



Linkage of within vineyard soil properties, grapevine physiology, grape composition and sensory characteristics in a premium wine grape vineyard.

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Analysis of numerous vineyards has revealed a very high degree of variation exists at the within vineyard scale and may outweigh in some cases broader mesoclimatic and geological factors. For this reason, selective harvest of high quality wine grapes is often conducted and based on subjective field sensory analysis (taste). This is an established practice in many wine growing regions. But the relationships between these subjective judgments to principle soil and grapevine physiological characteristics are not well understood. To move toward greater understanding of the physiological factors related to field sensory evaluation, physiological data was collected over the 2007 and 2008 growing seasons in a selectively harvested premium production Napa Valley estate vineyard, with a history of selective harvesting based on field sensory evaluation. Data vines were established and remained as individual study units throughout the data gathering and analysis phase, and geographic information systems science (GIS) was used to geographically scale physiological and other data at the vineyard level. Areas yielding grapes with perceived higher quality (subjective analysis) were characterized by vines with 1) statistically significantly lower ($P < 0.05$) leaf water potential (LWP) both pre-dawn (PD) and midday (MD), 2) smaller berry diameter and weight, 3) lower pruning weights, and 4) higher soluble solids (Brix). Strong positive correlations emerged between June ψ_{PD} and pre-harvest grape berry diameter ($R^2 = 0.616$ in 2007 and 0.413 in 2008) and similar strong correlations existed for berry weight ($R^2 = 0.626$ in 2007 and 0.554 in 2008). A trained sensory panel performed a sensory analysis and characterized fruit using and a multivariate, principal components, analysis (PCA). This approach indicated that grapes from vines with lowest midday leaf water potential at veraison (< -1.5 MPa) had sweeter and softer pulp, absence of vegetal characteristics, and browner and crunchier seeds, while grapes from vines of > -1.5 MPa were characterized by vegetal flavors and astringent and bitter seeds and skins. Data from vines were grouped into vines experiencing MD at veraison of < -1.5 MPa versus vines with MD > -1.5 MPa and subjected to single factor analysis of variance. This analysis revealed statistically significant differences (P less than 0.05) in many of the above properties – berry diameter, weight, pulp, and fruity versus vegetal characteristic. The groupings corresponded to the areas described as producing higher and lower quality fruit, respectively, based on field taste evaluation. Metabolomic analysis of grape skins from these two groups showed statistically significant differences in accumulation of amino acids and organic acids. Our results suggest there is not a continuous relationship between physiological water status (stress) and grape sensory characteristics, but rather the presence of an inflection point that may be related to early season PD in controlling grape development as well as composition. Soils analyses revealed the preferred fruit was on vines in areas where soils were shallower rather than any definitive characteristic related to particle size distribution or nutrient availability, suggesting that in this vineyard soil available water is the major controlling factor.