University of Nevada, Reno

The Affects Of High Winds On *Vitis vinifera* Buds During Post-dormancy

A thesis submitted in partial fulfillment
of the requirements for the degree of

Bachelors of Science in Biochemistry and Molecular Biology and the Honors Program

by

John Paul Baggett

Dr. Grant Cramer of Biochemistry and Molecular Biology, Thesis Advisor

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THE HONORS PROGRAM

We recommend that the thesis
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John Paul Baggett

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Abstract:

Vitis Vinifera's growth and fruit development are both highly affected by the environmental stresses that the plants undergo. High winds have been shown to negatively affect *Vitis Vinifera* through decreased time of stomata opening. The problem observed were buds dying during the post dormancy hypothesized to be caused by high winds creating water loss. To test this five different varietals are used with each containing a Wind Fence group, a Control group, Irrigation group, and multiple anti-transpirant groups. To test the hardiness of the lateral buds from the different groups bud break assays, dehydration assays, and thermal imaging has been done. Upon analysis of the results there was a difference about the genotypes but no statistically significant difference between the treatments. This year there was no need for application of the treatments as there was no added benefit to the buds.

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Introduction:

The growing of *Vitis Vinifera* and their use in wine is a multibillion-dollar industry in the United States. The optimization of yield and fruit quality in different environments is crucial to better growing practices. *V. Vinifera's* bud break and fruit yield can be greatly affected by the environment they are grown in and the stresses they are put under(Keller & Tarara, 2010). Variables that play a large roll are soil content, sunlight, temperature, and wind levels. High winds have been shown to cause negative effects on Vitis Vinifera. High winds can cause breaking of new branches, decreased photosynthesis, and decreased growth. Decreased photosynthesis and growth in *V. Vinifera* is due to stomata closing directly attributed to wind stress (Freeman, Kliewer, & Stern, 1982; Gokbayrak, Dardeniz, & Bal, 2008).

There are two prominent methods to protect plants from high winds. These are windbreaks and anti-transpirants. It has been shown that windbreaks can improve plant growth and photosynthesis through longer time of stomata opening and decreased plant stress (Freeman et al., 1982). It has also been shown that grapes that are protected by nettings have reduced transpiration rates (Suvočarev, Blanco, Faci, Medina, & Martínez-Cob, 2013). Anti-transpirants coat the plants with a water impermeable barrier that reduces water loss from transpiration. In this paper it is being shown that protecting *Vitis Vinifera* from high winds with windbreaks and anti-transpirants during post dormancy improves their bud break and fruit quality.

Nevada has previously not been a state with any *V. Vinifera* production due to the high desert climate. Part of the purpose of this research is to address the problems faced by trying to grow grapes in an arid high desert environment like Reno, Nevada. Reno has

an average wind speed of 5.2 miles per hour with wind ranging from 0-20 miles per hour normally. With the highest wind speed occurring around April 1st. (Office , 2014) (Beta , 2012)

Methods:

Experimental Design

The vineyard is located at the University of Nevada Agricultural Station and split up into two sections. The North vineyard contains Chardonnay and Cabernet Sauvignon varietals. The South vineyard contains multiple varietals but the ones being studied are Pinot Noir, Merlot, and Lemberger. For each varietal a wind fence was set up by attaching the Boddingtons's polyethylene mesh to the posts of the grape vine terracing in early January. These wind fences protected groups of five plants, as this is the distance between the wooden posts. The fences were attached to the wood using tin wiring at multiple points throughout the fence according to the instructions given by Boddingtons. Pinot Noir, Merlot, and Lemberger were treated with two antitranspirants groups, each containing five plants. The antitranspirants used for these groups were the commercial brands Wilt Proof and Wilt Stop. In the Chardonnay and Cabernet Sauvignon groups Wilt Proof and Wilt Stop were used as groups, with five plants each, as well as a third antitranspirants Moisturin. Moisturin had a group of five plants treated for each varietal. A small bristled wooden brush applied the antitranspirants by painting them onto the grape vines using a dilution at a 1 to 5 product to water ratio. This was done the first week in January. The final testing group was irrigation, which was applied to rows of each varietal twice throughout the winter months. A control group, for each varietal, of

five plants was used with no treatment applied throughout the winter to compare the treatments to.

