Evaluation of American Hybrid Winegrape Cultivars in a National Trial Vineyard in Massachusetts

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Selecting the right wine grape cultivar for the right location is the first key decision when establishing a new vineyard. Choosing wine grape cultivars that are both cold hardy, disease resistant and produces well are essential if a grower is to be successful in New England.

Prior to the turn of the 21st century, most U.S. states produced few to no winegrapes, primarily because of limitation in cold hardiness and disease resistance of the *Vitis vinifera*, the European winegrape species that comprises most commercial cultivars grown in the U.S. in traditional production regions[1].

While *Vitis vinifera* cultivars had been used for centuries throughout Europe they ran into trouble in the 1800's[2]. "The creation of interspecific hybrid grapes primarily came about because of problems encountered in France in the 1860s. A devastating phylloxera outbreak began there around 1860 and lasted for the next 20 years. During that time, about 90 percent of French vineyards were destroyed. To combat this epidemic, cultivars derived from phylloxera-resistant American species were planted. At one time, more than 25,000 acres of the American grape 'Noah' were planted in France, as were other American grapes such as 'Clinton,' 'Othello,' 'Lenoir,' 'Isabella,' and 'Herbemont.' 'Concord,' 'Catawba,' and 'Delaware' were tried but had low resistance to phylloxera. The importation of these varieties also brought with them new disease problems like downy mildew and black rot. In 1876, it was found that *V. vinifera* cultivars could be grafted onto American grapes successfully. The discovery helped transition back to *V. vinifera* grapes, but diseases were also a problem according to Stafne.

The introduction of interspecific Hybrid grape varieties in the USA commonly called French- American Hybrids[2]. French hybrids originally were developed from breeding efforts for rootstocks on which to place *V. vinifera* grapes. Amateur grape breeders pushed the breeding process forward to look for vines with roots resistant to phylloxera, foliage resistant to fungal pathogens, and fruit that could produce wines more similar to *V. vinifera* types. This stage of breeding produced some cultivars such as 'Baco noir' and 'Baco blanc.'

The second wave of breeding for interspecific hybrids used crosses between hybrids gained from the first stage[2]. Some of the influential breeders of this time period were Seibel, Bertille Seyve, Joannes Seyve, Galibert, and Landot. The third stage of hybrid breeding led to the modern hybrid grapes commonly grown today. These were usually crosses of hybrids from the second stage with *V. vinifera* grapes to gain superior wine quality. However, with the elevation of wine quality came the dilution of pest resistance. There are several breeding programs around the world now involved in creating high quality hybrid grapes. Some of the programs in the United States are in Arkansas, California, Florida, Georgia, Minnesota, Mississippi, New York, and North Carolina.

The introduction of new, interspecific hybrid cultivars has allowed for the development of grape industries in regions not previously considered possible[1]. As the wine grape industry continues to expand into the colder New England states it became important to evaluate potentially cold hard cultivars from multiple sources for adaptabilty for commercial production.

To this end a team of UMASS scientists participated in the "NE1720: Multi-state Coordinated Evaluation of Winegrape Cultivars and Clones: trial established

in 2005. The purpose was to evaluate the horticultural characteristics of each cultivar, the national project "NE1720: Multi-state Coordinated Evaluation of Winegrape Cultivars and Clones" has been developed. As part of that national project, the University of Massachusetts vineyard at the Cold Spring Orchard, Belchertown, has a variety trial with nine winegrape cultivars planted in 2005. Here we report results concerning survivability, timing of key phenological stages, Brix, and natural disease resistance to downy mildew. Part of NE1720 is to obtain consistent responses from stakeholders including support not only for continued cultivar development and evaluation, but also for developing best management practices to improve consistency, quantity, and quality of crops from evaluated winegrape cultivars and clones.

This report will cover results concerning survivability, timing of key phenological stages, Brix, and natural disease resistance to downy mildew.

