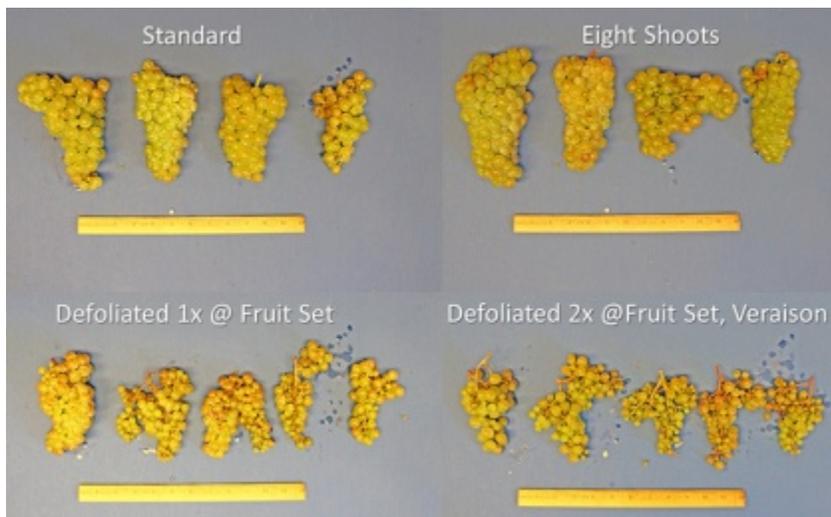


Grapes 101

How Defoliation, Defruiting, and Extreme Shoot Reduction Affected Clusters, Fruit Composition, and Bud Hardiness

by Tim Martinson



Representative Riesling clusters from standard, 8-shoot, defoliated at fruit set, and defoliated twice at fruit set and veraison treatments at a New York State Agricultural Experiment Station research vineyard in 2017.

Manipulating photosynthate sources (leaves) and sinks (shoot tips, clusters, trunks and roots) is the foundation of many viticultural practices. Dormant pruning reduces both early-season leaf area and crop. Early season shoot thinning reduces both shoot density and potential crop. Summer hedging and cluster-zone leaf removal reduce leaf area. Cluster thinning reduces the crop. All of these practices alter the ratio of sources and sinks.

The goal of these practices is to achieve the proper balance of fruit and foliage (leaf area) to maximize (or optimize) production of *ripe, quality fruit*. As managers, we want carbohydrates produced by leaves to be allocated in the appropriate relative amounts for canopy growth, fruit development, and vine reserves.

Too much fruit and too little foliage means the vine is *overcropped*, which can result in delayed ripening, lower quality fruit, and reduced storage of vine reserves (starch and N) to support the following season's growth.

Too little fruit and too much foliage means the vine is *undercropped*, which causes excess shoot vigor, and results in shading, unproductive excess leaf area, and vegetal flavors in the fruit.

Moreover, unbalanced vines are thought to have less midwinter hardiness than vines that have a good balance between fruit and leaf area. Undercropped vines produce large ‘bull canes’ that are thought to be less winter hardy. Overcropped vines may not have adequate reserves to ‘harden off’ buds, form periderm, and provide stored carbohydrates for the following growing season.

So what happens when we intentionally throw this balance off? This year, we started an experiment to find out.



Before and after vines were defoliated at fruit set (July 7, top) and veraison (August 24, bottom). Vines reestablished full canopy after the first defoliation.

Creating extremes in fruit to foliage ratios. In a Riesling block at the NYS Agricultural Experiment Station, we established several treatments to alter the fruit to foliage ratio. This is a 10 year-old block, with 6x9 ft vine spacing, four flat canes tied to two fruiting wires, vertical shoot positioning, and a target shoot density of 4 shoots per foot or 24 shoots per vine.

