ASSESSING BUNCH ARCHITECTURE FOR GRAPEVINE YIELD FORECASTING BY IMAGE ANALYSIS

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Abstract:

Context and purpose of the study - It is fundamental for wineries to know the potential yield of their vineyards as soon as possible for future planning of winery logistics. As such, non-invasive image-based methods are being investigated for early yield prediction. Many of these techniques have limitations that make it difficult to implement for practical use commercially. The aim of this study was to assess whether yield can be estimated using images taken in-field with a smartphone at different phenological stages. The accuracy of the method for predicting bunch weight at different phenological stages was assessed for seven different varieties.

Material and methods - During the 2017-18 growing season in the Coombe Vineyard at the Waite Campus of the University of Adelaide seven different varieties were chosen for this study: Semillon, Grenache, Shiraz, Merlot, Sauvignon Blanc, Tempranillo and Cabernet Franc. After fruitset, 30 vines per variety were selected and two shoots were flagged on each vine. Images of bunches were taken five times from EL stage 30-31 to EL stage 37-38 using a smartphone. Bunch volumes were estimated from images. At harvest bunches were collected, weighed and imaged in the laboratory to compare with field images.

Results - This new approach using a smartphone to forecast the yield showed promising results. Accurate weight forecast models could be obtained by taking bunch images at veraison (R^2 ranging from 0.71 to 0.84). As the bunch architecture of different varieties can vary further studies are required to improve the accuracy of this method. The tools used for this study are inexpensive, in common use, and do not need a high level of expertise to use them, furthermore, the labour required to obtain data, is not time-consuming.

Keywords - bunch architecture**,** yield prediction, image analysis, non-destructive method

1. Introduction.

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Introduction and Aim

- **Forecasting grape yield** is important in order to; adjust vineyard management, equipment requirements, negotiate pricing and future marketing strategies (*Liu et al., 2013*).
- As such, **non-invasive image-based methods** are being investigated for **early yield prediction**.
- Aim - to assess whether yield can be estimated using images taken in-field with a smartphone at different phenological stages.

Materials and Methods

Season	2017-18
Location	Waite Campus, The University of Adelaide
Varieties	Semillon, Grenache, Shiraz, Merlot, Sauvignon Blanc, Tempranillo and Cabernet Franc
Sampling	30 vines per variety were selected and images of bunches taken five times during the season (Fig.1) from EL stage 30-31 to EL stage 37-38

Results

- Bunch volume at different phenological stages correlated with bunch weight at harvest (Table 1).
- The best stage to forecast yield from images was EL 33-35.
- At harvest, no differences were observed between bunch volume measured in-field and in the laboratory for all varieties.
- Accurate models to forecast bunch weight were obtained by taking images of bunches with a smartphone in-field at veraison.

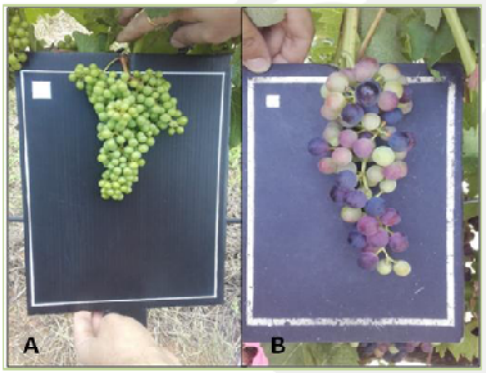

Figure 1. Example of images taken, using a smartphone, at different phenological stages (A) bunch closure and (B) veraison

Table 1. Coefficients of determination (R^2) of the correlations between bunch volume and bunch weight in eight varieties at different phenological stages.

	EL Phenological Stages					
Variety	**30-32**	**31-33**	**32-34**	**33-35**	**36-38**	**LAB**
Cabernet Franc	0.71	0.72	0.79	0.75	0.81	0.82
Grenache	0.64	0.71	0.79	0.77	0.80	0.84
Merlot	0.83	0.85	0.81	0.84	0.90	0.90
Semillon	0.76	0.70	0.72	0.71	0.80	0.85
Shiraz	0.59	0.64	0.70	0.71	0.74	0.77
Sauvignon Blanc	0.71	0.75	0.71	0.81	0.77	0.84
Tempranillo	0.70	0.68	0.69	0.82	0.74	0.74

The values reported are significant (p-value ≤ 0.001).

Discussion and Conclusions

- Bunch architecture and development explained the differences in the model's accuracy between varieties.
- Yield estimation using an innovative image-based smartphone technology can be achieved.
- More accurate models can be obtained by taking into account bunch architecture for different varieties.
- Smartphones are now ubiquitous and provide high computing capabilities; this could become an easy, quick and inexpensive tool for yield forecasting.
- Early yield prediction will allow grapegrowers to make informed management decisions to regulate the yield.

Reference

Liu, S. et al., 2013. Towards automated yield estimation in viticulture. In the Proceedings of the Australasian Conference on Robotics and Automation, Sydney, Australia, 2–4 December 2013.