Final Report FY 2006
Michigan Grape and Wine Industry Council, 2006

Project Title: Improving control of Phomopsis fruit rot in ‘Vignoles’ grapes.

1. Original goals and objectives of the project:
The goal of the project was to improve control of Phomopsis fruit rot in ‘Vignoles’ grapes and the specific objectives were to:

1) Determine tissue specificity/virulence of *Phomopsis viticola* isolates from ‘Vignoles’ vineyards
2) Evaluate the efficacy of late-season fungicide sprays against fruit rot development and simultaneously monitor spore release at the site.

2. Project Period: The research was conducted from January 2006 to December 2006. This study fits within a multi-year study on the biology and management of grape diseases.

3. Work accomplished during the period, including methods.
1) Determine tissue specificity/virulence of Phomopsis isolates from ‘Vignoles’ vineyards
Phomopsis isolates were collected from ‘Vignoles’ vineyards in different locations in Michigan. Isolates were collected from berries as well as vegetative tissues. ‘Niagara’ isolates from fruit and vegetative tissues were included for comparison. Growth rates of the isolates in culture (PDA) were compared at 25ºC since this has been shown to be correlated with virulence on fruit clusters. Representative isolates were inoculated onto leaves and fruit clusters of potted, 2-year-old ‘Vignoles’ and ‘Niagara’ vines to test their virulence. Plants were maintained in the greenhouse. The severity of infections on leaves and clusters was visually evaluated several weeks after inoculation. Treatments were replicated 3-4 times. Data were analyzed using the StatGraphics program.

2) Evaluate the efficacy of late-season fungicide sprays against fruit rot development with and without dormant sprays
The fungicide timing and efficacy trial was conducted in a mature vineyard at the Clarksville Horticulture Experiment Station in Clarksville, MI. Vines were spaced at 7 x 9 ft and were cordon trained on a 2-wire trellis and hand pruned. Treatments were applied to 3-vine plots and replicated 4 times in a randomized complete block design. Sprays were applied with an R&D Research CO_2 cart-styled sprayer equipped with six bottles (0.8 gal each), a twin gauge Norgren pressure regulator set at 55 psi, and a single XR TeeJet 8002VS nozzle on a 5-ft spray boom. Spray volumes were 40 gpa. Spray dates and approximate phenological stages were as follows: 3 May (budswell), 2 Jun (8 in. shoot), 16 Jun (immediate pre-bloom), 30 Jun (1^{st} post-bloom), 17 Jul (2^{nd} post-bloom, bunch closure), 3 Aug (3^{rd} post-bloom) and 24 Aug (veraison). Rainfall totals between sprays were 3.71, 0.98, 0.59, 1.67, 2.85, and 0.20 in., respectively. Disease was assessed on the center vine of each plot on 31 Aug. Phomopsis incidence (% clusters with at least one infected berry) and severity (% berries infected on diseased clusters only) were visually estimated on 25 randomly selected clusters per plot. On the same date, downy mildew and powdery mildew incidence (% leaves infected) and severity (% leaf area infected on diseased leaves only) were visually estimated on 25 randomly selected leaves per plot. Overall severity in each case was calculated as (incidence x severity)/100. Data were analyzed using StatGraphics.

4. Summary of the expenditures during the period.

Budget category	Original Budget ($)	Expenditures ($)
Salary	7,020	6,628
Fringe	2,808	2,975
Travel	1,500	1,920
Materials and supplies	372	307
Other direct costs	300	120
Total	12,000	11,950 (available in account)

5. Results and conclusions of the project.

The growth rate of the isolates in culture varied from 22 to 85 mm in 7 days (Fig. 1). There were no significant differences between isolates when they were grouped as originating from vegetative (leaf and petiole) or reproductive (rachis and berry) tissues. However, when considering specific plant parts, isolates from leaves and berries overall grew more slowly than isolates from petioles and rachises (50 and 57 mm vs. 65 and 67 mm, respectively). At Clarksville, the only site with both cultivars present, isolates from Niagara grew faster than isolates from Vignoles (70 vs 61 mm, respectively), but when looking at all locations, no difference was detected between isolates from different cultivars. Also, on average, cultures from Clarksville and Baroda grew faster (64 and 66 mm, respectively) than those from Fennville, MI (53 mm). The reason for these differences is not known but may reflect natural variation in the pathogen population in Michigan.

In the plant inoculations, isolates differed in the amount of foliar and fruit disease they caused but did not seem to be specialized on the host or tissue that they came from. There were differential reactions on the foliage, e.g. the Niagara-petiole 2 and Vignoles-leaf isolates were more virulent on Vignoles than on Niagara, whereas the Niagara-petiole 1 isolate was more virulent on Niagara than on Vignoles. Also, some isolates that were of relatively low virulence on Niagara leaves were highly virulent on Niagara berries. Only one Vignoles plant produced fruit, so virulence on Vignoles fruit could not be evaluated. Neither the growth rate nor the inoculation experiments gave clear indications that certain isolates are particularly specialized or consistently more virulent on Vignoles or Niagara.