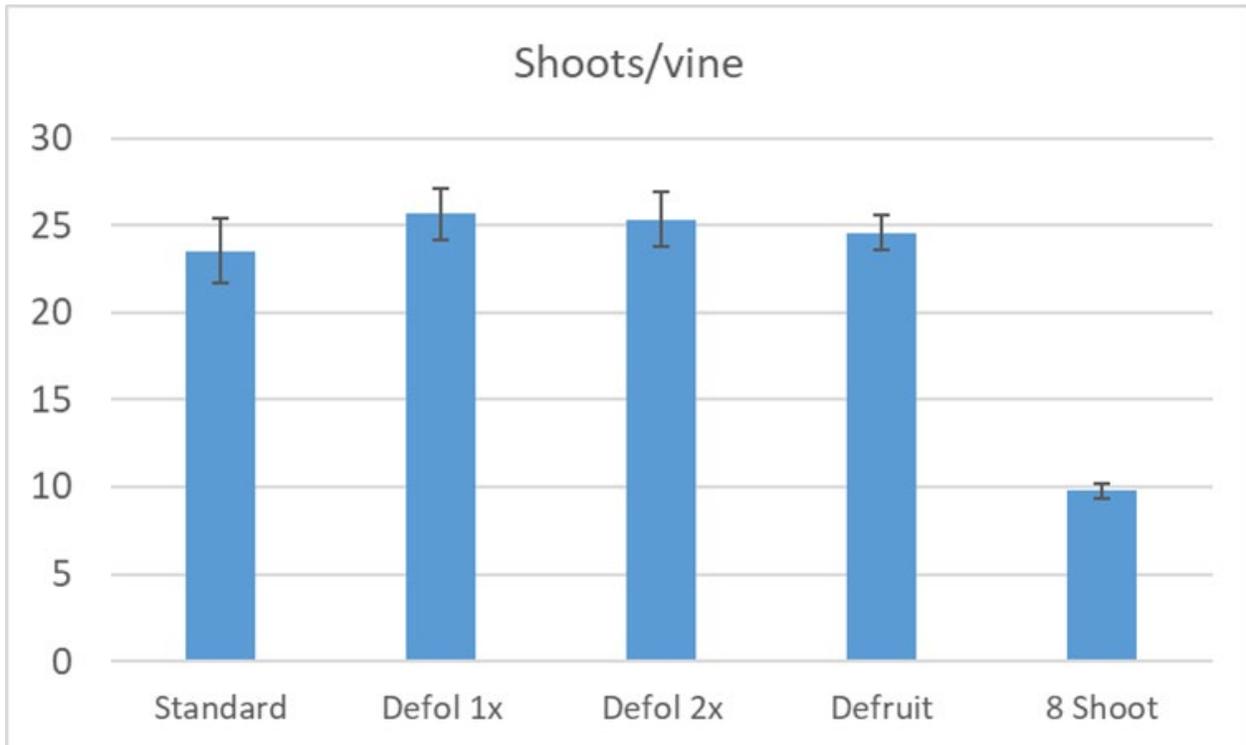
We had five treatments:

- **Standard (Control).** Vines were cane-pruned to 4 flat canes, with about 24 shoots per vine.
- **8-Shoot.** At about 8” of shoot growth, we reduced the number of shoots from 25 to 8 (4 at the ends of canes and 4 in the head area).
- **Defruited.** All clusters were removed after fruit set.

- **Defoliated 1x at Fruit set.** All leaves were removed in early July, except for the shoot tips.
- **Defoliated 2x at Fruit set and Veraison.** We defoliated half of the previously defoliated vines by cutting off the shoots and all remaining leaves on August 24, shortly after veraison.