Bud Break Assay

Two bud break assays were performed one at the end of the month of January and one at the end of February. Sample sets include Wilt Proof, Wilt Stop, Wind Fence, Irrigation and Control for the genotypes Chardonnay, Cabernet Sauvignon, Pinot Noir, Merlot, and Lemberger. There is also a sample set of Moisturin for Chardonnay and Cabernet Sauvignon. For each sample set four to five cuttings were taken from the top third of different plant's vines. Only plants with dark green centers were selected. Cuttings were taken to include between two to three buds and having a height between 2 to 6 inches in length. The cuttings were then put in 10 mL of water in a clean plastic tube. Water was added if the amount in the tube was less than 10 mL. Every week the water was changed to avoid bacterial growth. The assays were checked everyday for bud break, which constituted the first green leaf emerging from a lateral bud. The day of the first bud break was recorded and the data was analyzed through a 2-way ANOVA test.

Bud Water By Percent Mass And LTE Determination

Two tests were performed one the last week of January and one the last week of February. Chardonnay and Cabernet Sauvignon are the genotypes used for these tests. The treatments used as the sample sets are Wilt Proof, Wilt Stop, Wind Fence, Irrigation, and Control. For each of these sample sets two to three vines were cut, all with a deep green center. The vines were cut to contain at least 18 buds. Of these buds 9 were sent to

Jason Londo of the United States Department of Agriculture, Agriculture Research Service. He performed Low Temperature Endotherm determinations on those 9 buds. The other buds were dissected using a scalpel and dissecting goggles. Their fresh weight was measured. The buds were then put into a vacuum dehydrator for three days. Their weight was re-measured after drying. The water weight was determined by the equation $Percent\ Water\ Weight = \frac{weight\ lost\ by\ dehydration\ (grams)}{fresh\ weight\ of\ buds\ (grams)} \times 100$. In February for transport to Jason Londo the vines were sealed either end with wax and placed in a plastic bag with a moist paper towel. This was done to decrease water loss upon transport.

Post Dormancy Analysis

At the end of April the vines were checked for bud break. All vines that were treated were looked at for whether or not they had buds that had broken. The vines with broken buds were determined as vines that are live.

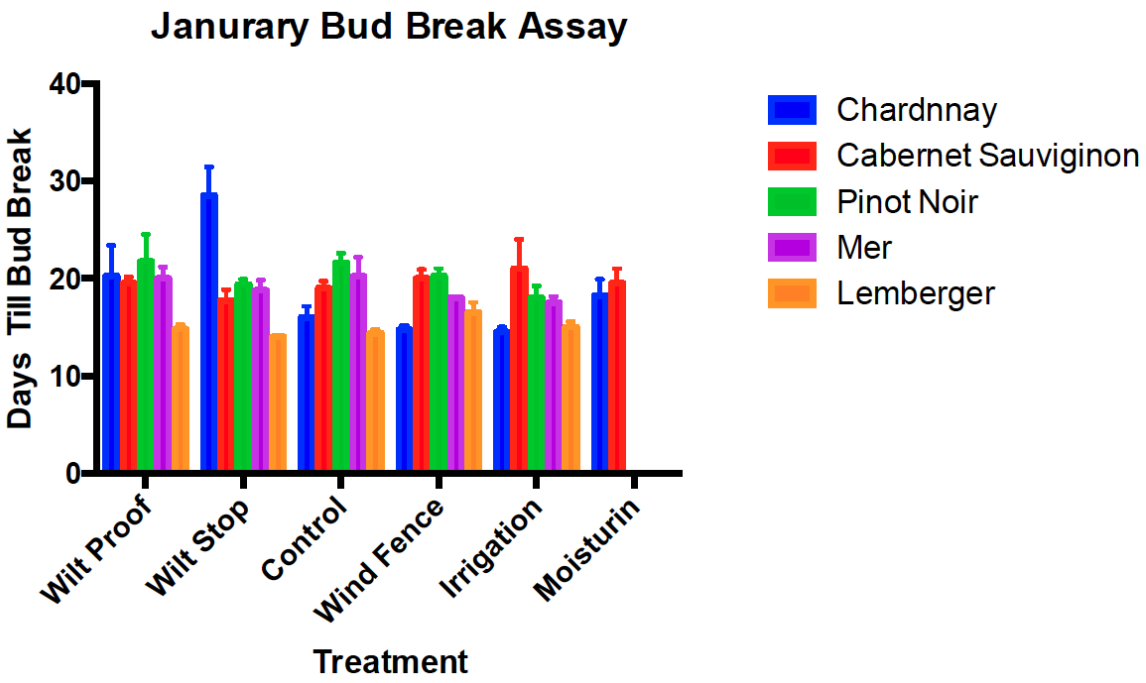
Results:

