# Recovery from Frost Injury in New York Training Systems Trials in 2015

Coyote Moon Vineyards
Clayton, NY

*Timothy E. Martinson and Chrislyn A. Particka*
*School of Integrative Plant Science, Horticulture Section, 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). A major freeze event occurred on the morning of May 23, when temperatures dropped to 27 $^{o}$F. This report outlines the recovery of vines after the freeze event.

**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.

**Methods:** On the early morning of May 23, when shoots were approximately 3-6" long, temperatures dropped to 27 $^{o}$F, killing over 90% of the shoots. There was a good emergence of "second crop" shoots, which likely emerged from secondary and tertiary buds on all training systems, as well as from latent buds on the cordon from TWC and UK. On June 22, we tagged the "first crop" shoots that survived the frost event, in order to be able to track differences in phenology between the first crop and second crop fruit. Due to extensive trunk damage that occurred during the winter of 2013/2014, there were too many missing Marquette vines in the training system study to continue it; therefore, we tagged first crop and second crop shoots in another area of the vineyard that had suffered less winter damage. Frontenac vines, however, had no trunk damage during winter 2013/2014, so we were able to collect data in the training study and first crop shoots on all vines were tagged.


*Left: Umbrella kniffin-trained Frontenac vine about one week after the May 23rd frost event, when temperatures reached a low of 27 °F. Right: A shoot that survived the frost on a Marquette vine, which illustrates the growth stages the vines were at when the frost occurred.*

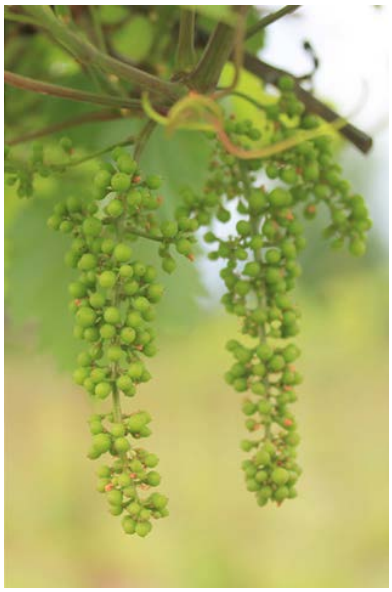
Also on June 22, we counted the total number of first crop and second crop shoots and clusters, and recorded the number of first crop and second crop shoots that had clusters. Preharvest fruit chemistry samples were collected starting shortly after veraison, then every 7-14 days until harvest from first crop and second crop clusters in both Marquette and Frontenac. In Frontenac, samples were collected across training systems except at harvest, when first crop and second crop samples were collected from each plot in the training system study, so we could determine if training system impacted fruit chemistry. At harvest in Frontenac, cluster number and total yield data were collected for each vine.

**Results:**

**Phenology:** The first crop shoots bloomed about June 15, with second crop shoots about July 10 in both Frontenac and Marquette. By August 14, Frontenac first crop clusters were at 10% veraison and second crop clusters were still green, and Marquette "first crop clusters" were at 35% veraison and second crop clusters had just begun to turn. By September 1, first crop clusters in both cultivars were at 100% veraison; second crop clusters in Frontenac were at 40% veraison and at 65% veraison in Marquette.


*A TWC-trained Frontenac (left) and Marquette (right) vines on June 29. Note the good growth and emergence of second crop shoots. First crop shoots are marked with yellow flagging tape.*

*First crop (left) and second crop (right) Frontenac shoots on June 15, displaying the difference in phenology at that time.*



*First crop cluster (left) and second crop cluster (right) in Frontenac on June 29. Note that the second crop cluster has not yet bloomed, while the first crop clusters have set berries.*

*First crop cluster (left, marked with pink flagging tape) and second crop cluster (right) in Marquette on September 28. Note that the first crop cluster has begun to shrivel; this was not the case with all first crop clusters, but a portion of first crop clusters, especially in Marquette, were in poor shape by harvest.*

**Frontenac Yield Data:**
In Frontenac, the first crop yield was quite small, and there were no differences among training systems (Table 1). However, there were differences among training systems in the second crop; yield was larger in TWC-trained vines, mainly due to more second crop shoots, which lead to more clusters per vine. Also, a higher percentage of second crop shoots had clusters on TWC compared to VSP and UK. TWC-trained vines likely had more second crop shoots (and therefore yielded more) than UK-trained vines due to latent buds on the cordon, which are not present on UK-trained vines. Additionally, VSP-trained vines likely had fewer secondary shoots and secondary shoots with clusters due to being more shaded than TWC. Although clusters produced on secondary shoots are often reported to be smaller than clusters from primary shoots, this did not appear to be the case in this study, as cluster weight was not different between first crop clusters and second crop clusters (*p=0.4389*).