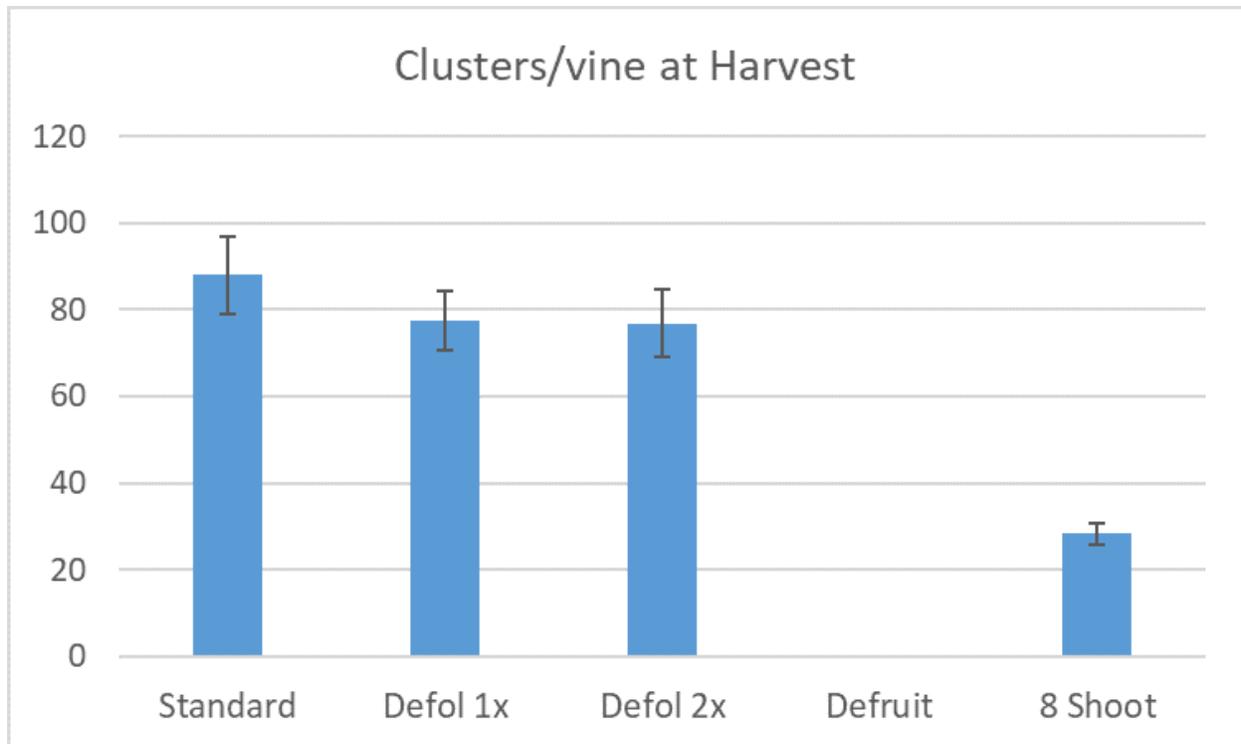
Here's what we found:

1. Shoots per vine. All treatments except the 8-shoot treatment ended up with about 25 shoots per vine.

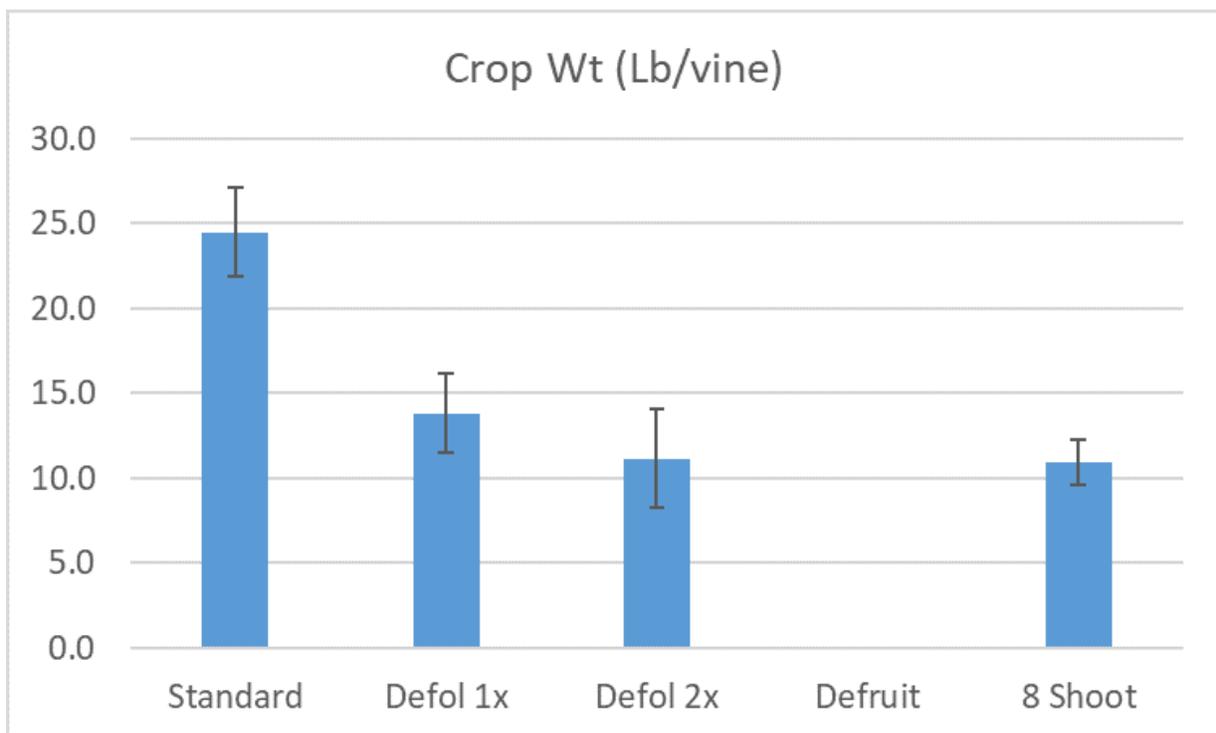


Note: All graphs include error bars that are +/- 2 SEM, roughly equivalent to a 95% confidence interval. (N=12 to 24 reps)

