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Assessment of the Feasibility of Growing Pierce's Disease Tolerant American and French-American Hybrid Bunch Grape Cultivars in Alabama

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Abstract

Eleven Pierce's Disease (PD) tolerant American and French-American hybrid bunch grape cultivars, including 'Black Spanish', 'Blanc du Bois', 'Champanel', 'Conquistador', 'Cynthiana', 'Favorite', 'Lake Emerald', 'Seyval Blanc', 'Seyval Blanc' grafted on Coudrec 3309 ('Seyval Blanc'/3309C), 'Stover', and 'Villard Blanc', were planted at the Sand Mountain Research and Extension Center (SMREC), Crossville, AL in 2008 to study the feasibility of growing PD tolerant bunch grapes in the Alabama environment. Our results indicate that 'Villard Blanc' produced the largest yield of 16.5 kg/vine in 2011 and had the greatest mean cluster weight of 238 g. 'Champanel' produced the largest berries (4.2 g), and was the most vigorously growing cultivar based on pruning weight. 'Cynthiana' had the highest soluble solids concentration (SSC) of 21.0%, followed by 'Lake Emerald' with 20.7%.

Grape, a member of the genus *Vitis*, is a commercial fruit crop in the United States. The genus *Vitis*, which occurs predominantly in the temperate and subtropical climate zones, is often divided into two groups: the Eurasian group and the American group (5). The European species, *Vitis vinifera* is the earliest and most well-known wine grape variety with good fruitfulness and good fruit quality (5). *Vinifera* grapevines were brought to America by English investors expecting to develop a wine industry (1). However, the 'continental' climate of the areas east of the Rocky Mountains with hot, wet summers and cold, dry winters, and some native North American pests such as the phylloxera (*Daktulosphaira vitifoliae* Fitch) and other diseases prevented *Vinifera* species developing and surviving in the eastern United States (1).

The American group contains between 8 and 34 species (5). Because of their varying resistance to North American grapevine diseases and pests (5), efforts were made by American breeders crossing *Vinifera* species with the native American species, or between two American species, to produce hybrids which would be environmentally adapted and have a good fruit quality. These hybrids are categorized as 'American hybrids' (1). American species were introduced into France in the 19th century. The phylloxera infested American vines nearly devastated French vineyards (1) leading French breeders to develop crosses between *Vinifera* species and phylloxera resistant or tolerant American species. The own-rooted hybrids containing improved disease resistance and relatively good wine quality were called 'French-American hybrids' or 'French hybrids' (3).

Although the quality of wine made from hybrid grape cultivars is generally inferior to the wine produced from *Vinifera* cultivars, the hybrid grapes have a distinct application in eastern United States, because they are adaptable to the climate and resistant to some native pests and diseases (3), such as Pierce's Disease (PD). PD caused by the bacterium *Xylella fastidiosa* is a very serious grapevine disease. Once in the plant, the bacteria multiply and block the vascular system of the plant, restricting water and nutrient supply to tissues. In susceptible varieties, such as most

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Vinifera vines, the bacteria usually kill the vine (9). Some hybrid cultivars have resistance or tolerance to PD. 'Orlando Seedless' was the first PD resistant seedless table grape cultivar to be developed (2). 'Blanc du Bois', 'Lake Emerald', and 'Stover' developed by the University of Florida breeding program were also reported to have PD tolerance (7, 8, 10). 'Seyval Blanc' was shown to be one of the wine cultivars best suited to the Ozark, Missouri region with high yield and large clusters (4).

The demand for high quality table and wine grapes is increasing in Alabama, but science-based information on PD tolerant hybrid grape cultivar performance is lacking in that environment. Alabama is located in a high PD pressure area (6) which is not suitable for *Vinifera* species. Growing hybrid cultivars with good fruit quality and disease resistance would, therefore, provide a sustainable production system.

The main objective of our research was to assess the feasibility of growing PD tolerant American and French-American hybrid grapes in Alabama, and to provide grape growers with recommendations on cultivar selection as a means to expand and sustain the grape growing industry in the state.

Materials and Methods

The grapes were planted at the Sand Mountain Research and Extension Center (SMREC) near Crossville, AL in 2008. In the 2011 season, vines were allowed to produce a full crop. Experimental vines were trained to a single wire trellis system and spur-pruned. Standard commercial practices were implemented for vineyard management. The experiment was designed in a randomized complete block design with 4 replications and 4 individual plants per replication. Hybrid bunch grape cultivars tested included 'Black Spanish', 'Blanc du Bois', 'Champanel', 'Conquistador', 'Cynthiana', 'Favorite', 'Lake Emerald', 'Seyval Blanc', 'Seyval Blanc' grafted on Coudrec 3309 ('Seyval Blanc'/ C3309), 'Stover', and 'Villard Blanc'. Unless indicated, the vines were own-rooted.