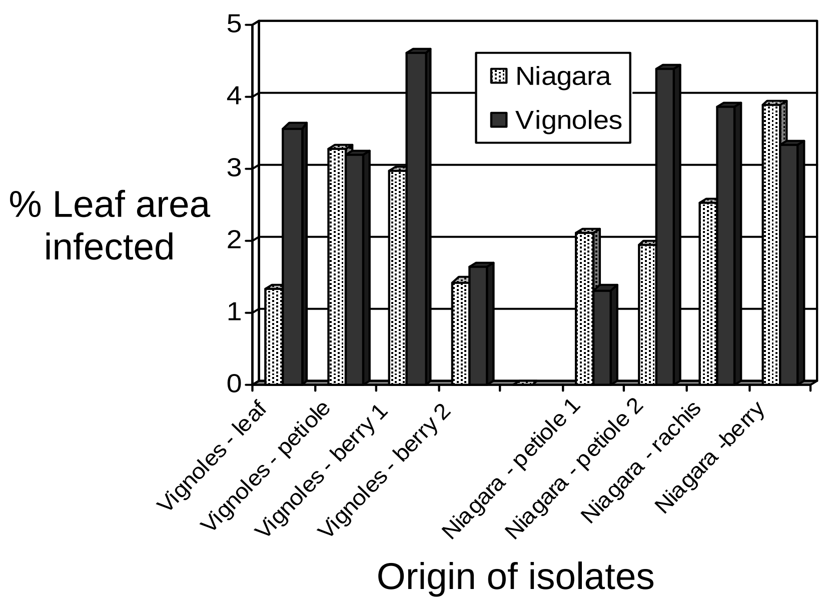


Fig. 1. Pathogenicity of *Phomopsis viticola* isolates on leaves or Niagara and Vignoles.

Disease pressure in the fungicide efficacy trial was severe for Phomopsis fruit rot (Table 1) and moderate to severe for powdery mildew and downy mildew. The fungicide efficacy trial showed that dormant sprays alone provided significant control of Phomopsis fruit rot in Vignoles, with Sulforix at 1 gal/acre appearing somewhat better than Cuprofix at 1.5 lb/acre (#2 vs #3). However, adding three post-harvest sprays of Pristine to the dormant spray significantly improved control (#3 vs #4). Adding a Dithane spray pre-bloom and a post-bloom Ziram spray was even better (#4 vs #8), with the difference most likely due to the pre-bloom Dithane spray. The latter program was not distinguishable from any of the other full-season spray programs, with program #5 having the fewest sprays. Adding a Pristine spray at veraison to this program (#6 vs #5) did not significantly improve control, suggesting that late-season infections are not important in fruit rot development. Substituting Pristine (10 oz) for Abound (12 fl oz) (#6 vs. #7) did not change the efficacy, indicating that Pristine is as effective as Abound against Phomopsis and may be a more economical as Pristine is less expensive than Abound. The trial further showed that a dormant Sulforix spray is equivalent to an early-season Dithane spray (#7 vs #8). Results with downy mildew and powdery mildew overall were very similar. Cuprofix and Sulforix as dormant sprays respectively provided 46.3% and 44% control of downy mildew and 45.3% and 53.9% control of powdery mildew. All full-season spray programs provided excellent control of both downy and powdery mildew (96-98% control), and were statistically somewhat better than the reduced spray program (#4) (83.5% control of downy mildew and 89.6% control of powdery mildew). Most likely, the 3rd postbloom spray, which was missing in the reduced spray program, was important for both of these diseases.

Table 1. Evaluation of fungicides and fungicide timing for control of Phomopsis fruit rot in 'Vignoles' grapes in Clarksville, MI, 2006.

