



Variation Within and Among *Vitis* spp. for Foliar Resistance to the Powdery Mildew Pathogen *Erysiphe necator*

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Background. Powdery mildew is one of the most widespread diseases of grapevines, and European (*V. vinifera*) grape cultivars are particularly susceptible. Because powdery mildew is capable of infecting all green tissues (leaves, shoots, berries and buds), controlling it requires fungicide sprays as well as canopy management. Some wild North American grape species have been reported to be more resistant to powdery mildew, but resistance has been difficult to define in absolute terms. This is likely because different isolates, or races, are present in different regions. Our goal was to conduct a comprehensive search for powdery mildew resistance in the USDA cold-hardy grape collection (Figure 1).



Figure 1. The USDA-ARS cold hardy grape collection in Geneva, N.Y., houses over 1200 vines of wild grape species and interspecific hybrids (photo courtesy of Lance Cadle-Davidson).

Experimental design. Three approaches were used to evaluate resistance: natural infections in an unsprayed vineyard in Fredonia, New York; natural, late-season infections in a vineyard in Geneva, New York; and challenge with a single fungal isolate on detached leaves in the lab. For the detached leaf assays, leaves from 1025 vines of wild species and interspecific hybrids were placed in petri dishes, inoculated with a single isolate of powdery mildew (Figure 2), incubated for 21 days, and rated from 1 to 10 for fungal development as a measure of their susceptibility. Field disease severity during natural infection was assessed for 1025 vines growing in the USDA vineyard in 2007 and 2008 and for a subset of 89 replicate vines growing at the Cornell Lake Erie Research and Extension Lab in Fredonia, New York, in 2006, 2007, and 2008.

Results. In the natural infection studies in Geneva, no species was entirely resistant, but *V.*

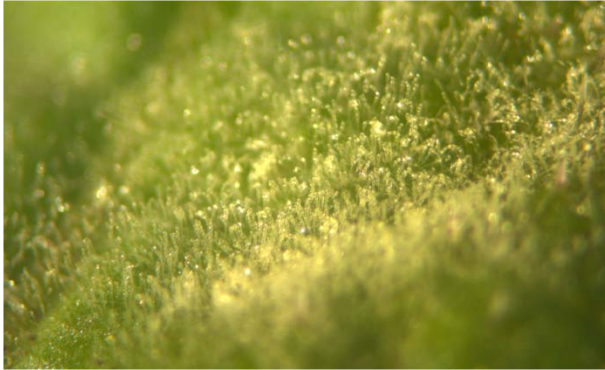


Figure 2. Powdery mildew seen at 25x magnification (photo courtesy of Lance Cadle-Davidson).

amurensis had a higher number of resistant individuals. In the 89 vines under natural infection in Fredonia, only one accession, a *V. riparia*, was completely resistant in all years and replicates. In the detached leaf assays with a single fungal isolate, accessions of *V. cinerea* were typically resistant.

Nearly all *V. labrusca* accessions were resistant in Geneva but not in Fredonia. This may be due to fungal isolates which have overcome this *V. labrusca* form of resistance

after many generations in the Concord vineyards in the Fredonia area.

For the 89 genotypes subjected to all three types of testing, resistance to a single isolate in the lab was not predictive of resistance in the field, but resistance ratings for Geneva and Fredonia were correlated ($r = 0.75$).

We also compared our results to those of previous researchers for 129 interspecific hybrids, and only three cultivars from four studies were consistently rated as resistant to powdery mildew: Cornell variety Cayuga White, heirloom variety Diana, and the Arkansas table grape Mars.

Conclusions:

- Most resistance to grape powdery mildew appears to be race-specific; just as powdery mildew evolves to overcome fungicides, it also can overcome resistant varieties
- Resistance to a single isolate in the lab was not correlated with resistance to diverse field populations
- The local populations of powdery mildew each year will determine whether a grapevine is resistant
- Three cultivars (Cayuga White, Diana, and Mars) were consistently rated as resistant across four independent studies, suggesting broad-spectrum resistance

The bottom line: Because fungal populations may differ by location, assessment for powdery mildew resistance in breeding programs may require uniform testing across different environments and years.