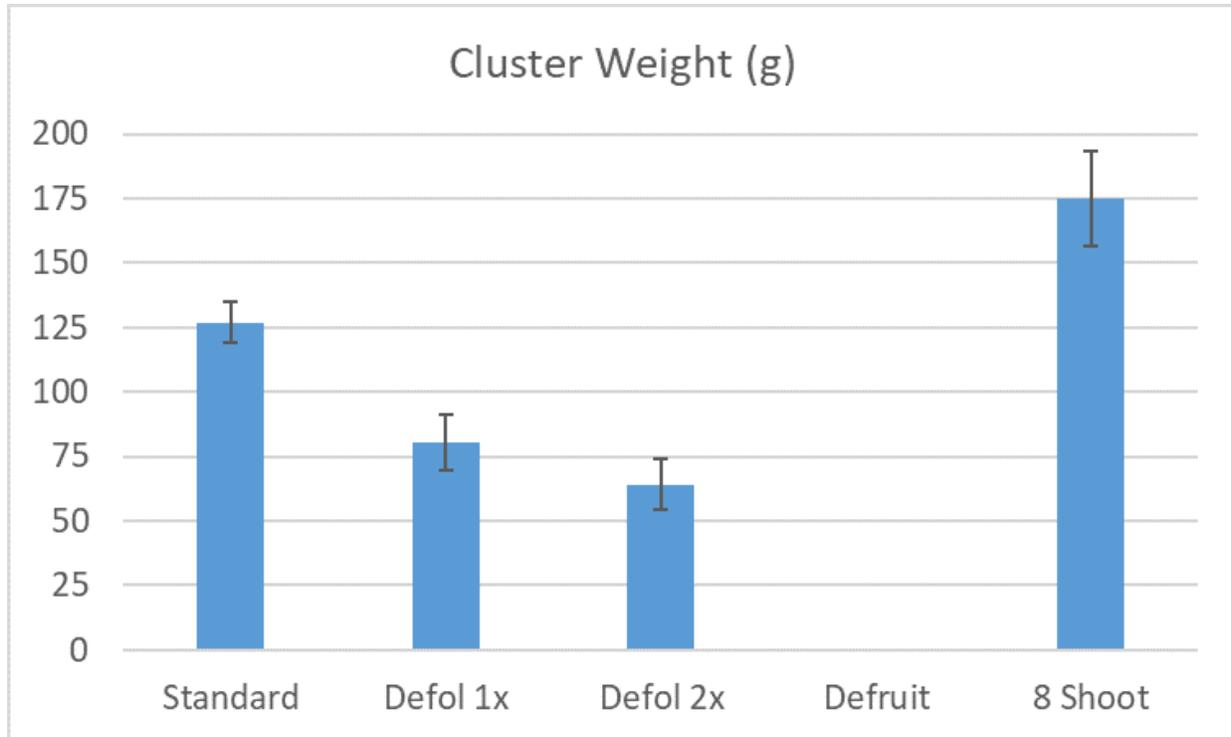
2. Clusters per vine. At harvest, defoliated vines (1x and 2x) had almost as many clusters as the 'Standard' vine – about 75-85. The 8-shoot treatment had 25 clusters.



