NORTHERN GRAPES PROJECT

Viticulture, enology and marketing for cold-hardy grapes

Frontenac Training Trial

Coyote Moon Vineyards
Clayton, NY

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Background and Rationale: Choice of training system influences yield, quality, and labor inputs for growing grapes. A goal of this training trial is to provide data that will allow growers to choose training systems for Frontenac grapes that minimize costs, maximize economic returns to growers and result in high quality, mature grapes for winemaking.

Treatments: We chose two high training systems and one mid-wire training system for comparison. Three training systems and follow up canopy management practices were applied, representing intensive, intermediate, and minimal post-shoot thinning treatments.

- **Vertical Shoot Positioning (VSP)**:
    - Midwire cordon with catch wires
    - Shoot position, shoot tip (hedging), leaf removal
    - *Intensive canopy management*
- **Top Wire Cordon (TWC)**:
    - High cordon
    - Shoot combing
    - *Moderate canopy management*
- **Umbrella Kniffin (UK):**
    - 3-4 long canes arched and tied to middle wire
    - No additional canopy management
    - *Minimal canopy management*

Methods. Training treatments were established in February 2012 during pruning. In both years, vines were pruned to 40-50 count buds per vine, and pruning weights were collected in spring of 2013. In 2013, shoot number was adjusted to approximately five shoots per linear foot of canopy (35 shoots/vine) at 3-5" shoot growth, but thinning was not required in 2012 due to spring frost damage or in 2014 due to extensive mid-winter low temperature damage. Bud and shoot count data were also collected at this time in both years. Vine management was done as needed throughout the growing season. In both years, preharvest fruit chemistry samples were collected starting shortly after veraison, then every 7-14 days until harvest. At harvest, cluster number and total yield (kg) data were collected for each vine. Also, during harvest in 2013 and 2014, samples were collected from the guard vines at the ends of the plots to look at differences in fruit chemistry between exposed and shaded clusters. 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).

Results:

Yield and Yield Components.

2012. As vines in the research plots had been previously trained to TWC, year 1 data (Table 1) reflects transition to the VSP and UK training systems. Post-budburst frost events caused freeze injury to some primary buds, resulting in lower than normal yields. The Ravaz index was within an acceptable range across treatments, but no significant differences were observed.

2013. With a full number of shoots and no spring freeze injury, yields were higher in 2013 (Table 1). There were no significant differences in yield or in any of the yield components, although yield was numerically lower in VSP compared to TWC and UK. There was a significant difference in the number of clusters per shoot, with UK having more clusters per shoot than VSP. There were significant differences in the Ravaz index, with VSP lower than both TWC and UK.

2014. Extreme cold temperatures during the winter of 2013-2014 caused extensive bud damage in Frontenac, as indicated by the very low yields (Table 1). TWC and UK trained vines had less damage, and therefore higher yields than VSP, although yield was still quite low. TWC vines had more clusters/vine than VSP, and UK vines had more berries per cluster and a higher cluster weight than VSP. VSP vines also had fewer shoots per vine than TWC vines.

Table 1. Yield and yield components in Frontenac training trial at Clayton, NY in 2012 - 2014.

Treatment	Yield t/acre	Yield lb/vine	Clusters /vine	Avg. berry wt. (g)	Cluster wt. (g)	Berries /cluster	Adj. # shoots /vine*	Yield (g)/adj. shoot #	Clusters /adj. shoot #	Pruning wt. (lb)	Ravaz index
2012											
TWC	4.0 a	10.0 a	51.4	1.1	87.9	81.0 a	35	129.6 a	1.5	1.5	8.1
VSP	2.5 b	6.2 b	37.8	1.1	72.9	66.0 ab	35	81.1 b	1.1	1.5	6.0
UK	3.2 ab	8.1 ab	46.6	1.1	79.3	70.0 b	35	105.4 ab	1.3	1.2	6.4
2013											
TWC	4.6	14.8	64.8	1.12	104.0	92.4	37.4	179.7	1.7 ab	1.3	13.9 a
VSP	4.0	12.9	57.2	1.17	102.1	86.6	35.2	167.5	1.6 b	1.4	10.4 b
UK	4.9	15.9	64.4	1.13	107.2	94.1	35.7	204.1	1.9 a	1.2	14.4 a
2014											
TWC	0.5 a	1.8 a	13.2 a	1.4	58.1 ab	41.4 ab	55.0 a	16.1 a	0.3 a		
VSP	0.1 b	0.5 b	4.5 b	1.3	48.3 b	36.0 b	41.4 b	5.0 b	0.1 b		
UK	0.4 ab	1.1 ab	8.0 ab	1.3	63.8 a	48.1 a	51.9 ab	9.8 ab	0.2 ab		