Bud Break Assay

These experiments were performed in order to see the depth of the dormancy of the sample sets as well as their viability. Plants in deeper dormancy will take longer to break buds. Vines that do not break buds are considered dead. The bud break assays had very good viability with only one cutting dead in the January sampling and eight dead in February. Figure 1 shows the days until bud break for the January sampling broken down by treatment and genotype. When run through two-way ANOVA testing based on the

criteria of genotype and treatment it was determined that there was no significant difference in treatment but there was a significant difference between genotype. This can be seen in figure 1 by the similarity of the bars of the same genotype, such as Lemberger, across the treatments. But if you look at one particular treatment, such as the Irrigation, there is significant difference among the genotypes of grapes.

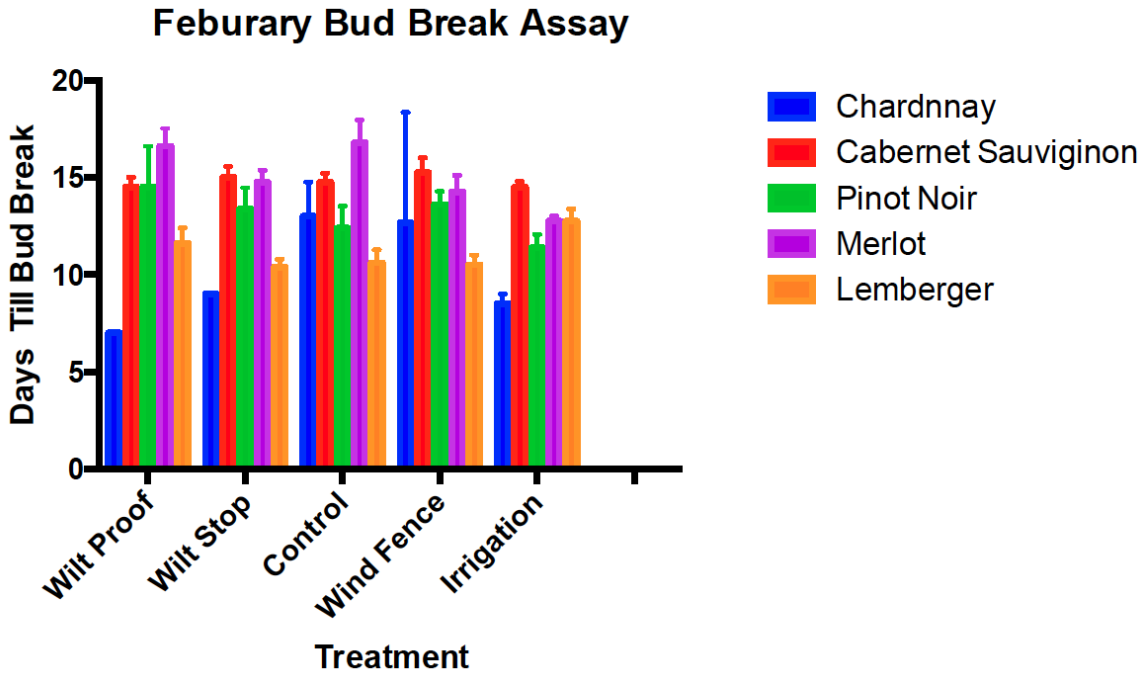
Figure 1. January Bud Break Assay. The days it took until the first bud break is plotted on the y-axis. The treatments are broken down into sample sets in the x-axis. Genotypes are color coordinated according to the legend.