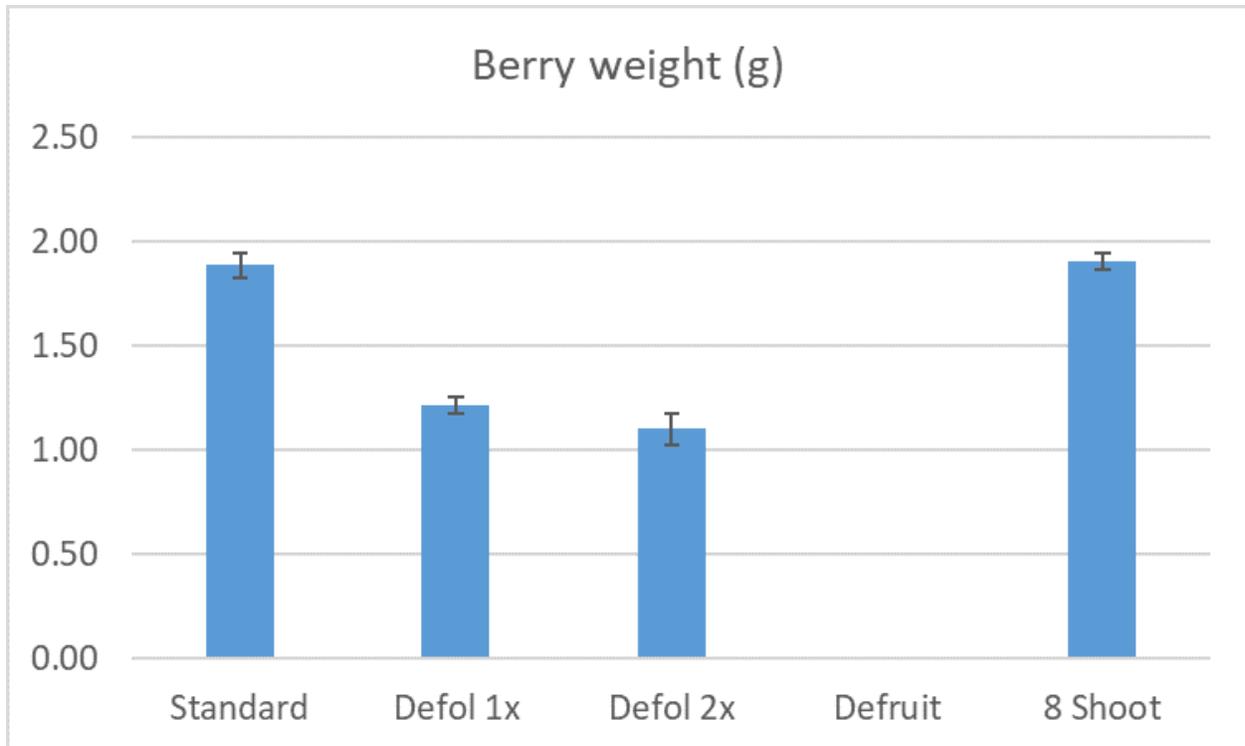
3. Yield. Standard vines yielded 24 lb/vine of fruit – which translates into a whopping 9.6 Tons per acre. The Defoliated 1x and 2x and the 8 shoot (with 25 clusters) vines averaged 11-13 lb/vine – in the 4.5 T/a range.



4. Cluster weight. Here is the big—and surprising—effect. Standard clusters weighed 125 g/cluster. The 8-shoot clusters were 40% larger at 175 g/cluster. In the two defoliated treatments, cluster weight was reduced by about one-third to one half (60-75 g/cluster).

