Viticulture, enology and marketing for cold-hardy grapes

Impact of Shading on Frontenac & Marquette Fruit Composition

Coyote Moon Vineyards
Clayton, NY

Timothy E. Martinson and Chrislyn A. Particka
Department of Horticulture, Cornell University

Background and Rationale: Training systems studies were initiated in commercial Marquette and Frontenac vineyards in 2012 in order to study effect of training system on yield, quality, and labor inputs. Data from 2012-2014 can be found here for Marquette (http://northerngrapesproject.org/wp-content/uploads/2015/02/Marquette-Training-Trials.pdf) and here for Frontenac (http://northerngrapesproject.org/wp-content/uploads/2015/02/Frontenac-Training-Trials.pdf). During harvest of these plots in 2013-2015, we have harvested clusters that were well-exposed to the sun and clusters that were shaded in order to determine the impact of sunlight exposure on fruit chemistry.

Treatments: Training systems studies were established in the spring of 2012. We are evaluating two high training systems [Top Wire Cordon (TWC) and cane-pruned Umbrella Kniffin (UK)] and one mid-wire system [Vertical Shoot Positioning (VSP)]. More details about these systems can be found in the 2012-2014 reports. This report focuses on the difference in fruit composition between clusters that were well-exposed to the sun, and clusters that were shaded.

Methods: The same day we harvested our training trials in each year, we collected clusters that were shaded from the sun and clusters that were well-exposed to the sun. In 2013, five exposed clusters and five shaded clusters were collected from one vine each in two of the four replicates of each training system (so six samples in all, two from each training system) in Frontenac. The five shaded and five clusters from each vine were bulked and analyzed for berry weight, Brix, pH, and titratable acidity (TA). In 2014, we collected five shaded and five exposed clusters from six Marquette vines, for a total of 60 clusters. Each cluster was measured separately for cluster weight, Brix, pH, and TA. In 2015, we collected five shaded and five exposed clusters from five Frontenac vines, for a total of 60 clusters. Each cluster was measured separately for cluster weight, Brix, pH, TA, malic acid and tartaric acid.

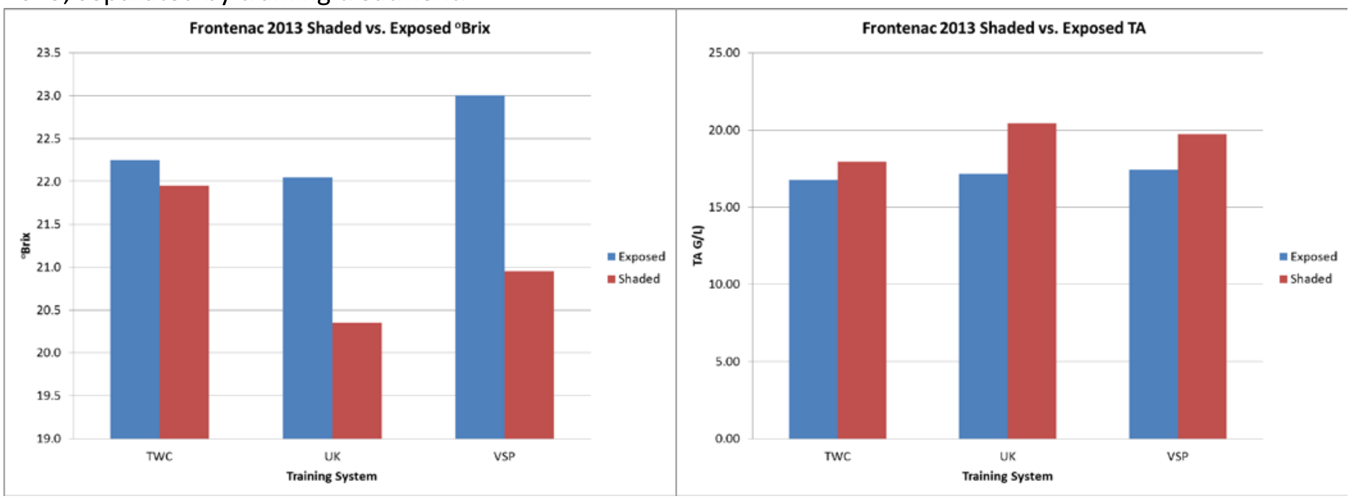
Results:

Frontenac 2013: Across treatments, brix were slightly higher (*p=0.0629*) and TA was lower (*p=0.0209*) on exposed clusters (Table 1). Berry weight and pH were not affected by sunlight exposure. When looking at the data separated by training treatment (Figure 1), differences in shaded vs. exposed clusters were smaller in TWC than in UK or VSP although we could not determine if there were any statistical differences due to how samples were collected. It is possible that the shoot combing we did on the TWC moderated the observed differences in Brix and TA. Of notable importance is that across treatments, exposed clusters had approximately 2 g/L lower TA than shaded clusters, and both the VSP and UK training systems had roughly 2 ^{o}Brix higher soluble solids in the exposed clusters.

