Vineyard Training Systems for Improving the Quality of 'Frontenac', 'La Crescent' and 'Marquette' Grapes
Hickory Creek Vineyard, Adel, IA
Snus Hill Winery, Madrid, IA

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Background and Rationale: Cold-hardy *Vitis riparia* hybrids have allowed the recent expansion of the wine industry into the upper Midwest, impacting the economy and culture of the region. While these hybrids have created new opportunities, they also present several challenges; they are cold-hardy, but often more vigorous than the traditional *V. vinifera* hybrids and tend to produce fruit with quality characteristics that challenge winemaking. During maturation, the fruit tend to retain high levels of acids, exhibit a rapid rise in pH, possess a different profile of malic to tartaric acid than other hybrids, and wines from these grapes often have an "herbaceous" character. These characteristics also have been associated with grapes grown in overly shaded canopies. This study was undertaken to determine if vineyard training systems can improve fruit and wine making characteristics of 'Frontenac' and 'Marquette' grapes, in Madrid, as well as 'La Crescent' grapes, in Adel, and assess the cost-effectiveness of the various systems.

Treatments: In 2012, vines originally trained to a single curtain bilateral cordon system were either left alone or converted to a single or split canopy system. The vines also were trained to following systems in 2013 and 2014.

- **Top Wire Cordon (TWC)**:
  - High cordon
  - Best management practices
    - Pre-bloom shoot thinning
    - Post bloom shoot positioning
    - Axillary shoot removal in the fruiting zone
    - Skirting

- **Geneva Double Curtain (GDC):**
  - TWC with a divided canopy
  - Best management practices
    - Pre-bloom shoot thinning
    - Post bloom shoot positioning
   - Axillary shoot removal in the fruiting zone
    - Skirting

- **Mid-wire cordon with catch wires (VSP)**:
  - Single canopy
  - Best management practices
    - Pre-bloom shoot thinning
    - Shoot positioning multiple times with 3 sets of movable catch wires
    - Axillary shoot removal in the fruiting zone
    - Hedging

- **Mid-wire cordon with a split canopy and VSP (SH):**
  - Scott Henry or Smart-Dyson
  - Split canopy
  - Best management practices
    - Pre-bloom shoot thinning
    - Shoot positioning multiple times with 3 sets of movable catch wires
    - Axillary shoot removal in the fruiting zone
    - Hedging and skirting

Methods: In 2013 and 2014, vines were shoot thinned to retain no more than five shoots per foot of cordon. Treatments were applied to three-vine panels and replicated four times in a randomized complete block design. Time to perform each practice per vine was recorded. Fruit were harvested, weighed and a 300-berry sub-sample was collected to analyze fruit quality characteristics (Brix, pH, TA, and malic and tartaric acids) of those cultivars with fruit in 2013. Due to bird and raccoon predation to the 'Marquette' and 'Frontenac' vines, a harvestable crop was not produced in 2014, but labor time was recorded for applying treatments. Data of labor and yield variables were analyzed using Tukey's adjustment for multiple comparisons.

Results: 2013: In 'Frontenac' and 'La Crescent' vines training systems that included vertical shoot training (VSP and SH) required more labor than without (TWC and GDC), (Figure 1). The vines of 'Frontenac' and 'La Crescent' were older and more vigorous than the 'Marquette' vines use in this experiment, and their shoots were much larger and more difficult to handle and control in the vertical systems thereby increasing labor time. In 'Frontenac' the GDC and SH training systems, that maximized the cordon length utilized per vine, were more productive than TWC and VSP (Figure 2). The opposite trend was noted in the 'La Crescent' vines, with a higher yield obtained by TWC.

2014. Fruit quality variables of 'Marquette' berry samples taken in September 2014 from Snus Hill Winery's vineyards showed no differences among training system treatments for average berry weight, Brix and pH. TA was higher in fruit from vines trained to a mid-wire cordon with catch wires (VSP) system.
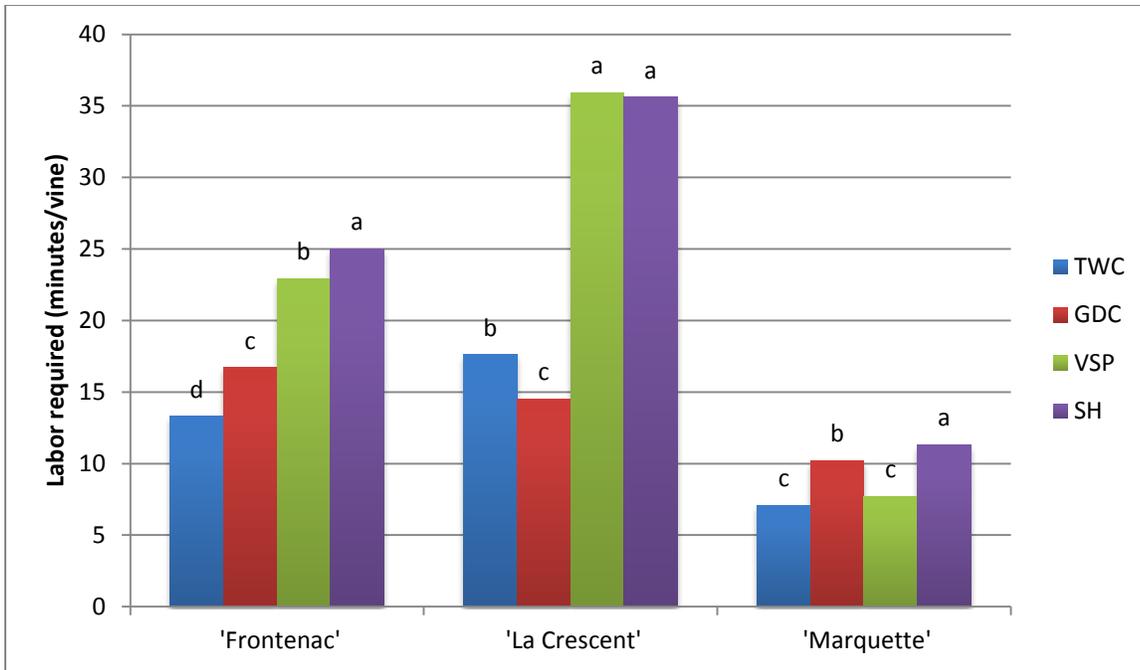
Treatment means followed by the same letter within a column are not significantly different at the α=0.05 level.

