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An investigation into the effect of grapevine age on vine performance,
grape and wine composition, sensory evaluation and epigenetic
characterisation.

by

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Adelaide in fulfilment of the requirements for the degree of

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An investigation into the effect of grapevine age on vine performance, grape and wine composition, sensory evaluation and epigenetic characterisation.

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Abstract

The grapevine *Vitis vinifera* L. is a perennial cropping plant capable of surviving for decades or centuries. Examples exist of cultivated grapevines still fruitful after more than 400 years. However, in commercial viticulture multiple biotic and abiotic factors challenge longevity. Vineyards of greater vine age are often highly regarded due to the perceived quality of fruit and wine they produce. This is an entrenched phenomenon in the wine industry and media which has barely been exposed to critical examination.

The aim of this research was to assess the influence of vine age on grape and wine production. This research is ambitious and the goal is to serve as an investigation into the potential influence of vine age and a guide to future studies. Several key areas were selected for investigation: grapevine performance, fruit and wine composition and sensory analysis, wine metabolomic analysis and molecular (genome and epigenome) analysis.

Five Shiraz vineyards with genetically related ‘young’ and ‘old’ plantings in close proximity were selected with an average age difference of over 97 years. To date, this represents the greatest spread and extreme of vine ages to be subjected to scientific scrutiny.

Vine age was found to influence reproductive performance; older vines produced greater yields however, all vines were influenced by seasonal variation irrespective of vine age. Greater trunk circumference may be a key determining factor in increased reproductive capacity with age. Other measures of vine performance such as Y/P, shoot number, count shoots or shoot mass did not differ with age.

Wine quality is largely determined by the characteristics of the fruit from which it is made. This research used common chemical and modern ‘omics techniques to elucidate quality traits that may be unique with increased vine age. Large differences in vine age did not produce differences in basic grape composition. Interestingly, older vines had a lower pH at similar Brix level. Compositional measures did not differentiate vine age categories and they were more indicative of the region where the fruit was grown. Analysis of secondary metabolites such as tannins and phenolics showed greater differentiation of growing region. Phenolic profiling revealed regional based influences of key compounds of known sensory outcomes, these results were supported by sensory analysis.

Sensory Descriptive analysis was undertaken on both grapes and wine over three seasons. Despite similar maturity profiles, differences were detected associated with grapevine age in both grape and wine samples. Grapes and wine from older vines showed consistent sensory characteristics across seasons, generally described as a lighter fruit profile. Targeted metabolomic analysis of fermentation derived volatile compounds also differentiated between vine-age groups at most sites.

Using modern next generation sequencing and reduced representation libraries, analysis of the genome and epigenome was undertaken. Genetic similarity between sites and ages was not detected, however, global DNA methylation level differed with vine age. DNA methylation was also associated with geographic distance and method of propagation. Differential methylation markers (DMMs) were found via pairwise comparisons between the sites one to four and the oldest two sites only. Site five presented no DMMs and a unique global methylation profile attributed to propagation technique, despite an age difference of 87 years.

Despite large differences in grapevine age, both site and season are highly influential in a broad range of qualitative assessments. The greater perceived quality attributed to grapevine age is subject to environmental influence and is more complex than previously thought

Declaration

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and to the best of my knowledge and belief, contains no material previously published or written by another person, except where due references has been made in text.

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Dylan Grigg

16/10/2017

Date

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