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JUICE CARBON ISOTOPE DISCRIMINATION IS RELATED TO VINE GROWTH AND FRUIT QUALITY OF BAROSSA SHIRAZ

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Abstract

Aim: Interactions between soil, climate and management that modulate vine growth, yield and grape composition are strongly defined by vine water availability and nutrient uptake during the season. Carbon isotope discrimination (δ13C) has been used as an integrative measurement of vine water availability during the season, with the potential to identify spatial variations of terroir in vineyards that do not receive irrigation. We measured juice δ13C at harvest across multiple vineyards with the aim to discriminate sub-regions based on soil water availability due to variation in climate, soil and management (especially supplementary irrigation). We explored the relationship between δ13C and pruning mass, yield and fruit parameters important for wine quality.

Methods and Results: The study was conducted in 2019 in irrigated Shiraz vineyards spread across six sub-regions in the Barossa Valley, SA. A total of 63 samples collected at harvest (approx. 25^{o} Brix) were subject to δ13C analysis, this included three samples from each of 21 vineyards. Yield, pruning mass and berry maturity (total soluble solids, titratable acidity and pH) and quality parameters (total tannins, anthocyanins and phenolics) were assessed. Carbon isotope composition of the grape sugars was measured on autoclaved berry juice using a continuous flow isotope ratio mass spectrometer. δ13C discriminated between sub-regions and within vineyards. Vineyards from sub-regions, Eden Valley, Central and Northern Grounds had lower δ13C than vineyards from the Western Ridge and Eastern Edge, with the Southern Grounds. Similarly, zones within a vineyard with lower plant biomass, as indicated by PCD imagery, showed lower δ13C. A significant relationship was observed between δ13C and yield (r = -0.72***), pruning mass (r = -0.54**), anthocyanins (r = 0.65**) and total phenolics (r = 0.61**). Higher water stress (< δ13C) during the season was associated with a lower yield, lower pruning mass but with higher total anthocyanins and phenolics. No significant relationships between δ13C and other berry traits (including total tannins) were observed.

Conclusions: δ13C is a useful method to integrate and distinguish components of terroir that affect vine productivity and some fruit quality parameters which remains sound even when the vines receive irrigation.

Significance and Impact of the Study: This study shows the potential use of δ13C to discriminate between blocks with different moisture availability that may induce changes in yield and some aspects of fruit quality. δ13C may emerge as a proxy for terroir in zoning studies of irrigated vines, but further validation is needed using cluster analysis that integrates soil, climate and fruit composition geospatially across multiple seasons.

Keywords: Carbon isotope discrimination, water availability, grapevine growth, fruit composition, terroir