Materials & Methods

Location, plant material, and management. The vineyard is located at the Cold Spring Orchard in Belchertown MA (42.2, -72.36). In 2005, Chambourcin, Corot Noir, Frontenac, La Crescent, Marquette, Noiret, Riesling, St. Croix, and Vidal (Table 1) were planted in a randomized complete block with three plants per block replicated in four rows (Figure 1). Riesling is a vinifera cultivar that was used as a comparison. Grapevines were trained in high wire with a cordon-spur pruning system for hybrids and a low wire with a cordon-spur pruning system with vertical shoot positioning (VSP) for *vinifera*.

In spring, shoots are thinned annually to 4 shoots per foot. Early in the summer, shoots are combed for the high wire training system or positioned vertically

Table 1. The nine winegrape cultivars evaluated at the vineyard at the University of Massachusetts Cold Spring Orchard, in Belchertown.

Cultivar	Wine color	Year released	Breeding program or breeder
Chambourcin	Red	1963	Seyve
Corot Noir	Red	2006	Cornell
Frontenac	Red	1996	UMN
La Crescent	White	2002	UMN
Marquette	Red	2006	UMN
Noiret	Red	2006	Cornell
Riesling	White	NA	NA
St. Croix	Red	1981	Swenson
Vidal	White	1930	Vidal

Row 4		Row 3		Row 2		Row 1	
Variety	Plant number	Variety	Plant number	Variety	Plant number	Variety	Plant number
St. Croix	1	Noiret	1	La Crescent	1	Riesling	1
St. Croix	2	Noiret	2	La Crescent	2	Riesling	2
St. Croix	3	Noiret	3	La Crescent	3	Riesling	3
Vidal	1	La Crescent	1	Riesling	1	Corot Noir	1
Vidal	2	La Crescent	2	Riesling	2	Corot Noir	2
Vidal	3	La Crescent	3	Riesling	3	Corot Noir	3
Chambourcin	1	Riesling	1	Chambourcin	1	Marquette	1
Chambourcin	2	Riesling	2	Chambourcin	2	Marquette	2
Chambourcin	3	Riesling	3	Chambourcin	3	Marquette	3
Riesling	1	Marquette	1	Corot Noir	1	Frontenac	1
Riesling	2	Marquette	2	Corot Noir	2	Frontenac	2
Riesling	3	Marquette	3	Corot Noir	3	Frontenac	3
Marquette	1	Frontenac	1	Vidal	1	Noiret	1
Marquette	2	Frontenac	2	Vidal	2	Noiret	2
Marquette	3	Frontenac	3	Vidal	3	Noiret	3
La Crescent	1	Vidal	1	St. Croix	1	Chambourcin	1
La Crescent	2	Vidal	2	St. Croix	2	Chambourcin	2
La Crescent	3	Vidal	3	St. Croix	3	Chambourcin	3
Corot Noir	1	Chambourcin	1	Frontenac	1	Vidal	1
Corot Noir	2	Chambourcin	2	Frontenac	2	Vidal	2
Corot Noir	3	Chambourcin	3	Frontenac	3	Vidal	3
Frontenac	1	St. Croix	1	Noiret	1	La Crescent	1
Frontenac	2	St. Croix	2	Noiret	2	La Crescent	2
Frontenac	3	St. Croix	3	Noiret	3	La Crescent	3
Noiret	1	Corot Noir	1	Marquette	1	St. Croix	1
Noiret	2	Corot Noir	2	Marquette	2	St. Croix	2
Noiret	3	Corot Noir	3	Marquette	3	St. Croix	3

Figure 1. Experimental design used in the winegrape cultivars trial at the University of Massachusetts vineyard at Cold Spring Orchard in Belchertown, MA.

for the VSP training system. Mid-summer, leaves are pulled to expose the fruits to sun. Pests are managed using a regular conventional pesticide program.

Soil. According to the USDA National Cooperative Soil Survey, the soil is classified as 315B (Scituate fine sandy loam), which is a moderately well-drained fine sandy loam with 3 to 8 percent slopes.

