

Defining Crop Load Metrics for Quality Pinot Noir Production in Oregon

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Summary

A three year study began in 2013 to determine the impact of varying crop levels on vine growth and vine balance. The project involves two components: 1) a large grower collaborator crop load study and 2) a study that monitors vine growth, nutrition and physiology measures within four sites from the larger study. During 2013, the project included a total of 13 vineyard and winery businesses from across six AVAs in the Willamette Valley of Oregon. Collaborators successfully completed their first season of data collection as of this reporting, and results are being compiled and in spring/summer 2014. The additional data from the four sites within the study are being analyzed in spring/summer2014, but preliminary data that shows no difference in vine photosynthetic assimilation or vine nutrition at bloom or véraison when comparing full crop (non-thinned vines) with those cluster-thinned to one cluster/shoot.

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Cooperators: Project cooperators during 2013 included thirteen commercial vineyards and/or winery businesses in Oregon: Adelshiem Vineyard, Airlie Winery, Archery Summit, Atlas Vineyard Management, A to Z Wineworks, Bethel Heights Vineyard, Chehalem Winery, Domaine Serene, Ken Wright Cellars, Lemelson Vineyard, Van Duzer Vineyards, Willakenzie Estate, and Winemakers Investment Properties.

Objectives and Experiments Conducted to Meet Stated Objectives

Objective 1: Develop the statewide research effort to implement and conduct research trials in commercial vineyards and wineries to address vine growth, fruit and wine quality as a result of yield management.

The statewide research program was initiated in 2012 with the recruitment of the first set of ten collaborators who successfully implemented the project. Now that the basic framework for operation has been established, the goal is to increase participation into other areas of the state of Oregon. A recruitment call was released in April 2013. The application process required the completion of an application form and review by the PI. Only businesses that met the following criteria were approved to join the study: a healthy, uniform Pinot noir vineyard of >5 years of age and at least 1 to 1.5 acres in size to use for the trial, enough acreage to support involvement in a trial of this size without compromising their overall production, ability to conduct the research for at least three years in the same vineyard block, willingness to follow project protocols for experimental design and ability to collect data required according to project protocols. Since all new collaborators were from the Willamette Valley and in close proximity, they were trained through one-on-one meetings in the vineyard. The PI made initial site visits to each vineyard to check the suitability of the research block for use in the project and provided training on experimental design and layout for the project. Follow-up visits were conducted by the PI and faculty research assistant (FRA) as needed to ensure collaborator confidence in taking part in the study. Training was also conducted as needed by the PI and FRA on a one-on-one basis for any new employees at companies who had joined the project previously.

A collaborator meeting was held in April 2013 to discuss protocols and ensure greater understanding of all collaborators in the group. The group decided to add two additional data collection components to the study, including fruitfulness (early season counts of clusters/shoot) and tissue nutrient analysis. The members-only website continued to serve as a central hub for locating protocols, data sheets, data entry files and for posting questions and providing updates for the entire group.

Collaborators in the study chose to implement between two and five different crop levels within their vineyards. The majority chose to implement either two or three crop levels, with the most common treatments being 1 cluster/shoot, 2 clusters/shoot or no crop thinning. Because our fruitfulness is approximately 2 clusters/shoot or less, crop thinning was easily managed on a larger scale by using these two thinning treatments. Those who joined the study in 2012 utilized the same experimental blocks, and new collaborators developed their vineyard experiment using the same randomized complete block design with whole row plots and at least three field replicates.

Collaborators followed specific protocols developed by the PI for data collection. All data was collected from 10-vine reference plots within three replicates of each treatment. Data collection included fruitfulness counts in spring, shoot and cluster counts before thinning and post-thinning, yield at harvest and pruning weights. All field data was collected by staff of the commercial vineyard following our outlined protocols. Data sheets are provided to the collaborators for collection as well as a calibrated hanging scale for yields and pruning weights.

Vine nutrition samples were collected at véraison by collaborators from these reference vines and submitted to a commercial lab where they were analyzed for macro- and micro-nutrients. Wilco Coop (Matt Fagerness) volunteered in this study to arrange for sample coordination and delivery from the collaborator to the commercial lab and shuttling the data to the PI at OSU.