Table 1. Fruit chemistry and analysis of berries collected from shaded and exposed Frontenac clusters during harvest in 2013, averaged across training treatments.

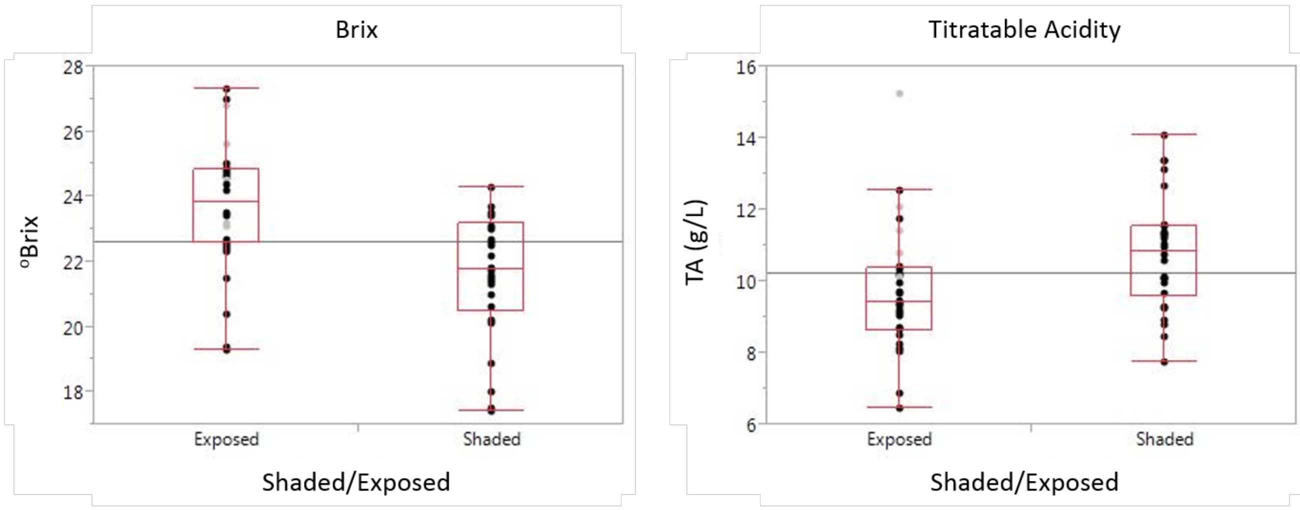
2013 Exposure	Avg.berry wt. (g)	pH	Brix	TA
Shaded	1.08	3.04	21.08 b	19.37 a
Exposed	1.08	3.05	22.43 a	17.10 b

Figure 1. Fruit composition of berries collected from shaded and exposed Frontenac clusters during harvest in 2013, separated by training treatment.