The data for February (figure 2) is very similar to that from January. There is a statistically significant difference on days of bud break across genotypes in the same treatment. The difference among treatments for the same genotype is not statistically significant. This is evident by the similarity of the day of bud bread across a varietal, such as how all the Lemberger buds broke around day 10 to 12. The Moisturin sample set was left out of figure one because there was not enough data for a statistically significant plotting. It was consistent through both trails that there is a genotype difference but not a treatment difference.

The lack of statistical significance of the difference in treatment is thought to be due to not having collected enough data. There needs to be data from four to five years of treatments for the data to start being statistically significant. So the next step is to continue these experiments for the following years.

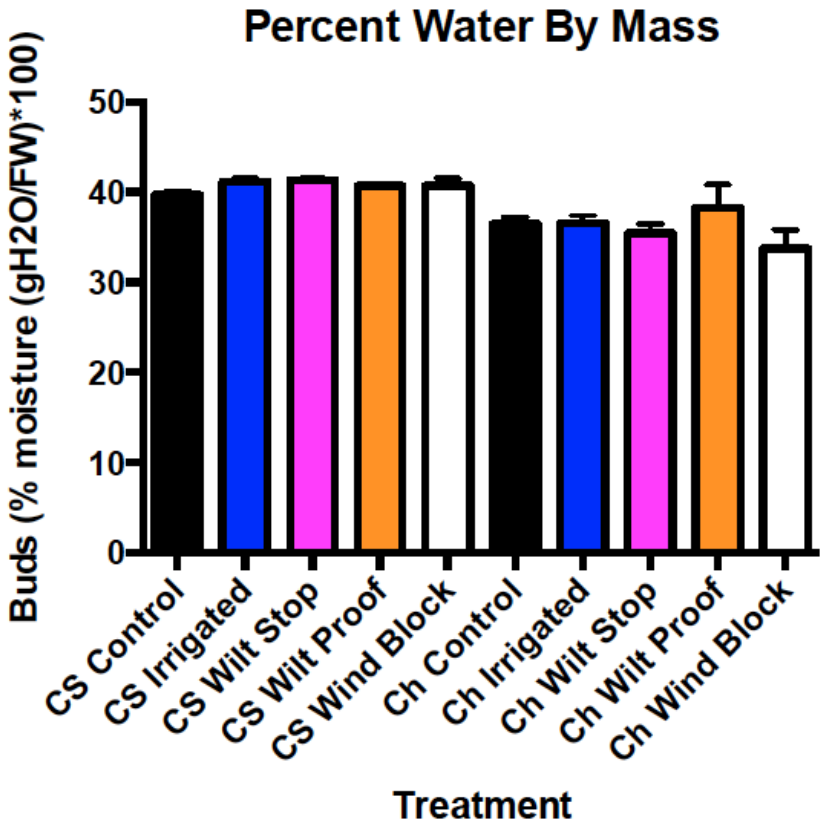
Figure 2. February Bud Break Assay. The days it took until the first bud break is plotted on the y-axis. The treatments are broken down into sample sets in the x-axis. Genotypes are color coordinated according to the legend.



