Mid-Year Progress Report (March 2018) Virginia Wine Board

Relationship Between Soil pH and Fruit pH

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Objectives: 1) Assist Virginia winegrowers in understanding the potential impact that soil pH has on fruit and wine quality. 2) Help develop evidence-based liming recommendations for Virginia vineyards with a focus on wine quality.

Introduction

High fruit and must pH is a common obstacle faced by Virginia winemakers year after year. Our work attempts to isolate the relationship between soil pH and fruit/wine pH in *Vitis vinifera* grapes to help growers understand the potential impact that soil pH has on fruit and wine quality and build a foundation for industry-wide liming recommendations. pH is a principal wine quality parameter which can be managed to some degree in the vineyard, but a more robust dataset from Virginia vineyards is needed before we start making broad recommendations regarding soil pH and potential fruit quality.

Background

Soil pH directly influences the amount of potassium (K) available to vines and vine K status is related to potential wine pH. Bates, et al. (2002) showed an inverse relationship between soil pH and plant tissue potassium (suggestive of fruit pH) in Concord grapes. Rettalack and Burns (2016) identified an inverse relationship across the Willamette Valley between wine pH and minimum soil pH reported for the associated soil series, as mapped in the county soil survey. Because of such findings, many industry professionals suggest that amending vineyard soils with more (dolomitic) lime than traditionally utilized in our region could be a solution to combat high fruit pHs.

Accomplishments/Benefits to date:

Methodology

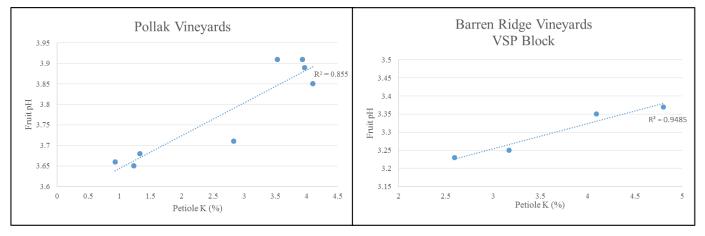
We implemented the following methods at each of our three (3) research sites:

- Soil EC mapping (provided by HydroGeo at no cost to the Wine Board) to delineate unique soil zones
- Selection of discrete sample locations (2 panels x 2 rows) based on spatial layout of soil variability; locations marked in field using differential GPS technology
- Soil auger holes at specific predetermined locations; collection of composite soil samples from discrete depths at each auger hole (four- to six auger holes per sample location)
- Soil chemical analysis by Waypoint Analytical Laboratories; samples analyzed from discrete depths at each sample location
- Subsoil texture and moisture analysis; samples analyzed from discrete depths at each sample location
- Petiole sampling at same predetermined locations. Plant tissue analysis by Waypoint Analytical.
- Berry sampling at same predetermined locations. Juice Analysis by Laboratoire Natoli & Assoc.
- Test pits at select sample locations; follow up soil sampling chemical analysis by Waypoint Analytical Laboratories and texture analysis by HydroGeo
- Pruning weight measurements

Preliminary Findings

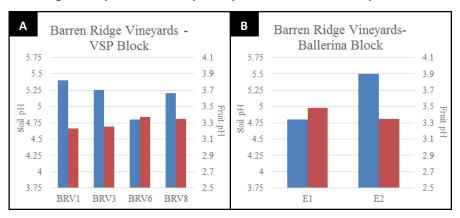
At two of our research sites, Pollak Vineyards and the Barren Ridge Vineyards (BRV) VSP Block, we observed a strong correlation between bloom petiole K and fruit pH at harvest ($R^2 = 0.86$ and 0.95

respectively), suggesting that plant tissue K has a major influence on fruit pH at these sites (**Plot 1**). Our third site, Adventure Farm, contains too many confounding viticultural variables (namely vine age and disease) for this relationship to be well studied at this time.



Plot 1: Plots showing a strong positive correlation between bloom petiolar K (% reported by Waypoint Analytical Laboratories from composite bloom petiole sample) and fruit pH (as measured with a YSI 556 multimeter 3 days after composite berry sample collection) at Pollak and Barren Ridge Vineyards.