[z] *In 2012 and 2013, shoots were thinned to approximately 35 shoots/vine; shoot counts were done after thinning in 2013, but not in 2012. In 2014, no thinning was done due to the severity of winter damage.*

[y] *Treatment means followed by the same letter within a year and column are not significantly different at the α=0.10 level. Columns where no letters are present indicate a lack of significant differences among treatments.*

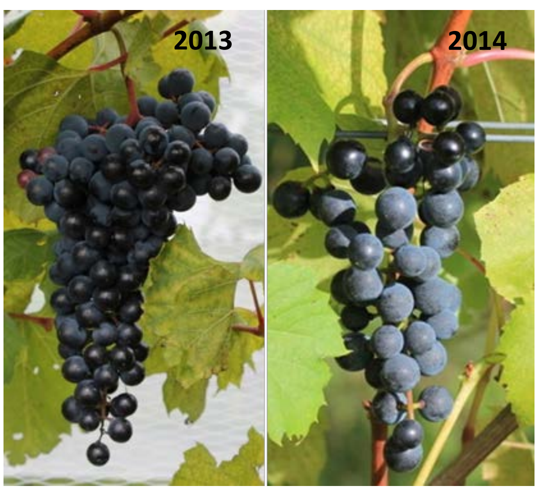
Fruit Composition. In 2012, fruit chemistry (Table 2) reflected ample heat unit accumulations during the early season (across treatments, soluble solids around 24.5 °brix; titratable acidity about 13 g/L). In 2013, titratable acidity was much higher (about 17 g/L across treatments) and brix were only slightly lower (about 23 °brix) than in 2012, despite the much cooler year. In 2014, despite the extremely low crop, brix were not very high (23.5) and TA was high (17 g/L), and was again a cool year. Despite some numerical differences in fruit chemistry among training systems at harvest, none were statistically significant, except for a slight, yet significant, differences in titratable acidity in 2014 (16.3 g/L in VSP vs. 18 g/L in UK).

Table 2. Fruit composition at harvest in Frontenac training trial at Clayton, NY in 2012 - 2014.

Treatment	°Brix	pH	TA (g/L)
2012			
TWC	24.6	3.15	12.88
VSP	24.2	3.17	12.69
UK	24.8	3.15	13.22
2013			
TWC	23.4	3.09	17.55
VSP	22.9	3.10	16.79
UK	23.1	3.08	17.93
2014			
TWC	24.0	3.17	17.18 ab[z]
VSP	23.5	3.20	16.28 b
UK	23.8	3.18	17.98 a

[z] Treatment means followed by the same letter within a year and column are not significantly different at the α=0.10 level. Columns where no letters are present indicate a lack of significant differences among treatments.

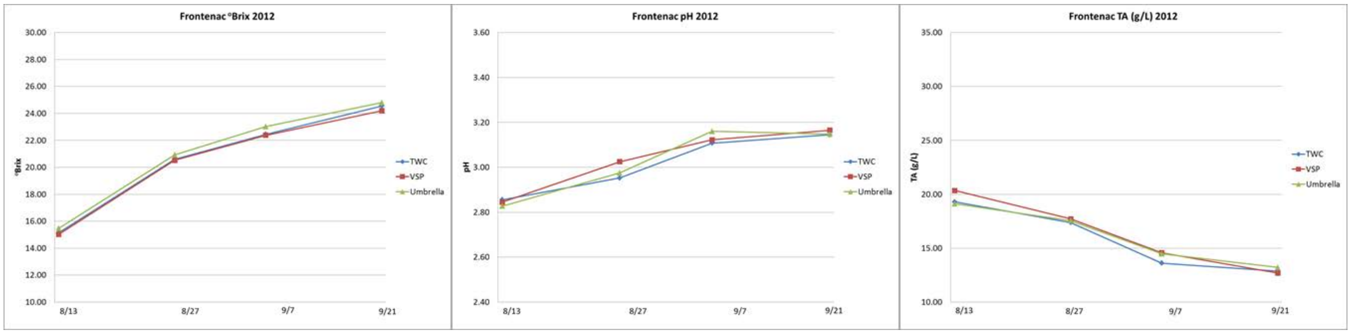
The fruit chemistry trends in all years (Figure 1) show that TA dropped sharply between the first two sampling dates, then levels off. Brix also generally increased more between the first two sampling dates. There were little differences in fruit chemistry during ripening, even just after veraison.