Figure 1. Total labor required per vine for each of the different training systems on 'Frontenac', 'La Crescent', and 'Marquette', Adel and Madrid, IA, 2013.
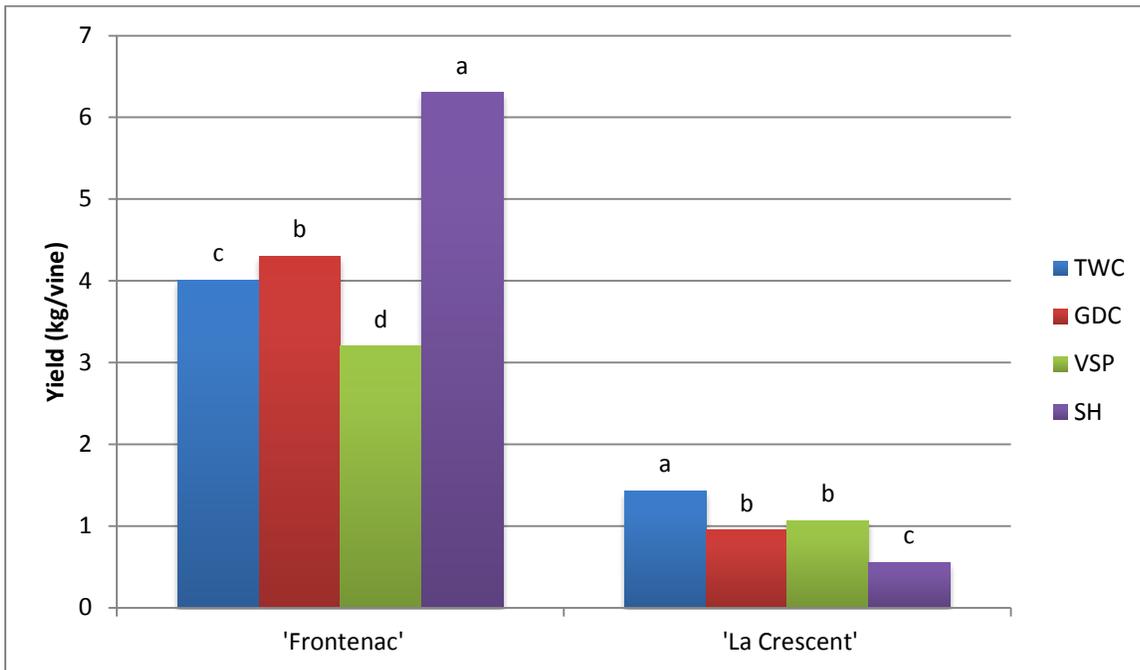
Treatment means followed by the same letter within a column are not significantly different at the α=0.05 level..

Figure 2. Yield at harvest (kg/vine) for each of the different training systems on 'Frontenac', and 'La Crescent', Adel and Madrid, IA, 2013.

Table 1. Fruit quality of 'Marquette' vines trained to a top wire cordon (TWC), Geneva double curtain (GDC), mid-wire cordon with catch wires (VSP), or mid-wire cordon with a split canopy and VSP (Scott Henry -SH) system, September 2014.

Training System	Avg. Berry Wt. (g)	Brix	pH	TA
TWC[z]	150.0[y] a	19.7 a	3.5 a	8.8 b
GDC	102.5 a	20.5 a	3.6 a	7.8 b
VSP	114.5 a	20.5 a	3.5 a	10.1 a
SH[x]	-	-	-	-
P value[w]	0.103	0.17	0.32	0.009

[z] TWC also called single curtain; VSP refers to vertical shoot positioning within catch wires of a mid-wire cordon
[y] Means of four replications
[x] Fruit not available due to bird and raccoon predation
[w] Means within columns followed by the same letter are not significantly different (LSD, alpha = 0.05)

What the results mean:

- No pattern emerged that connected labor and yield across all cultivars.
    - In 'Frontenac', higher labor requirements were needed for the Scott Henry training system, resulting in the highest yield.
    - In 'La Crescent', higher labor requirements of Scott Henry were not offset by increased yields.
    - 'Frontenac' may not be suited for the Vertical Shoot positioning training system because it requires higher labor without a corresponding high yield.

- Additional growing seasons for the experiment will assist in determining the most efficient training system to correspond with profitable fruit yield and the best fruit quality for each cultivar.