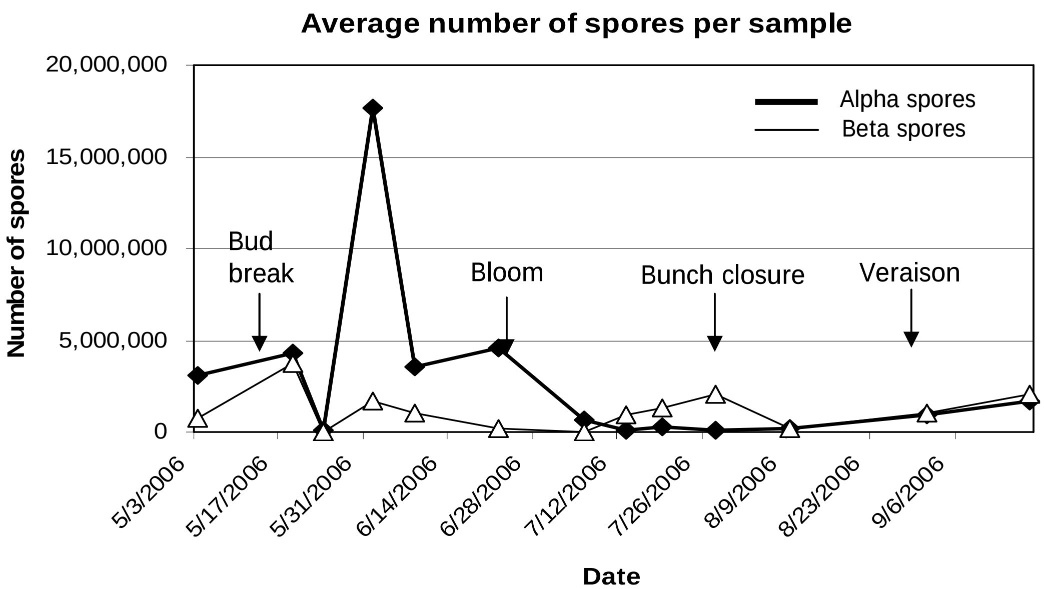
		Phomopsis fruit infection		
Treatment, rate/A	Application timing[z]	Incidence (%)	Overall severity (%)	Control [%][w]
1. Untreated		100 a[y]	64.0[x] a	
2. Cuprofix Ultra 1.5 lb	1	100 a	40.2 b	[37.2]
3. Sulforix 1 gal	1	96 a	33.7 b	[47.3]
4. Sulforix 1 gal	1,			
Pristine 38WG 10 oz	4, 5, 7	56 b	5.7 c	[91.1]
5. Dithane Rainshield 3 lb	2, 3,			
Abound 2.08SC 12 oz	4, 5,			
Ziram 76DF 4 lb	6	39 c	2.5 d	[96.1]
6. Dithane Rainshield 3 lb	2, 3,			
Pristine 38WG 10 oz	4, 5, 7			
Ziram 76DF 4 lb	6,	34 c	2.1 d	[96.7]
7. Dithane Rainshield 3 lb	2, 3,			
Abound 2.08SC 12 oz	4, 5, 7			
Ziram 76DF 4 lb	6,	34 c	1.9 d	[97.0]
8. Sulforix 1 gal	1,			
Dithane Rainshield 3 lb	3,			
Pristine 38WG 10 oz	4, 5, 7			
Ziram 76DF 4 lb	6,	33 c	1.9 d	[97.0]

[z]Spray dates: 1 = 3 May (budswell), 2 = 2 Jun (8 in. shoot), 3 = 16 Jun (immediate pre-bloom), 4 = 30 Jun (1st post-bloom), 5 = 17 Jul (2nd post-bloom, bunch closure), 6 = 3 Aug (3rd post-bloom) and 7 = 24 Aug (veraison).

[y]Column means followed by the same letter are not significantly different in Fisher's Protected LSD test ($P \leq 0.05$).

[w]Bracketed values denote percent control relative to the untreated check.

Spore release was monitored in the untreated control plots in cv. Vignoles at CHES throughout the season. Alpha spores are the infective spores, whereas beta spores are thought to play a role in mating of the fungus. Alpha spores were more common than beta spores. Spores were already detected before bud break, but a major peak in spore production occurred during the first week in June, followed by a smaller peak during mid- to late bloom. Spore release was greatly diminished after the pea-sized berry stage. This patter of spore release is also common in Niagara juice grapes, particularly in rainy years and reinforces the need to apply fungicide sprays early in the season. From this graph, it appears that sprays up to and including the 2nd postbloom spray may have been necessary for control. The spore release pattern does not indicate that *Phomopsis viticola* in 'Vignoles' is different from that in 'Niagara' grapes.



6. Communications Activities, Accomplishments, and Impacts:
The results from this research were presented in the Wine Grape Session at the Great Lakes Expo in Grand Rapids, MI, on December 6, 2006. Portions of this research were also presented in the grape session at the Northwest Michigan Orchard Show in Acme, MI on Jan 16, 2007; at the Southwest Horticulture Days in Benton Harbor, MI on 6-7 Feb, 2007; and at the Grape IPM Day at the Northwest Michigan Horticultural Research Station in Traverse City, MI, on 6 April, 2007. The data have also been used to adjust recommendations for disease management in grapes in E-154, the MSU Fruit Management Guide. In addition, one wine grape grower has started using a dormant spray as well as Pristine in a spray program for control of Phomopsis in Vignoles grapes, significantly reducing Phomopsis fruit rot incidence. These treatments can replace mancozeb and captan which would be beneficial to farm workers and consumers. Lack of control in practice does not seem to be due to the fungus being biologically different on Vignoles grapes, but rather to management practices.

7. Funding Partnerships:
No funding partnerships for this specific research project were established; however, the Viticulture Consortium East and National Grape Cooperative simultaneously funded closely related, complementary research projects on improving Phomopsis control in juice grapes.