INFLUENCE OF PARTIAL ROOTZONE DRYING ON ASPECTS OF GRAPE AND WINE QUALITY

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ABSTRACT

The effect of partial rootzone drying (PRD) on the composition of grape and wine secondary metabolites was investigated. At harvest, total anthocyanin and phenolic concentration in fruit of *Vitis vinifera* L. cvs Shiraz and Cabernet Sauvignon was either unaltered or increased in response to PRD over two seasons. Where an increase in anthocyanin concentration was found with PRD, this was found to be independent of berry size. Rather, increases in anthocyanin concentration were most likely due to an increase in anthocyanin production in the berry skins. In Cabernet Sauvignon wine made from one vintage, total colour was enhanced by 10% in response to the PRD treatment, although in that season total anthocyanin concentration was unaltered in the fruit or wine.

This colour enhancement was due to an increase in coloured pigments in copigmented or polymeric form, that is in association with other anthocyanins or phenolic compounds. This is a significant finding, as it shows that the colour of wine is not dependent upon anthocyanin concentration alone, but rather on reactions taking place during winemaking and wine-ageing. The colour enhancement was found to be maintained after a year's ageing in the bottle. A key question which arises from this work is which component(s) of total phenolics in PRD-treated wines is responsible for this effect. Preliminary investigation of seed proanthocyanidins and flavan-3-ols showed that their content per berry was unaltered by the PRD treatment. However, where berry weight was decreased due to PRD, the concentration of these seed tannins was increased on a per gram basis. This could potentially lead to an increased contribution of seed tannins to total wine phenolics in PRD wines. The effect of this is two-fold. Firstly, seed tannins are known to be weak copigments and could in part account for the increased copigmentation and polymerisation of anthocyanins observed with PRD. Secondly, an increased concentration of seed tannins in PRD wines could alter wine astringency and mouthfeel properties.

In both fruit and wine samples, PRD was found to cause a decrease in the contribution malvidin-glucosides to total anthocyanins. Thus, levels of non-malvidin glucosides, namely delphinidin and cyanidin, were increased by PRD. This effect was investigated as fruit matured post-veraison, and was evident from early in berry development. Preliminary results indicate that this response requires the presence of high incident light levels to the fruit during development, but is not mediated by increased bunch exposure alone. Shading of fruit led to a significant decrease in all anthocyanin types, and caused a shift in the ratio of acetyl- and 3p-coumaryl-glucosides to mono-glucosides. The PRD treatment, however, did not cause changes in the proportions of acetyl-, 3p-coumaryl- and mono-glucoside anthocyanins. These results show that the response of the anthocyanin pathway to the PRD treatment is most likely mediated by physiological signals within the fruit and vine, rather than due to a change in bunch zone microclimate.

An important class of potential flavour and aroma compounds in grapes are the C_{13}-norisoprenoids. As the precursors to these compounds are fruit-derived, rather than by-products of fermentation, the potential exists for their manipulation using viticultural practices. Previously, bunch exposure has been thought to be the primary factor mediating the final levels of C_{13}-norisoprenoids in fruit. The current study has shown that total shading of developing bunches using artificial means led to a significant decrease in the levels of these compounds in both fruit and wine samples of Shiraz. However, when fruit of this variety was subjected to natural changes in bunch exposure, resulting from alterations in canopy structure, the response of the C_{13}-norisoprenoids to these conditions was either small or insignificant. Of the three C_{13}-norisoprenoids studied, namely ß-damascenone, ß-ionone and TDN, only TDN showed a significant response to bunch exposure under these conditions.

Preliminary results of this study on Shiraz indicated that the concentration of the C_{13}-norisoprenoids ß-damascenone and TDN can potentially be influenced by changes in vine shoot vigour and canopy architecture, induced by a water-deficit. This finding was validated by a study on Cabernet Sauvignon, where the effect of PRD on fruit C_{13}-norisoprenoids was investigated. The concentrations of the C_{13}-norisoprenoids ß-damascenone, ß-ionone and TDN were shown to be increased by up to 30% in response

to PRD in Cabernet Sauvignon fruit over two vintages. The changes in these compounds in the fruit were associated with increased levels of the carotenoids lutein and ß-carotene, which are potential precursors to the C_{13}-norisoprenoids. The results of the current study have shown that the regulation of C_{13}-norisoprenoid concentration in grapes and wine may not be primarily due to the level of incident light on developing bunches, although the presence of light is necessary for their production. Rather, the effect of deficit irrigation practices on whole-vine physiology and vine shoot vigour holds stronger potential as a tool for the viticultural manipulation of these compounds in fruit and wine.