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**Environmental effects on Cabernet
Sauvignon (*Vitis vinifera* L.) when grown in
different sub-regions within Hawke's Bay
(New Zealand)**

A thesis presented in partial fulfilment of the requirements for the degree of
Doctor of Philosophy in Plant Science

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The list of abbreviations and indices

Abbreviation	Description
r	Coefficient of simple correlation
R	Coefficient of multiple correlation
SE	Standard Error
CDA	Canonical Discriminant Analysis
PCA	Principal Component Analysis
CV	Coefficient of variation (%)
FTIR	Fourier Transform Infrared
ppt	Parts per trillion
TSS	Total Soluble Solids (°Brix)
TA	Titrateable Acidity (g/L)
IR	Index of Ripeness, or gluco-acidometric index
IRA	Index of Ripeness corrected for Anthocyanins
AC	Concentration of anthocyanins in wine (g/L)
d.w.	Dry Weight
f.w.	Fresh Weight
O.D.	Optical Density
AOC	<i>Appellation d'origine contrôlée</i>
GDD	Growing Degree-Days (°D)
ET	Estimated potential evapotranspiration (mm)
ESA	Estimated exposed leaf Surface Area
SC	Canopy density ScoreCard points
CDI	Canopy Density Index
RDI	Regulated Deficit Irrigation
IPF	Index of precocity of flowering
IPV	Index of precocity of véraison
IPCY	Index of precocity of the vegetative cycle
SF	"Soil Factor"

Environmental effects on Cabernet Sauvignon (*Vitis vinifera* L.) when grown in different sub-regions within Hawke's Bay (New Zealand)

Abstract

During three consecutive seasons a study was undertaken in order to characterise viticultural environments for cv Cabernet Sauvignon in Hawke's Bay. The initial 1996/97 study showed that phenology, titratable acidity and canopy characteristics were of central importance for site characterisation. Based on fruit and canopy attributes of the initial 28 sites, six were selected for a detailed study in the 1997/98 and 1998/99 seasons. Air temperatures varied slightly between the six sites and some differences were observed in temperature amplitudes and rainfall. Variability between sites in solar radiation was low. A large variability was observed in soil temperatures, with gravel and sandy soils warmer than silt and clay. A budburst model based on air and soil temperatures is presented. Canopy density was affected by seasonal variability of soil moisture and soil temperature. Yield to pruning ratio was higher at sites with light soils than at others. Flowering date was correlated with temperature and rainfall in the month preceding flowering and with shoot length before flowering. Duration of flowering was negatively correlated with temperature and with fruit set. *Véraison* and ripening were significantly affected by soil and air temperatures. Soluble solids in fruit at harvest were positively correlated with air and soil temperature and negatively with soil moisture content. Total phenolic and anthocyanin concentration in berry skins was correlated with soil temperature and soil moisture content.

Harvest dates at each of the studied sites were chosen solely by their respective vineyard managers and the information driving these decisions was not made available. Differences between seasons and sites were found in sensory evaluation scores of unreplicated wines produced by microvinification. High wine scores were associated with precocity in

phenological stages, favourable canopy density and optimal Mg status of the vines. The novel TSS/malic acid*pH maturity index was positively correlated with wine scores and appears to offer potential for early prediction of Cabernet Sauvignon wine quality. Air and soil temperatures for the final ripening month were positively correlated with wine scores. Wines from soils of limited water capacity or limited root growth achieved highest sensory evaluation scores, probably by reducing vegetative growth and thus inducing canopy characteristics favourable for fruit development and ripening.

The use of a 'Soil Factor' (SF) that integrates soil temperature, soil moisture volumetric content, depth of topsoil and water availability index based on soil texture is proposed. SF is significantly correlated with several attributes of vine vegetative growth, véraison date, soluble solids, tartaric acid, malic acid, total phenolics and anthocyanins in fruit, and with wine scores. It appears that environmental characterisation of vineyard sites in Hawke's Bay based mainly on SF is possible. This site characterisation could eventually lead to determination of future viticultural 'terroirs' for Cabernet Sauvignon.

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