectrometry (GC-MS). This technique is robust, completely solvent free and was proved to provide repeatable results in terms of percentage relative standard deviation (%RSD) of between 2.3 and 9.8%. The results obtained by this procedure were used for creating a database of about 40 volatiles occurring in the 60 wines. The database was subjected to chemometrical analyses including ANNOVA, Principle Component Analysis, Cluster Analysis and Discriminant Analysis. After chemometrical analysis it was possible to classify a certain wine in terms of cultivar based on its chemical composition. This analysis technique is very promising for correlating chemical data with sensory data for wines.

Application of Headspace Sorptive Extraction for the Determination of Volatiles in Wine

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A novel headspace extraction technique termed Headspace Sorptive Extraction (HSSE) was evaluated for the extraction of volatile compounds in wine prior to analysis by Gas Chromatography – Mass Spectrometry (GC-MS). A magnetic stir bar coated with a thick film of polydimethylsiloxane (PDMS) acts as a liquid extraction phase since the polymer is employed above it's glass transition temperature. This coated stir bar is placed in the headspace of a wine sample for a predetermined time while agitating the wine continuously. After extraction the stir bar is thermally desorbed and analysed by GC-MS. Compounds that can be determined in this way include: ethyl acetate, ethyl isobutyrate, ethyl butyrate, ethyl isovalerate, isobu-

tanol, isoamyl acetate, isoamyl alcohol, 1-butanol, ethyl hexanoate, hexyl acetate, ethyl lactate, acetoin, 1-hexanol, ethyl octanoate, vitispirane, 1-octanol, g-butyrolactone, ethyl decanoate, diethyl succinate, b-phenylethyl acetate and b-phenylethyl alcohol. All the compounds are detected well above their limit of quantitation. The repeatability of the method (n = 5) was evaluated in terms of percentage relative standard deviation (%RSD) and ranged from 3.2% to 11.4%. It can be concluded that the method developed is a simple, robust and completely solvent free procedure for determination of volatile compounds in wine and offers an excellent alternative to classical liquid-liquid extraction procedures.