Fruit samples were collected across the entire plot for all treatments during at least two time points prior to harvest to monitor ripening progression. At harvest, a 20-cluster fruit sample was collected from the reference vines in each plot, weighed and measured for cluster weight by the grower, and picked up by OSU for processing and shipping to ETS Labs. Fruit was analyzed using ETS Lab's basic ripening panel and rapid phenolic panel (total soluble solids, pH, TA, L-malic acid, tartaric acid, glucose + fructose, ammonia, alpha-amino acids, YAN, K, catechin, quercetin glycosides, tannins, polymeric anthocyanins, total anthocyanins, and catechin/tannin index). This service was donated by ETS Labs in 2013. Their donation of services was critical to obtaining more data than is possible through a small-scale grant.

At harvest, growers producing wine from the trial arranged for wine production. The majority of collaborators (11 of 13) made wines from the trial in 2013. All plots per treatment were bulked for wine production in a minimum of 1.5 ton fermentations. Wines were produced to each collaborator's commercial standard per winery but using the same method for all wines in the study. Wines will be evaluated by a sensory group in-house and by a trained panel through OSU's Oregon Wine Research Institute (OWRI). Dr. Elizabeth Tomasino and Dr. James Osborne, both of OSU, are working to develop in-house sensory methods for collaborators to begin using in 2014. All wines are to be bottle-aged two years before they will be entered into sensory evaluation by the trained panel at OSU.

Objective 2: Evaluate vine growth and nutrient status data with fruit/wine composition data to develop better vine balance metrics for Oregon Pinot noir.

Four sites were selected from the research group outlined in Objective 1 during 2013 to focus on more detailed plant growth and physiology measures than those gathered by the collaborating vineyards in Objective 1. Preference was given to those sites where vine vigor varied significantly (high and low pruning weights). The four vineyards were monitored for shoot length and shoot leaf area at bloom and véraison, leaf gas exchange (assimilation and stomatal conductance) and leaf chlorophyll measures at both bloom and véraison during 2013. Leaf area and vine canopy measures were determined with various techniques, several of which are under development as potential new methods for field researchers to more efficiently measure leaf area. All measures were done in-field using non-destructive methods. Canopy density and incident sunlight was measured at véraison using a LP-80 ceptometer (Decagon Devices, Pullman, WA) to get another measure of canopy density and solar radiation interception of the canopy to compare with leaf area data. Leaf assimilation and stomatal conductance was measured using a LICOR 6400 XT (LI-COR Biosciences, Lincoln, NE) during véraison at all four sites within the same week of data collection. Leaf greenness (an estimate of chlorophyll) was measured with a SPAD-502 meter (Konica-Minolta, Ramsey, NJ). These data are currently being analyzed in winter 2014 to determine vine photosynthetic productivity and how it relates canopy leaf area, yield, pruning weight and crop load (Ravaz; yield/pruning weight). Nutrient status of vines were analyzed from both leaf blades and petioles collected at bloom and véraison. Vine nutrient and carbohydrate (sugars and starch) reserves are being measured in cane tissues collected in mid-January 2014. Pruning weights were also measured during the time of dormant sample collection in January, and those data are being collated with other vine growth data, nutrient data, and pending carbohydrates for statistical analysis in 2014.

Summary of Major Research Accomplishments and Results by Objective

Objective 1: Develop the statewide research effort to implement and conduct research trials in commercial vineyards and wineries to address vine growth, fruit and wine quality as a result of yield management.

A total of 13 companies are currently collaborating in this research project. Ten companies joined in the first year (2012) and an additional four companies joined the project in 2013. We had one collaborator who began in 2012 that was no longer able to take part in the study in 2013. All collaborators are from the Willamette Valley, but they span across six AVAs (Chehalem Mountain, Dundee Hills, Eola-Amity Hills, Ribbon-Ridge, Willamette Valley, and Yamhill-Carlton). The composition of the collaborators also spans across different production goals and a diversity of site characteristics that allow for a greater ability to assess vine balance across the region. During 2013, we were able to successfully recruit and train the new collaborators, and we received 100% of the data for all sites from spring data collection to harvest. At this reporting, we have over 50% of the pruning weight data already collected from collaborators to finalize the 2013 data collection season. Data analysis is still underway during 2014, and results will be shared with the collaborators in a spring meeting.

Objective 2: Evaluate vine growth and nutrient status data with fruit/wine composition data to develop better vine balance metrics for Oregon Pinot noir.

Four sites within the larger “Statewide Crop Load Project” outlined in Objective 1 were identified for vine physiological measurements. These sites were chosen based on their diversity in vine vigor, crop level and vineyard site diversity observed in 2012. Two sites are located within the Eola-Amity Hills and the other two are located in Yamhill-Carlton. Focus of research was placed on the same cropping level across all sites (1 cluster/shoot and no thinning) to ensure that sufficient yield differences were being tested within the larger study for the vine physiological measures.

