Sensitivity of Northern Grape Cultivars to Fungicides and Cultivar Susceptibility to Diseases

Madison, WI and Sturgeon Bay, WI

Patricia McManus, Victoria Kartanos, Matt Stasiak, and David Jones
University of Wisconsin-Madison

Background and Rationale: While many synthetic fungicides are failing owing to the emergence of fungicide-resistant pathogen populations, copper- and sulfur-based fungicides remain effective despite decades of use in vineyards. In grape production, sulfur is used primary to control powdery mildew, whereas copper is used primarily to control downy mildew. Some copper- and sulfur-based products are allowed for use in organic production, and many formulations are relatively inexpensive. Thus, copper and sulfur continue to have an important place in modern grape production. Unfortunately, some grape cultivars are sensitive to injury from copper and/or sulfur. Likewise, possible injury to hybrid grape cultivars from the fungicide difenoconazole has prompted the manufacturer to post warnings on product labels. Information on the sensitivity of "northern" wine grape cultivars to copper, sulfur, and difenoconazole is limited because many of the cultivars have only recently been widely planted. In Year 4 of the project we concluded field trials to assess sensitivity of several cultivars to copper, sulfur, and difenoconazole. Further, we initiated a study of disease susceptibility of northern cultivars.

Treatments:

- Products and numbers of applications varied across the 11 trials conducted in 2012-2015, but all trials included two to six applications of copper- and sulfur-based fungicides applied at the highest rate permitted on product labels (metallic copper at 1.2-2.0 lb/acre; micronized sulfur at 8 lb/acre). Difenoconazole was applied at the highest rate permitted on product labels (0.114 lb/acre) two to four times per season in eight trials. Fungicides were always applied alone and not mixed with adjuvants or other pesticides. Treatments were applied to whole cordons or individual shoots.
- The following 10 cultivars in a vineyard established in 2008 were treated at Peninsular Agricultural Research Station (PARS) in Sturgeon Bay, WI: Brianna, Frontenac, LaCrescent, LaCrosse, Leon Millot, Maréchal Foch, Marquette, Noiret, NY76, and Vignoles.
- In a vineyard established in 2008 at West Madison Agricultural Research Station (WMARS), the same cultivars (except Noiret and Vignoles) plus MN1220 and Petite Pearl, were treated.
- The following eight cultivars were treated in vineyards established in 2012 at PARS and WMARS: Brianna, Frontenac, Frontenac Gris, LaCrescent, LaCrosse, Marquette, St. Croix, and Valiant.
- Not all cultivars were treated in each year (see Tables 1 and 2).
- In 2015, diseases were evaluated on unsprayed vines of all eight cultivars in the vineyards established in 2012. Additional ratings will be conducted in 2016.

Methods: Foliage was rated for injury from fungicides one to seven times each growing season in 2012-2015 at approximately 2-week intervals. Foliage was rated for susceptibility to diseases at weekly intervals season long in 2015. A visual scale of 1 (= no injury) to 4 (= severe injury) was used. Because the rating system was subjective, ratings were conducted by one person in any given trial. Individual leaves were not assessed; rather, the canopy as a whole was evaluated. For the fungicide sensitivity trials, the mean injury severity rating for each fungicide on each cultivar on each date was compared to the rating for that cultivar's control group using a two-tailed, paired t-test.

Results: A rating of 2.5 or higher represents a level of injury that would be noticeable and possibly alarming to growers. Treatment with copper resulted in leaf injury severity ≥ 2.5 that was significantly different ($P \leq 0.05$) from the corresponding non-treated controls on at least one date for Brianna, Frontenac, Frontenace gris, LaCrescent, Leon Millot, Maréchal Foch, Marquette and St. Croix (Table 1). However, for LaCrescent, Marquette, and St. Croix, the 2.5 threshold was met or exceeded in just one trial each and then only after copper had been applied six times. Treatment with sulfur resulted in leaf injury severity ≥ 2.5 that was significantly different ($P \leq 0.05$) from the corresponding non-treated controls on at least one date for Brianna, LaCrescent, Leon Millot, Maréchal Foch, and St. Croix (Table 2). However, for LaCrescent and St. Croix, the 2.5 threshold was met or exceeded in just one trial each and then only after sulfur had been applied five times. Noiret was the only cultivar that rated ≥ 2.5 after treatment with difenoconazole, and that occurred in just one of the two trials that included Noiret.