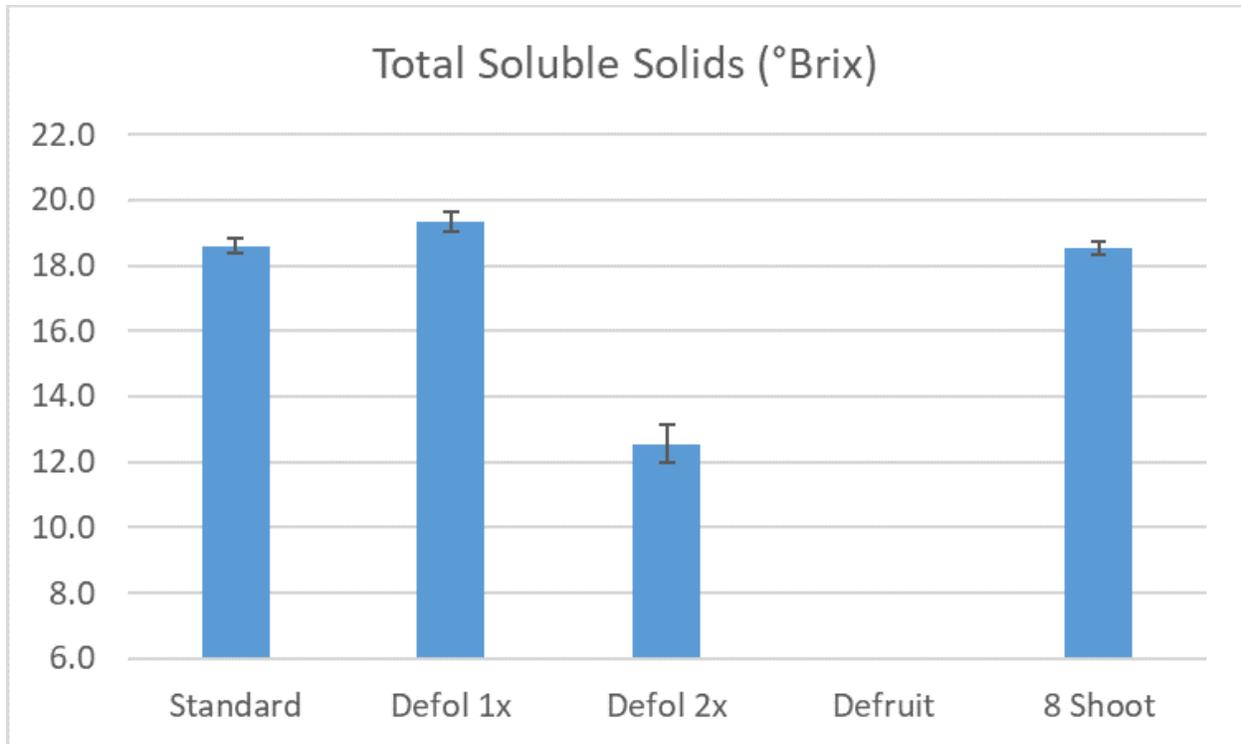


5. Berry weight. Both the standard and the 8-shoot berries weighed in at 1.8-1.9 g/berry. These are huge berries (Riesling berries are often in the 1.3-1.5 g range). Defoliating vines after fruit set reduced berry weight by 0.6 g, or about one third. Defoliating a second time did not further affect berry size.

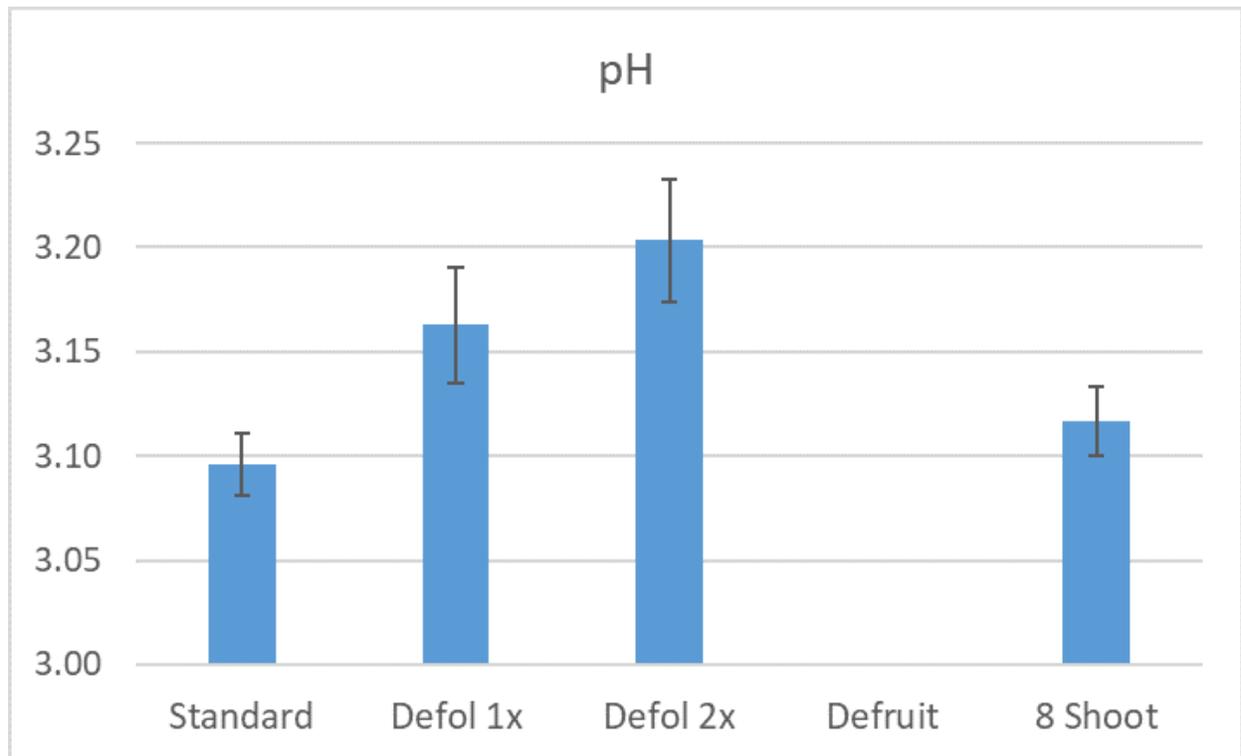


What about fruit composition? We might expect that defoliating a vine and reducing shoot number (intentionally undercropping the vine) would alter fruit ripening. But these treatments did not change fruit composition as much as you might think:

