Describing the ultraviolet radiation environment of the grape bunch

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INTRODUCTION

In recent years the focus of much research has turned to the influence of light and heat loads on wine grape quality. Findings over the past years have illustrated negative influences of excessive bunch sunlight exposure and high fruit zone temperatures, impacting on colour development, accumulation of secondary metabolites (Downey et al., 2004) and berry sunburn and skin integrity. Importantly, berry ultraviolet radiation exposure, particularly to UVB, may enhance the accumulation of compounds such as carotenoids (Steel and Keller, 2000) and resveratrol (Threlfall et al., 1999), but may also have negative impacts such as berry sunburn.

METHODS

Sophisticated equipment is available for the measurement of temperature and visible light in very small spaces however measurement of UV radiation has until now required the use of quite cumbersome light meters. In this project we have utilised a system for measurement of UVB exposure which utilises UV dosimeters - small films of polysulphone sensitive to light wavelengths shorter than 330 nm. Dosimetric measurement has been utilised in previous research on horticultural crops (Parisi et al., 2003), however to the best of the author's knowledge this is the first instance of this technology being used for viticultural research.

Dosimetes, measuring 3 cm by 3 cm, were applied to Shiraz bunches in a VSP canopy from véraison to harvest during the 2010 ripening season, in a vineyard sited at Latitude 28° 48' S and 730m elevation. Bunches were situated in the shaded canopy interior, in the west facing side and the east facing side of a N-S oriented row, dosimeters positioned at the top, bottom and north, east, south and west sides of the bunches. A reference dosimeter was also positioned on a horizontal plane to record UV radiation in ambient light.

Prior to placement dosimeter absorbances were read at 330 nm, dosimeters collected after 24 hours and absorbances read again. The absorbance difference was used to calculate the UV radiation at different positions on the bunch as a percentage of the horizontal plane ambient UV radiation.

RESULTS AND DISCUSSION

Results of this project illustrate the differences in UV light exposure on six faces of the bunch; the side exposed to the sun obviously receiving the highest percentage of UV radiation. It is also interesting to note that the northerly faces of exposed bunches were subject to greater UV exposure than the southerly faces; likely due to the more northerly orientation of the sun in the Southern Hemisphere sky.

Vineyard floor management in this vineyard comprised a mid row sward and undervine wood chip mulch. As trial bunches were all situated in the same part of the vineyard with the same vineyard floor management it is unlikely that the vineyard floor impacted on UV exposure of the bottom of bunches, the greater UV exposure of the base of the 'shade' bunches possibly due to albedo reflection from the cordon.

"Shade" bunch

"West exposed" bunch (5 pm)

CONCLUSIONS

The results of this project clearly illustrate the differences in the amount of UV radiation impacting on different parts of the bunch, and suggest that dosimetry has valid application for viticultural research. Future direction of this project seeks to employ dosimetry to explore the impacts of vineyard factors such as trellis type and row orientation, canopy management and vineyard floor management on the UV environment of the bunch. It is intended to further progress this work to investigate relationships between UV exposure and fruit quality.

REFERENCES

Downey, M.O., Harvey, J.S. and Robinson, S.P. (2004) 'The effect of bunch shading on berry development and flavonoid accumulation in Shiraz grapes'. Australian Journal of Grape and Wine research, 10, pp 55-73

Parisi, A.V., Galea, V.J. and Randall, C (2003) 'Dosimetric measurement of the visible and UV exposures on field grown soybean plants'. Agricultural and Forest Meteorology, 120, pp 153-160

Steel, C and Keller, M (2000) 'Influence of UV-B irradiation on the carotenoid content of *Vitis vinifera* tissues.' Biochemical Society Transactions, 28, pp 883-885

Threlfall, R.T., Morris, J.R., and Mauromoustakos, A. (1999) 'Effect of variety, ultra violet light exposure and enological methods on the *trans*-resveratrol level of wine'. American Journal of Enology and Viticulture, 50 (1), pp 57-64

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