Vine nutrient samples were collected at bloom and véraison 2013, and the tissues were analyzed in fall 2013 by the Schreiner Lab. Bloom and véraison data were analyzed separately, using a 2-way ANOVA model with location (site), treatment and their interaction as factors. For both bloom and véraison, treatment (crop level) did not have an effect on any leaf or petiole nutrient concentrations ($p>0.05$). However, there were large differences in vine nutrient status among the sites. We anticipate that there may be greater differences in nutrient status between crop levels in the future, and the lack of differences found this year may be due to the fact that different crop levels were first applied in 2012 and may have had little impact on the nutrient status at this point. One site in particular has low nitrogen (N), and we anticipate a greater impact of crop level on vine N in 2013.

Single leaf gas exchange was measured at véraison in all four sites in September 2013. There were no differences found by crop level for photosynthetic assimilation or stomatal conductance at any of the four locations. Again, we believe we may have more differences as we continue with this study. With different crop levels maintained on vines over time, we will eventually be able to monitor shifts in vine nutrition and vine vigor and gain a better understand long-term impacts of maintaining different crop levels.

All data collection is complete for the 2013 season. However, carbohydrate analysis is still in progress. The entire data set are in the process of being statistically analyzed within and across sites to determine vine balance effects on both growth and fruit composition.

Outside Presentations of Research

The first results from this research (Objective 1, funded in 2012 by OWRI) have been presented by the PI to peers and industry at various events/venues during 2013. Results from 2012 were shared with the collaborators and industry advisors at an April 2013 meeting. A presentation of the first year of the study was presented to the Oregon industry at the Oregon Wine Research Institute’s Grape Day in April 2013. Presentations about crop load research of the PI were also made at the Wineries Unlimited conference in Richmond, Virginia in March 2013, and some preliminary data from 2012 was included. Seminars were presented to industry during regional meetings throughout the state, and in regional technical group meetings (consisting of industry members) during 2013. Since the first year data for Objective 2 is still in progress, no presentations have been made on this component of the research to date.

Research Success Statements

Given the strong grower collaboration in this study, this effort to better define vine balance metrics is important to Oregon vineyards and wineries. From our conversations with the vineyard collaborators, we are reaffirmed that reducing canopy management (crop thinning) costs and increasing yields without compromising fruit quality is of paramount importance to the Oregon winegrape industry. With labor becoming more difficult to secure for manual processes such as crop thinning, and the increasing costs of production, growers are more inclined to experiment with new ideas directly to help make future management decisions for their companies. Conducting this research actively with grape growers and winemakers taking an active role in the research is beneficial for their understanding of the effects of crop thinning on their own vineyards and the resulting wine. As active participants in the research, they also learn how to design on-farm studies to help address questions in a systematic way and possibly look at their vineyard productivity in a different way to influence their management decisions.

There is a lack of scientific data to support current crop thinning practices for high quality Pinot noir, and crop adjustments are likely being managed to potentially invalid metrics. Vine balance metrics currently published for optimum quality (Ravaz Indices, leaf area to yield ratios) are not suited to cool climate Pinot noir production. Research conducted by the PI in other crop load studies (2011-2013) show that lower yields do not unilaterally mean increased grape quality nor hastened ripening. This larger research project will help expand this crop load research conducted in Oregon Pinot noir and help develop better metrics that allow a flexible approach to managing vine balance and fruit quality rather than applying a rigid target yield without regard to vine vigor, growing region, and season.

Fund Status

The project outlined in Objective 1 was initiated in 2012 and funded by the Oregon Wine Research Institute through a pilot project program. The funding provided in 2013/14 through the Oregon Wine Board allowed for expansion of Objective 1 to new collaborators and begin a new avenue of research within the project through Objective 2. Funds were used to support half of a full time faculty research assistant (Michael Kennedy) who works in the Skinkis Lab and assists in the communication and coordination of information between the PI, co-PI and industry collaborators. Funding for Objective 2 was used to travel to four research sites and collect additional data including nutrient samples, canopy measurements (vine leaf area, shoot lengths, etc.) and conduct analyses of light and photosynthetic assimilation. We will continue to use funds through August 2014 to finalize data collection from Year 1 of the project.

The research team wants to thank the Oregon Wine Board for the financial support of this research project and for their continued support of other research within the program of the PI.