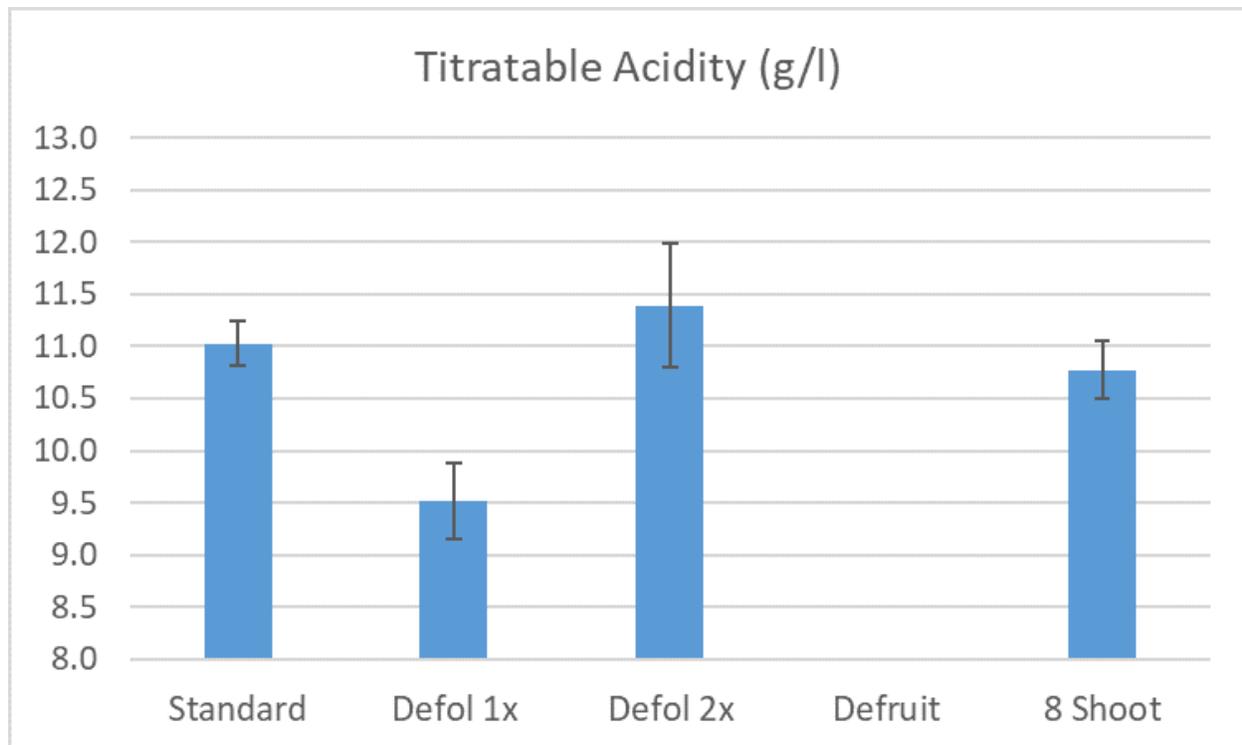
6. Soluble solids (Brix). Soluble solids in the Standard, 8-shoot, and defoliated 1x treatments were in the same range: 18.5 to 19.5 °Brix. Only the defoliated 2x vines lagged behind at 12.5 °Brix.



7. Juice pH. Juice pH ranged from 3.1 to 3.2. It was significantly higher in the two defoliated treatments, which also had clusters completely exposed to sunlight (not shaded by leaves).



8. Titratable Acidity. At harvest TAs ranged from 10.7 to 11.3 g/liter for the Standard, Defoliated 2x, and 8 shoot treatments. It was significantly lower (9.5 g/liter) in the defoliated 1x treatment.