Our preliminary results shown in **Plot 2** suggest a relationship between soil pH and fruit pH – even within a very narrow soil pH range. We observed a strong negative correlation between soil pH and fruit/wine pH in both blocks at Barren Ridge Vineyards, the only study site without a history of intense soil fertilization.



Soil pH (average of topsoil + subsoil pH values as measured by Waypoint Analytical Laboratories)
 Fruit pH (as measured with YSI 556 multimeter 3 days after composite berry sample collection)

Plot 2: Bar graphs based on preliminary results illustrate the relationship between soil pH and fruit pH for sample locations within the Barren Ridge study areas. Note sample locations with higher soil pH levels have lower associated fruit pH levels, and vice versa, consistently across both the VSP and Ballerina blocks at Barren Ridge Vineyards (A&B).

In a concurrent differential harvest experiment with winemaker Tim Jordan at Barren Ridge Vineyards, we are exploring fruit ripeness and resulting wine quality as a function of soil pH, rock content, and K status. We used soil EC maps to identify homogenous picking zones (high EC and low EC) in both the VSP and Ballerina Petit Verdot blocks (**Figure 1**).

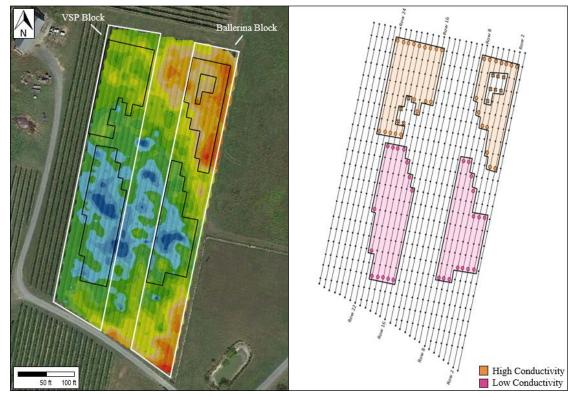


Figure 1: Harvest zones at Barren Ridge Vineyards determined using soil EC mapping and laid out in the field using differential GPS technology. Homogenous high and low conductivity zones were delineated in both the VSP and Ballerina Blocks.

All fruit within each zone was picked and vinified separately with identical winemaking protocols. Harvest parameters (cluster weight, berry weight, yield, foliar surface:fruit weight ratio) and Brix, pH, and titratable acidity were measured. Two lots (Ballerina, VSP) each with two treatments (high soil EC, low soil EC) were vinified through malolactic fermentation and a single free-run barrel of each treatment was produced.

Preliminary results (summarized in Table 1) suggest lower harvest pH in the High EC zones with higher rock content, and higher soil pH. Berry K appears to correspond to the different soil zones as well, though more data points within each zone are needed for a statistically robust analysis.

	Ballerina Block		VSP Block	
Soil Zone:	High EC	Low EC	High EC	Low EC
рН	3.23	3.30	3.12	3.28
°Brix	23.9	24.7	23.3	22.9
Avg. Berry K	2,140 ppm	2,400 ppm	2,160 ppm	2,485 ppm

Table 1: Preliminary results for experimental wines at the BRV research site. Each canopy treatment contains two unique soil zones, harvested separately.

Significant Outreach Activities:

- December 2017: "Update on Soil pH, Potassium and Fruit Properties" Follies 2017 Technical meeting of numerous leading growers in the Mid-Atlantic (Bubba Beasley, Charlottesville, VA)
- March 2018: "Mapping Soil, Geology, and Landscape on the Vineyard Scale" Presentation at the Eastern Winery Exposition (Bubba Beasley; Lancaster, PA) – included a section dedicated to this research
- Fall 2018: Discussing with Cain Hickey, Viticulture Extension Specialist at UGA, planning a soil
 workshop for Georgia winegrowers to share the results of this research with a broad producer
 audience across the southeast. (Bubba Beasley; Athens, GA)

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