Data collection. In 2021, survivability of each cultivar (number of alive plants out of all original plants for a given cultivar) after 16 years was computed. For key phenology, we evaluated bud burst (stage 4, Figure 2), flowering (stage 26, Figure 2), and veraison (stage 35, Figure 2). We also quantified juice soluble solids (Brix). For disease, we focused on downy mildew, one of the most economically important diseases, in MA.

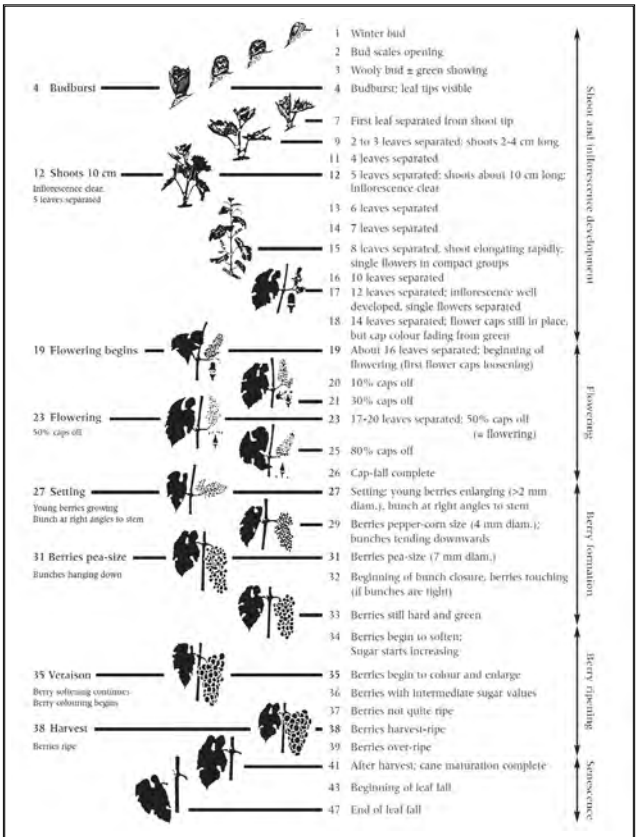

Figure 2. Modified E-L system for identifying major and intermediate grapevine growth stages from Dry and Coombe 2004.

Results

Survivability. In 2021, the levels of survivability were the lowest for Riesling (42%) and Chambourcin (50%), followed by Noiret and Vidal (both 75%), Marquette (83%) and Corot Noir (92%) (Figure 3). Frontenac, La Crescent and St. Croix did the best and all survived (Figure 3).

Key phenology and total soluble solids (Brix). Bud break in 2019 occurred around 15 May (day of year 135) (Table 2). The nine winegrape cultivars had bud break on different days, from early to late bud break as follows: La Crescent, Marquette, Frontenac, St. Croix, Vidal, Chambourcin, Noiret, Corot Noir, and Riesling (Table 2). Bloom occurred around 24 June (day of the year 175) in 2019 and around 16 June (day of the year 167) in 2021 (Table 2). For both years, cultivars that bloomed the earliest were La Crescent, Marquette and Frontenac and the latest were Corot Noir and Riesling. Veraison occurred around 28 August (day of the year 240) in 2019 and 23 August (day of the year 235) in 2021 (Table 2).

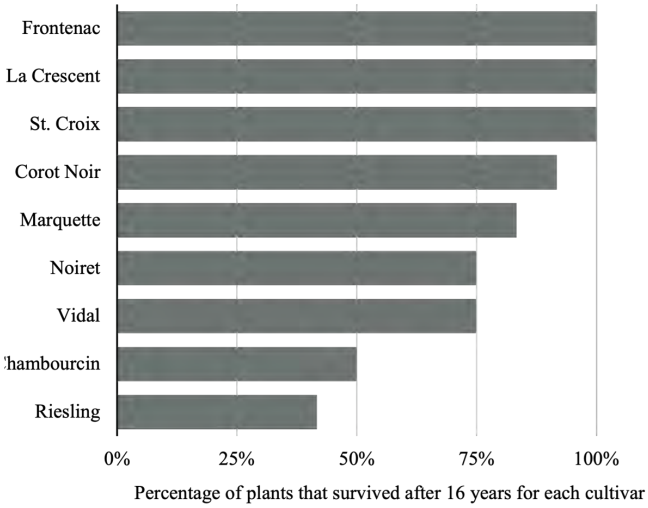

Figure 3. Survivability of each of nine winegrape cultivars at the University of Massachusetts vineyard at Cold Spring Orchard in Belchertown, MA.