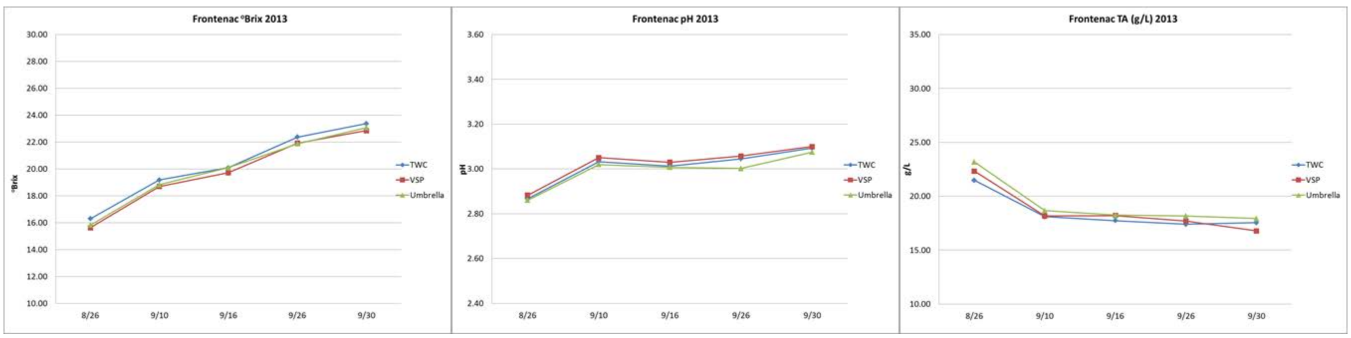
Frontenac clusters were smaller in 2014 than in previous years. There were fewer berries per cluster, but berry weight was similar to previous years.

Figure 1. Fruit composition trends in Frontenac training trial at Clayton, NY in 2012 - 2014. Samples were collected from shortly after veraison until harvest.