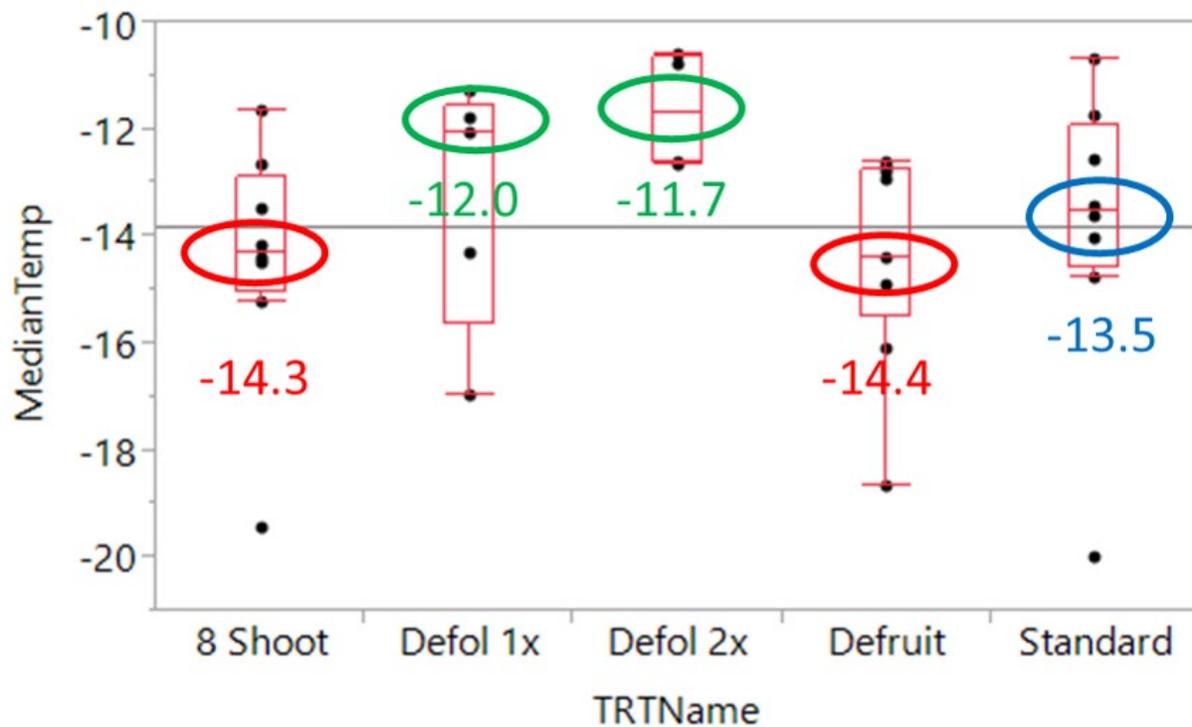


Summary. Reducing the number of shoots led to 33% larger clusters than the standard. Vines compensated by setting more berries (90 per cluster versus 70 per cluster in standard treatment). Completely defoliating the vine in early July—right after fruit set—reduced berry size, but did not change other yield components. Following the early defoliation, vines ‘regrew’ their canopy—so vines defoliated once (Defol 1x) had half the yield of our standard vines, but ripened normally. Only vines defoliated again in late August (Defoliate 2x) lagged behind the other treatments in maturity. Even without foliage, vines with fruit will try to ripen that fruit.

Effect on bud hardiness. We are in the process of determining bud-freezing temperatures throughout the dormant season. Our first bud freezing run in late October showed some promising results:

9. October 24 and November 1 Median bud freezing temperatures. Median bud freezing temperatures (LT50) in the standard treatment (blue circle) averaged -13.5 °C (7.7 °F). Buds from defruited and 8-shoot (red circles) vines had slightly lower LT50s (about 6°F, indicating more-hardy buds), and the two defoliated treatments (green circles) had higher LT50s (10.4 and 10.9 °F) than the standard treatment. These results are what one would expect: 'Source-limited' vines

(Defoliation) were less cold-hardy than 'Sink-limited' vines (Defruited and 8-Shoot). The 'Standard' treatment fell right in the middle.



Still to come: This winter we will determine pruning weights on all the treatments, lay down another four canes for next season, and follow the early growth and shoot growth to determine carryover effects in the 2018 crop year. I expect that we'll see large effects on pruning weights, grown shoot length, and return bud fruitfulness.

The payoff will be a better understanding of how manipulating fruit and foliage affect winter injury and return crop. By going to extremes of no fruit, no foliage, and an extremely limited number of shoots, I hope this will provide some insights on how vines respond to a short growing season, overcropping and undercropping in our cool climate production regions.

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