Regression analysis between VineLOGIC-predicted versus observed values for key variables

Purpose

The aim was to provide a snapshot of the performance of the VineLOGIC model, published through the CSIRO Data Access Portal (https://doi.org/10.25919/5eb3536b6a8a8), by regressing model-predicted values for phenology, yield and yield component variables, and berry anthocyanins, against values from the three datasets (WNRA0103, WNRA0305 and WNRA0506) provided with this collection.

Methods

Linear regression models have been used to compare VineLOGIC-predicted versus observed values for budburst, flowering, veraison and maturation dates, yield, berry and bunch fresh weights and berry anthocyanin concentration. We have used data from the 9, 9 and 11 treatments in the WNRA0103, WNRA0305 and WNRA0506 datasets, respectively (n = 29 treatments), except for berry anthocyanin concentration where n = 28 treatments, i.e. those involving the red-berried varieties, Cabernet Sauvignon and Shiraz. For the phenology variables, involving dates, the dates were converted to day-of-year values.

Results

The results of regression analyses are shown in Table 1. Statistically significant relationships were obtained between predicted and observed values for budburst date, vine yield, vineyard yield, berry and bunch fresh weights (all $p < 0.001$) and berry anthocyanin concentration ($p = 0.001$). The relationship between predicted and observed values for veraison was also significant ($p < 0.05$). However, the relationships between predicted and observed values for flowering and maturation dates were not significant.

The variance between predicted and observed values increases from budburst through to maturation, e.g. the predicted dates relative to observed dates for budburst, flowering, veraison and maturation across all treatments ranged from 'days early' to 'days late' of -8 to +3, -12 to +9, -12 to +22 and -10 to +42 days, respectively.

Budburst, flowering (the model predicts first flowering) and veraison dates in VineLOGIC correspond with development stages E-L 4, E-L 19 and E-L 35, respectively (Westover 2018). Measured dates for budburst, flowering and veraison in the vineyard were based on the following: (a) budburst, when 50% of buds have burst, (b) flowering, at the time of 80% cap fall (WNRA0103) and when 50% of inflorescences were flowering (WNRA0305 and WNRA0506), and (c) veraison, when 50% of berries had softened/changed colour. Differences between how the model determines the date for a phenological stage and the protocol used to measure the date for that phenological stage in the vineyard may contribute to the variation.

In the context of measured data sets for a specific parameter, it is important to aim for an extensive and robust data set, in terms of per vine measures, across multiple vines, to best

capture vine and vineyard variability. Of course, this is not always possible due to labour and time constraints.

Table 1. Outputs of regression analysis between model predicted and measured values for dates of budburst, flowering, veraison and maturation, vine yield, vineyard yield, berry and bunch fresh weights and berry anthocyanin concentration. ns = not significant; FW = fresh weight.

Variable	Adjusted R^2	Probability (p)	Slope	Constant
Budburst date	0.728	<0.001	0.797	54.92
Flowering date	ns	ns	0.275	225.69
Veraison date	0.140	0.026	0.405	9.89
Maturation date	0.089	0.064	0.225	43.69
Vine Yield (kg/vine)	0.555	<0.001	0.902	-0.35
Vineyard Yield (kg/ha)	0.548	<0.001	0.898	-347.93
Berry FW (g)	0.585	<0.001	0.691	0.22
Bunch FW (g)	0.682	<0.001	0.846	2.77
Anthocyanin (mg/g berry FW)	0.348	0.001	1.335	-0.20

Further comparative options

Further comparison between model predicted and measured values for key variables is possible using a test script included with the VineLOGIC source code publication (https://doi.org/10.25919/5eb3536b6a8a8). The test script allows the model to be run against treatments in a VIX file obtained from any of the WNRA0103, WNRA0305 or WNRA0506 data sets, generating output and optionally comparing against expected output.

Reference

Westover, F. (2018) Grapevine phenology revisited. Using growth stages to improve vineyard management. Wines and Vines, March 2018.