The 2015 growing season was favorable for disease, but since 2015 was the first year that fungicides were not used on experimental vines, incidence of anthracnose, Phomopsis leaf and cane spot, and black rot were relatively low. Nearly 100% of clusters on Valiant at both PARS and WMARS were destroyed by downy mildew by mid season. LaCrosse developed severe foliar downy mildew by mid season, but clusters were unaffected at both sites. LaCrescent and St. Croix both developed moderate to severe downy mildew later in the season at both sites, 4-6 weeks after severe symptoms were first observed on LaCrosse and Valiant. Clusters of both LaCrescent and St. Croix were unaffected by downy mildew through harvest. Frontenac and Frontenac Gris developed light to moderate downy mildew later in the season, particularly on older leaves, but clusters were unaffected. Marquette had very light to no downy mildew at either site through the entire 2015 growing season, despite significant sporulation on nearby vines of other cultivars.

What the results mean: Most cultivars tested were not highly sensitive to injury from copper, sulfur, or difenoconazole, but there were important exceptions:

- **Brianna** should be considered highly sensitive to copper and moderately sensitive to sulfur. Injury was apparent from copper in most trials, and sometimes after just one or two sprays.
- **Leon Millot** and **Maréchal Foch** should be considered highly sensitive to sulfur and moderately sensitive to copper. The sensitivity of these sibling cultivars to sulfur has been noted before, and they served as good indicators in our trials. They exhibited sensitivity to sulfur in three of six trials, sometimes after just two or three sprays.

For other cultivars, it should be possible to integrate two to three sprays of copper, sulfur, or difenoconazole into spray programs without risk of significant leaf injury. Disease susceptibility findings are preliminary and data will be collected again in 2016.

Table 1. Sensitivity of northern wine grape cultivars to copper fungicides

	Vineyard (number of sprays applied)										
	2012 PARS-1 (6)	2013 WMARS-2 (3)	2013 PARS-1 (6)	2014 WMARS-1 (5)	2014 WMARS-2 (5)	2014 PARS-1 (2)	2014 PARS-2 (2)	2015 WMARS-1 (3)	2015 WMARS-2 (3)	2015 PARS-1 (6)	2015 PARS-2 (6)
Brianna	1	3	4	5	4					2	2
Frontenac	5				2						
Frontenac gris					2						6
LaCrescent			6								
LaCrosse											
Leon Millot			6	5						6	
Maréchal Foch	6		4	5							
Marquette			6								
MN1220											
Noiret											
NY76											
Petite Pearl											
St. Croix											6
Valiant											
Vignoles											

Black shading indicates a leaf injury severity rating ≥ 2.5 and significantly different ($P < 0.05$) from the control on at least one rating date. Numbers in black shaded cells refer to the number of times copper was applied before a leaf injury severity rating ≥ 2.5 and different from control was recorded. Gray shading indicates that the cultivar was tested in that trial, but the severity rating was < 2.5 on all dates. No shading indicates that the cultivar was not tested in that trial.

Table 2. Sensitivity of northern wine grape cultivars to sulfur fungicides

	Vineyard (number of sprays applied)										
	2012 PARS-1 (6)	2013 WMARS-2 (3)	2013 PARS-1 (6)	2014 WMARS-1 (5)	2014 WMARS-2 (5)	2014 PARS-1 (2)	2014 PARS-2 (2)	2015 WMARS-1 (3)	2015 WMARS-2 (3)	2015 PARS-1 (6)	2015 PARS-2 (6)
Brianna			6	5	5						
Frontenac											
Frontenac gris											
LaCrescent					5						
LaCrosse											
Leon Millot	5		6	4							
Maréchal Foch	5		3	2							
Marquette											
MN1220											
Noiret											
NY76											
Petite Pearl											
St. Croix					5						
Valiant											
Vignoles											

Black shading indicates a leaf injury severity rating ≥ 2.5 and significantly different ($P < 0.05$) from the control on at least one rating date. Numbers in black shaded cells refer to the number of times sulfur was applied before a leaf injury severity rating ≥ 2.5 and different from control was recorded. Gray shading indicates that the cultivar was tested in that trial, but the severity rating was < 2.5 on all dates. No shading indicates that the cultivar was not tested in that trial.