Research in Plain English (RIPE)

Using cell phones to obtain accurate prebloom cluster counts

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By Michelle Podolec.

The Takeaway

- Current methods for estimating grapevine yield involve manual cluster counts and/or destructive cluster sampling to obtain cluster weights.
- With manual labor, only small samples that may not be representative of a variable vineyard block can be collected.
- As a result, manual sampling can have a high error rate (up to 23.5%), which leads to significant over- or under-estimates of fruit at harvest.
- Researchers have developed a new method for estimating cluster numbers at prebloom using smartphones and easily accessible image analysis software for growers.
- Automated image capture and analysis means that a larger number of vines can be sampled, increasing coverage and accuracy.
- The new computer vision-based method had an improved yield estimate error (maximum of 12.6%).
- While it isn't yet calibrated to region, cultivar, or variable growing seasons, the new method may offer vineyards a new option for estimating grapevine yield sooner, with less expense and more accuracy.

A farm utility vehicle or atv can be modified for use in automatic sensing in vineyards by mounting a light panel and a smartphone on a gimbal. Photo by Jonathan Jaramillo.

Background

Estimating grapevine yield is a challenging aspect of vineyard management. Yield estimates are used to help vineyard managers assign and plan for equipment and labor costs, expected tank space and packaging needs, and to predict annual finances. Better estimation processes and accuracy could be really helpful to vineyards as it would provide operators more time to prepare for labor, crop, and processing.

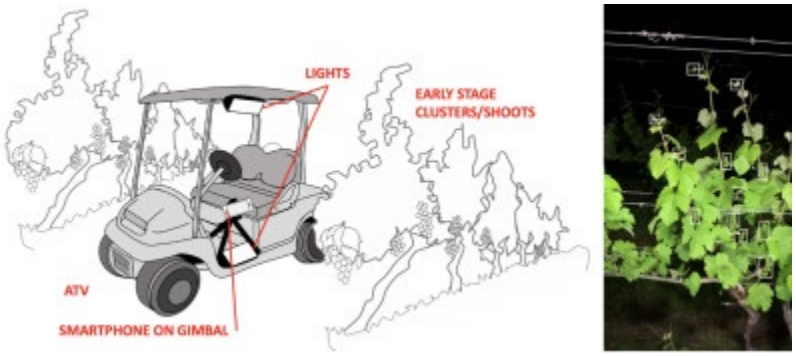
Current methods available for yield estimation (Largest Cluster Weight Method, Lag-Phase Method, Growing Degree Day Method) are destructive and expensive, requiring the manual collection of many grape berries. To be accurate, data collectors must learn specific techniques and the process can take a lot of time to complete. The methods currently available are also not very accurate, and tend to rely on long-term averages. Climate change and dramatic annual fluctuations can make yield estimation methods even less reliable.

What if this could be automated? Automating yield prediction would be ideal if it could be made reliable and low-cost. Vine image analysis has advanced in sophistication, but the systems currently used for yield estimation include high cost technology and software, and focus on warm climates with small vines, putting them out of the reach of many vineyards. Scanning vines in the northeast is particularly hard due to the region's high vigor grapevines.

In this study, the researchers wanted to find a better, more accessible and effective yield estimation method that would be more accurate for cool climate vineyards.

Methods

The study compared manual cluster counts performed by several individuals with smart-phone cluster counts obtained from static images and using video 'drive-by' footage obtained from a vehicle-mounted cell phone aimed at the fruiting zone. Researchers used four widely-used object detection models to compare the accuracy of the manual cluster counts versus machine-trained automated counting image analysis.



Automated counting image analysis software uses the data obtained from a scan the vineyard vegetation to provide a more accurate cluster count. Photo by Jonathan Jaramillo.

Conclusions and Practical Considerations

In this experiment, traditional methods using manual counting of clusters and shoots were 9 to 26 % inaccurate, and the variation depended on who did the counting. The current method of overcoming this wide range of error is to sample more of the vineyard, which takes more time and labor.

By using an automated method of a tractor mounted LED panel, smartphone, and software that identified and counted clusters and shoots, researchers were able to generate more accurate estimates than manual counting, in part because the software does a better job and more consistent job accounting for variability in the number of clusters per panel. The automated method allows the user to quickly scan the entire vineyard and obtain a larger data set that provides better coverage and greater precision. The researchers suggest several improvements for improving future automated data collection methods. Overall, this experiment was very promising in presenting a low-cost, easy to use, and inexpensive method for increasing yield prediction accuracy.

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