**Table 1.** Yield and yield components of the first crop and the second crop in the Frontenac training trial at Clayton, NY in 2015.

| 1st crop | Yield t/acre[z] | Yield lb/vine | Clusters/ vine | Avg.berry wt. (g) | Cluster wt. (g) | Berries/ cluster | Shoot # | # of shoots w/ clusters |
|---|---|---|---|---|---|---|---|---|
| TWC | 0.13 | 0.4 | 2.8 ab | 1.24 a | 71.2 | 57.4 | 2.5 | 2.0 |
| VSP | 0.07 | 0.2 | 1.1 b | 1.15 ab | 71.5 | 79.6 | 1.8 | 0.8 |
| UK | 0.15 | 0.5 | 3.2 a | 1.10 b | 62.9 | 57.0 | 3.1 | 2.1 |
| **2nd crop** | | | | | | | | |
| TWC | 2.4 a | 7.86 a | 43 a | 1.34 | 82.6 | 61.5 | 49.6 a | 19.0 (38%) a |
| VSP | 0.9 b | 3.46 b | 20.3 b | 1.30 | 75.9 | 58.6 | 35.5 b | 11.0 (30%) b |
| UK | 1.1 b | 2.90 b | 18.5 b | 1.32 | 69.7 | 52.8 | 30.5 b | 9.1 (30%) b |

[z] *Treatment means followed by the same letter within a crop and column are not significantly different at the $\alpha$=0.05 level. Columns where no letters are present indicate a lack of significant differences among treatments.*

**Marquette and Frontenac Fruit Composition:**
In Frontenac, there were significant differences in fruit composition at harvest between the first crop and second crop, although the differences between the first and second crop became smaller as ripening progressed (Fig. 1). Further, there were no differences in fruit chemistry at harvest among the training systems, except for titratable acidity of the second crop, where VSP-trained vines had one less g/L of acid than TWC and UK (Table 2). While this difference was significant, it likely would not make much difference in terms of quality of the fruit for winemaking.

Due to how samples were collected in Marquette, we were not able to run statistics, but differences in brix and TA between the first and second crop were still apparent at harvest (Fig. 1). As with Frontenac, differences in fruit composition between the first crop and second crop became smaller as the fruit continued to ripen.

**Figure 1.** First crop vs. second crop fruit composition trends in Frontenac (top) and Marquette (bottom) at Clayton, NY in 2015. Samples were collected from shortly after veraison until harvest.