Dormant pruning was done in March 2011 and individual pruning weight was recorded. Experimental vines were hand-harvested based on color and taste of berries. Total yield per vine was measured at each harvest date. Average cluster weight was determined on the total weight of 5 typical clusters per vine. Mean berry weight was based on the total weight of a 50 berry sub-sample per vine. Fruit soluble solids concentration was analyzed using a digital refractometer (Pal-1 Atago, Co., Tokyo, Japan). PD symptom expression was visually rated after harvest using the following scale: 0 = no symptoms; 1 = 1 to 20% leaves with symptoms; 2 = 21 to 40% leaves with symptoms; 3 = 41 to 60% leaves with symptoms; 4 = 61 to 80% leaves with symptoms; 5 = 81 to 100% leaves with symptoms.

The experimental data were analyzed using PROC GLIMMIX (SAS Version 9.2, SAS Institute Inc., Cary, NC). Differences among cultivars were determined using Tukey's test with the normal distribution at $\alpha = 0.05$.

Results and Discussion

The results for pruning weight indicate significant differences among cultivars tested in 2011 (Table 1). 'Champanel' had the highest pruning weight of 2.2 kg/vine and the greatest trunk cross sectional area (TCSA) of 7.19 cm^2 (data not presented). 'Blanc du Bois', 'Lake Emerald' and 'Villard Blanc' were also vigorous cultivars. 'Seyval Blanc' and 'Seyval Blanc'/3309C had the lowest pruning weight of 0.2 kg/vine, indicating that these two cultivars had the weakest vegetative growth.

Total yield per vine, and fruit quality characteristics including average cluster weight, mean berry weight, and SSC differed significantly among the cultivars tested (Table 1). The highest yielding cultivar was 'Villard Blanc' with 16.5 kg/vine, followed by 'Black Spanish' with 10.1 kg/vine. 'Favorite' and 'Cynthiana' also produced a good crop of 8.8 and 8.0 kg/vine, respectively. The lowest yielding cultivar was 'Conquistador' producing an average of 2.2 kg/vine.

Table 1. Pruning weight, yield per vine, average cluster weight, mean berry weight and soluble solids concentration (SSC) of selected Pierce's Disease tolerant American and French-American hybrid bunch grape cultivars grown in Crossville, AL 2011.

Cultivar	Pruning weight (kg)	Yield per vine (kg)	Average cluster weight (g)	Mean berry weight (g)	SSC (%)
Blanc du Bois	1.1 bcd	4.0 ef	112.3 bcd	3.4 b	16.1 d
Black Spanish	0.6 de	10.1 b	151.2 b	1.7 fg	19.9 ab
Champanel	2.2 a	4.9 def	101.4 d	4.2 a	14.1 e
Conquistador	0.6 de	2.2 f	56.0 e	1.3 i	17.6 c
Cynthiana	0.7 cde	8.0 bcd	110.5 cd	1.3 i	21.0 a
Favorite	0.6 e	8.8 bc	149.2 b	1.6 gh	19.4 b
Lake Emerald	1.6 ab	3.1 ef	73.1 de	1.5 h	20.7 ab
Seyval Blanc/3309C	0.2 f	4.5 ef	122.6 bcd	2.0 de	18.3 bc
Seyval Blanc	0.2 f	5.7 cde	136.4 bc	1.9 ef	17.3 cd
Stover	0.5 e	6.6 bcde	86.0 d	2.3 cd	17.2 cd
Villard Blanc	1.2 bc	16.5 a	238.1 a	2.6 c	14.6 e

A powdery mildew infection occurred on 'Conquistador' before harvest that caused about 20% yield loss. Feeding by green June beetles *(Cotinis nitida)* caused about 30% yield loss of the early ripening cultivars 'Seyval Blanc', 'Seyval Blanc'/3309C, and 'Blanc du Bois'.

'Villard Blanc' produced the largest clusters (238.1 g), while 'Conquistador' produced the smallest (56.0 g). 'Champanel' had the largest berries (4.2 g), while 'Conquistador' and 'Cynthiana' produced the smallest (1.3 g). 'Cynthiana' berries had the highest SSC of 21.0% at harvest, while 'Champanel' and 'Villard Blanc' had a relatively low SSC. PD symptoms were not observed on the experimental vines during the 2011 season (data not shown).

According to the results in 2011, significant differences were found among tested PD tolerant American and French-American hybrid grape cultivars in terms of their vegetative growth, cropping potential, and fruit quality. 'Villard Blanc' was the overall best performing cultivar in our test with excellent vine vigor, productivity, and good fruit quality. 'Black Spanish' and 'Cynthiana' also had vigorously growing vines and good productivity. Research will continue and multiple season data will be collected in order to fully assess the feasibility of growing PD tolerant hybrid bunch grape cultivars in Alabama that can help sustain a grape growing industry in the Southeast of the USA.

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