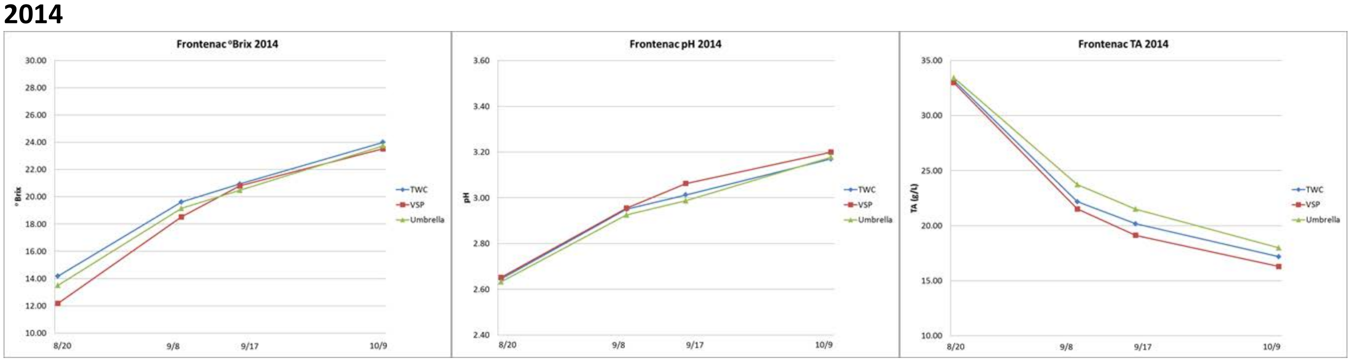
2012



2013



2014

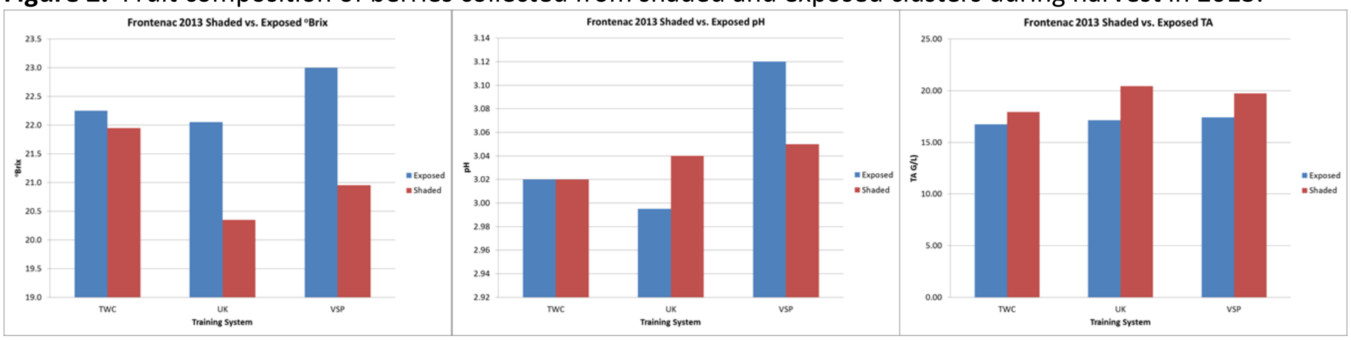


Fruit chemistry of shaded vs. exposed clusters. Across treatments, brix were higher (*p=0.04*) and TA was lower (*p=0.04*) on exposed clusters (Table 3). When looking at the data separated by training treatment (Figure 2), differences in shaded vs. exposed clusters were smaller in TWC than in UK or VSP. 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 3. Fruit chemistry and analysis of berries collected from shaded and exposed 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	19.37
Exposed	1.08	3.05	22.43	17.10

Figure 2. Fruit composition of berries collected from shaded and exposed clusters during harvest in 2013.



What the results mean:

- The warm 2012 season produced high brix and low titratable acidity, but had a reduced yield due to spring frosts. The more moderate 2013 season provided a more reasonable expectation of maturity levels under northern NY growing conditions, with slightly lower brix and higher acidity at harvest. The 2014 season produced fruit with rather high TA and typical brix, despite very low crop loads.
- In 2012, yields were influenced both by spring frost and the transition to new training systems.
- In 2013, Frontenac trained to UK yielded almost 1 ton/acre more than VSP-trained vines.
- In 2014, yields were very low due to extreme winter cold temperatures. VSP seemed to suffer more damage than UK and TWC.
- With just 0.1 to 0.3 clusters per shoot in 2014, it is clear that many of the shoots came from generally fruitless secondary and tertiary buds. However, no trunk injury was observed and all vines developed a full canopy. Normal range (2013) of clusters per shoot is 1.6 – 1.9).
- In 2014, clusters weighed less than half as much as in 2012 and 2013, again suggesting that most came from secondary or tertiary buds.
- There were no statistically significant differences in fruit chemistry in any year, except a small difference in titratable acidity in 2014.
- Well-exposed clusters had more favorable fruit chemistry (higher Brix, lower TA) than shaded clusters.
- TWC and UK have provided a yield advantage and fewer hand-labor passes through the vineyard than VSP. Some estimates show about a 30% difference in labor inputs.
- UK, without shoot positioning, has the lowest labor costs during the growing season, although as a cane-pruned system, it does require tying after dormant pruning, which is not the case with cordon-spur trained systems (TWC and VSP). Growers using cane pruning may save on post-budburst shoot thinning (canes will not produce ‘noncount’ shoots; cordons will), but if there is no downward shoot positioning (as in our study), the cluster zone may be more shaded than on the TWC + shoot combing treatment.
- 2013 and 2014 results suggest that maintaining cluster exposure and avoiding shading is more important that training system, per se, in minimizing acidity and maximizing soluble solids.