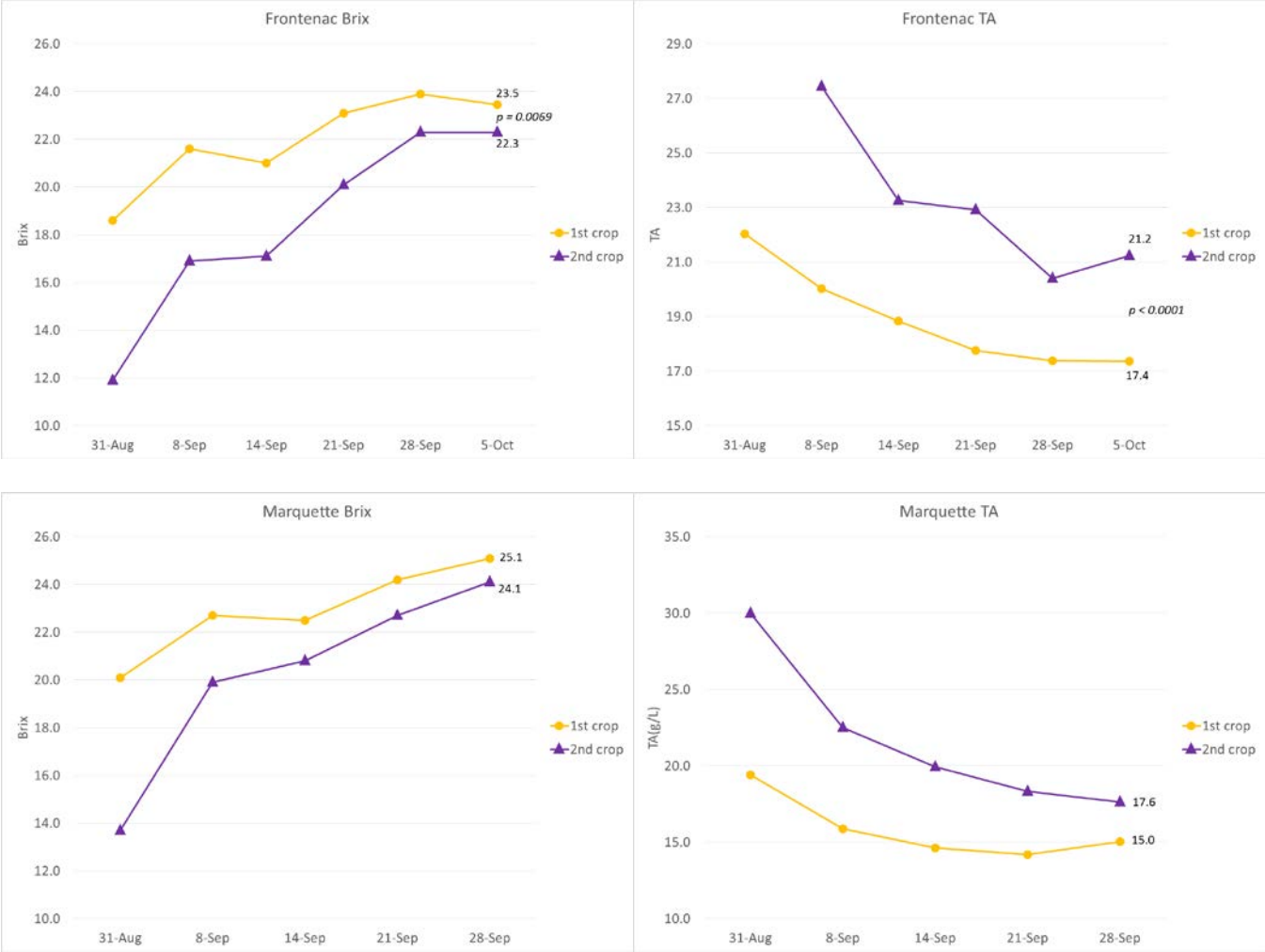



**Table 2.** Fruit composition of first crop and second crop fruit at harvest in Frontenac training trial at Clayton, NY in 2015.

| 1st crop | Brix[z] | pH | TA |
|---|---|---|---|
| TWC | 23.7 | 3.17 | 18.2 |
| VSP | 23.3 | 3.22 | 16.3 |
| UK | 23.4 | 3.24 | 17.4 |
| **Avg.** | **23.5** | **3.20** | **17.4** |
| **2nd crop** | | | |
| TWC | 22.1 | 3.06 | 21.6 a |
| VSP | 22.5 | 3.10 | 20.5 b |
| UK | 22.3 | 3.05 | 21.6 a |
| **Avg.** | **22.3** | **3.07** | **21.2** |

[z] *Treatment means followed by the same letter within a crop and column are not significantly different at the $\alpha$=0.05 level. Columns where no letters are present indicate a lack of significant differences among treatments.*

***What the results mean:***

- Both Marquette and Frontenac pushed another flush of shoots after the late May freeze. These shoots were likely a mixture of secondary, tertiary, and latent (arising from the cordon) buds.
- There was very little yield from the first crop in Frontenac.
- In Frontenac, the second crop was greater on TWC than UK or VSP, mostly due to more shoots.
- Spring frost delayed bloom by three to four weeks, and veraison by about three weeks. Both crops were harvested on the same date.
- By harvest, soluble solids on the second crop were within $1^{o}$ of the first crop. However, titratable acidity was separated by almost 4 g/L in Frontenac and 2.5 g/L in Marquette.
- After veraison, first and second crop clusters are not distinguishable, but fruit composition is quite different; this can result in some difficult harvest-time decisions.
- In the coming year, we hope to be able to determine if the late-ripening second crop had any effect on return bloom.