Bud Water By Percent Mass And LTE Determination

To test the hypothesis that the grapevines are getting losing water due to the high winds, bud water content was performed. The bud water content is a good indication of the hydration of the grapevine. The bud percent water by mass for January, in figure 3, was right around 40 percent for all the treatments of Cabernet Sauvignon and 35 percent for all the treatments of Chardonnay. This is consistent with what was found in the bud break assays that there is a difference among genotype but not treatment. These results are mirrored in February with the percent water of Cabernet Sauvignon right around 40 and the Chardonnay at around 35 percent. Leading to the conclusion that more sample sets must be collected to determine if a treatment difference does in fact exist.

Figure 3. January Bud Percent Water By Mass. The y-axis is the bud percent water by mass and the x-axis is the treatment. CS is Cabernet Sauvignon and Ch is Chardonnay.



The Low Temperature Endotherm (LTE) results shown in figure 5 show the temperature at which the water in the dissected buds crystalize. This temperature tells how cold tolerant the vines are. For Cabernet Sauvignon in January all of the buds had crystallization around -15 °C. In February the Cabernet Sauvignon treatments had a greater spread of temperatures. The Wind Fence was down to -17 °C while the Wilt Stop and Irrigation samplings were up to -14 °C. This spread of temperature points shows that the plants are coming out of dormancy at different times. More information is needed to conclude if one treatment deepens or lessen the plants dormancy.

The Chardonnay values for the January sampling vary from -18 °C for the Irrigated and -15°C for the Wind Fence. These values are similar to those of the Cabernet Sauvignon at this time point but with no conclusive results. The February sampling of Chardonnay showed no change in the crystallization temperature for the Wind Fence and Wilt Stop, but a rising of temperature for the Control, Irrigation, and Wilt Proof groups. These samplings are not similar to the changes that happened in Cabernet Sauvignon. More samplings need to be taken for a pattern to emerge.

Figure 4. February Bud Percent Water By Mass. The y-axis is the bud percent water by mass and the x-axis is the treatment. CS is Cabernet Sauvignon and Ch is Chardonnay.

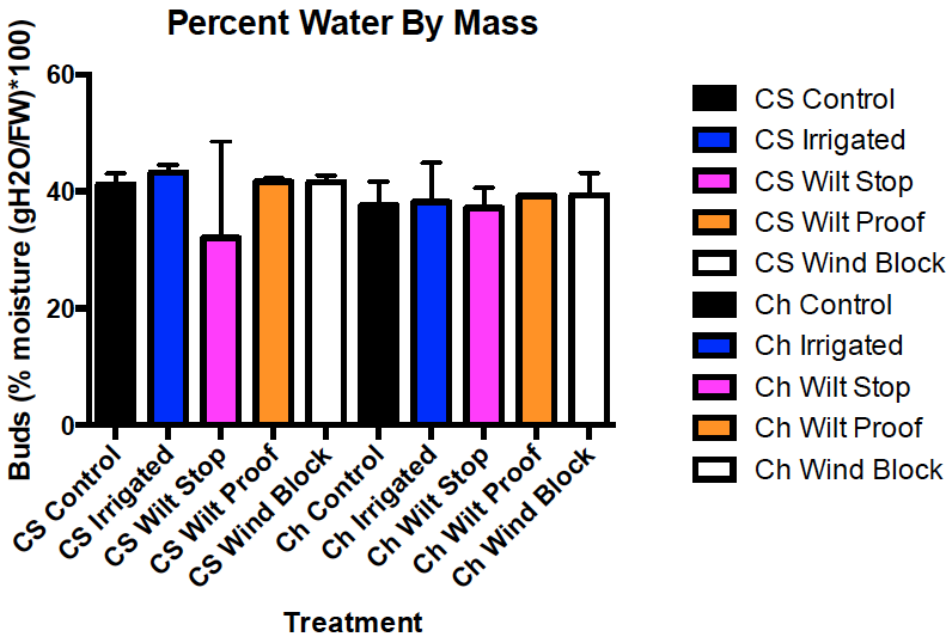


Figure 5. LTE Time Point Comparisons. The graph on the left is of Cabernet Sauvignon and the graph on the right is of Chardonnay. Time point T1 is the January sampling and T2 is the February sampling.