Marquette was the first cultivar to go through veraison and Riesling the last (Table 2). Brix was measured for all winegrape cultivars the same day, 20 September 2021. Marquette had the highest Brix and Riesling the lowest (Table 2).

Natural resistance to downy mildew. In 2021, among the nine cultivars tested, Vidal, Riesling, La Crescent, had the least natural resistance to downy mildew while St. Croix showed average symptom level and Chambourcin, Noiret, Frontenac and Marquette showed the most resistance (Figure 4).

Variety	Bud break 2019 (DOY)*	Full bloom 2019 (DOY)	Full bloom 2021 (DOY)	Veraison 2019 (DOY)	Veraison 2021 (DOY)	Brix on Sept 20, 2021
La Crescent	133	172	163	243	234	18.2
Marquette	133	172	163	232	221	25.1
Frontenac	134	172	163	233	224	19.9
St Croix	135	172	165	235	230	20.8
Vidal	135	177	168	255	239	17.2
Chambourcin	136	177	170	245	242	17.1
Noiret	136	175	167	236	240	17.0
Corot Noir	137	178	172	245	242	16.9
Riesling	138	180	175	257	247	16.5

Table 2. Key phenology and total soluble solids (Brix) measured in 2019 and 2021 for nine winegrape cultivars at the University of Massachusetts vineyard at Cold Spring Orchard, Belchertown. Bud break data were not available for 2021 and Brix was not available for 2019. *DOY: Day of Year.

Conclusions

At the University of Massachusetts vineyard at Cold Spring Orchard, cultivars that were the most suitable based on survivability, level of sugar and downy mildew resistance are Frontenac, Marquette and St Croix. Cultivars that are the least adapted are Vidal and Riesling.

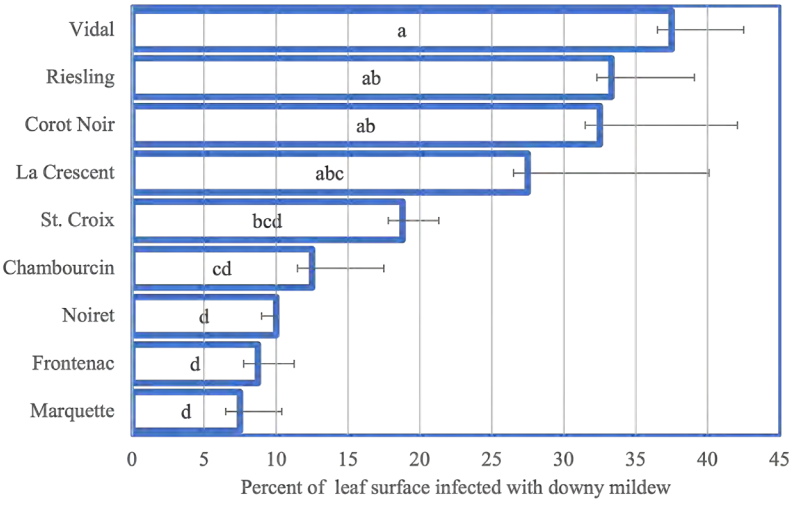

Figure 4. Level of susceptibility to downy mildew according to winegrape cultivar. Bars with the same letter are not different at odds of 19:1.

Acknowledgements

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Citations

[1]NE1720: Multi-state Coordinated Evaluation of Winegrape Cultivars and Clones
https://www.nimss.org/projects/view/mrp/outline/18405
[2]Interspecific Hybrid (French-American) Wine Grapes, 2019. Eric Stafne
https://grapes.extension.org/interspecific-hybrid-french-american-wine-grapes