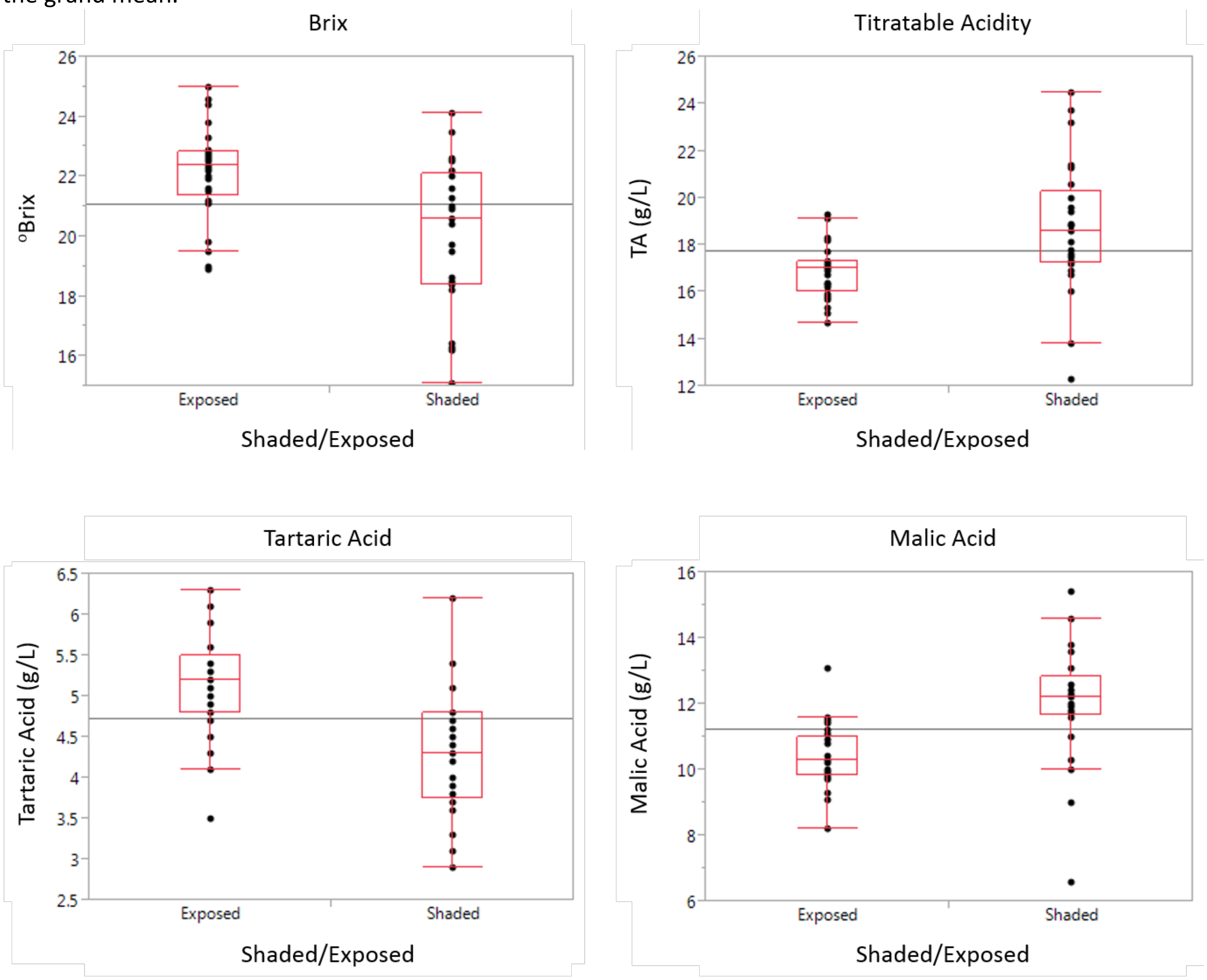
Marquette 2014: Brix were significantly higher (*p < 0.0001*) on clusters well-exposed to the sun; average brix on shaded clusters was 21.6, whereas it was 23.7 on exposed clusters. Titratable acidity was significantly lower (p = 0.0051) on exposed clusters, with 9.7 g/L in exposed clusters and 10.8 g/L in shaded clusters. Juice pH and cluster weight were not affected by sun exposure. Looking at outlier box plots for brix and TA (Fig. 2), you can see the difference in spread between shaded and exposed clusters for both Brix and TA. [Probably need to say more, not really sure how to phrase it.]

Figure 2. Outlier box plots showing Brix and TA for berries collected from shaded and exposed Marquette clusters during harvest in 2014. The top and bottom of the boxes represent the 75th and 25th percentile, respectively, and the "whiskers" that extend above and below the box represent the entire range of values. The line in the middle of each box is the median value. The black line running across the entire plot is the grand mean.



Frontenac 2015: Brix were significantly higher (*p < 0.0001*) on exposed clusters, with 22.1° vs. just 20.1° on shaded clusters. Titratable acidity was significantly lower (*p = 0.0018*) on exposed clusters, with 16.8 g/L of acid compared to 18.7 g/L in shaded clusters. Exposed clusters had lower pH (*p = 0.0054*) as well. Cluster weight was not affected by sun exposure. This year, we were also able to measure malic and tartaric acid; interestingly, tartaric acid was higher in exposed clusters (4.3 g/L in shaded clusters vs. 5.1 g/L in exposed clusters, *p=0.0002*), whereas malic acid was lower in exposed clusters (12.0 g/L in shaded clusters vs. 10.4 g/L in exposed clusters *p=0.0003*). If this holds true in subsequent years and cultivars, this has interesting implications for winemaking, as malic acid is generally harder to remove during the winemaking process, whereas tartaric acid is easier to remove. Looking at outlier box plots for Brix, TA, Tartaric Acid, and Malic Acid (Fig. 3), it is one again apparent that the spread of values for exposed clusters is much smaller than the spread for shaded clusters.

Figure 3. Outlier box plots showing Brix, TA, Tartaric Acid, and Malic Acid for berries collected from shaded and exposed Frontenac clusters during harvest in 2015. The top and bottom of the boxes represent the 75th and 25th percentile, respectively, and the "whiskers" that extend above and below the box represent the entire range of values. The line in the middle of each box is the median value. The black line running across the entire plot is the grand mean.



What the results mean:

- Well-exposed clusters had more favorable fruit chemistry (higher brix and lower TA) in all years the study was conducted.
- When comparing differences in fruit chemistry due to training system (see Marquette and Frontenac training study reports) vs. sunlight exposure, the results suggest that maintaining cluster exposure and avoiding shading is more important than training system, per se, in minimizing acidity and maximizing soluble solids. Little differences in fruit chemistry due to training system were observed in our studies.
- Results from 2015 which indicate that malic acid is reduced and tartaric acid is increased in sun-exposed clusters compared to shaded clusters is particularly interesting and warrants further evaluation in upcoming years, as tartaric acid is generally easier to manage during the winemaking process than malic acid.