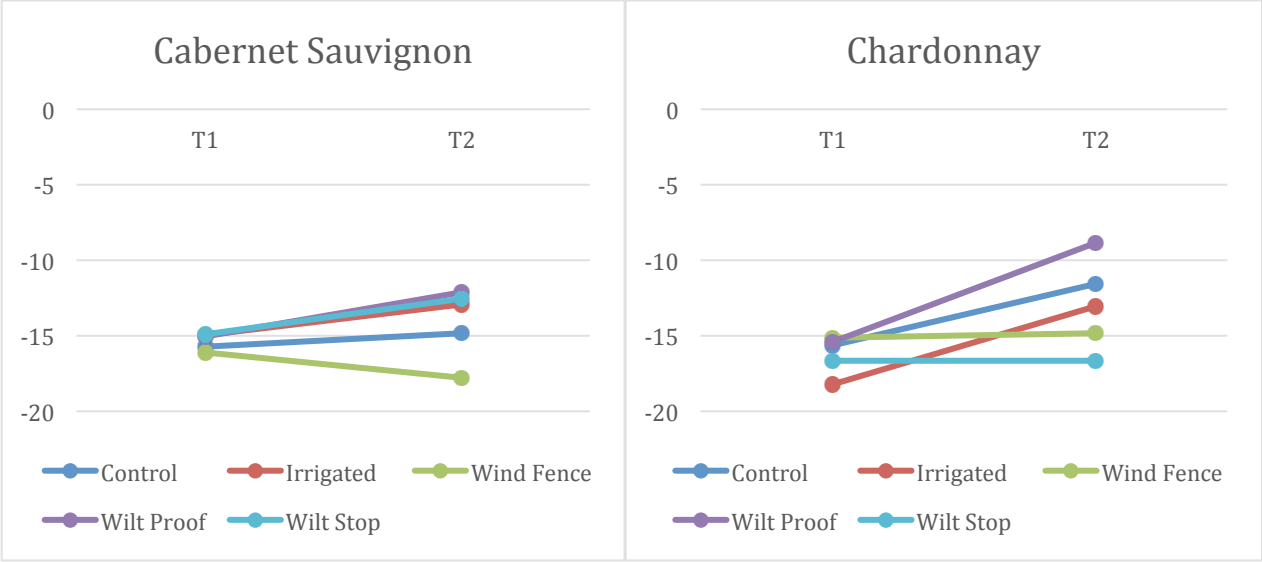


Table 1. Post Dormancy Bud Vitality. All vines contained buds that were alive. There was no added benefit to bud vitality by any treatment.

	Cabernet Sauvignon	Chardonnay	Pinot Noir	Merlot	Lemberger
Wilt Proof	alive buds	alive buds	alive buds	alive buds	alive buds
Wilt Stop	alive buds	alive buds	alive buds	alive buds	alive buds
Control	alive buds	alive buds	alive buds	alive buds	alive buds
Irrigation	alive buds	alive buds	alive buds	alive buds	alive buds
Wind Fence	alive buds	alive buds	alive buds	alive buds	alive buds
Moisturin	alive buds	alive buds	x	x	x

All the vines contained buds that were alive (table 1) during their post-dormancy analysis. There was no increased vitality of the buds due to any treatment. It can be conclusively said that this year no treatment improved bud health or bud vitality. Therefore the treatments were not necessary in order to help the buds survive their winter dormancy.

Discussion:

There is a difference among genotype in the days till bud break and water weight of buds, but there is no treatment difference. It can be conclusively said that this year there was no added benefit to the buds by any of the treatments. Therefore the applications of such treatments in a winter like that of 2014-2015 in Reno, NV are not necessary for bud health. The main direction of this experiment is to continue it for multiple years to see if there is a difference in treatment under different environmental conditions.

Work Cited:

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