Oregon State University
Oregon Wine
Research Institute

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Resistance is Futile? Strobilurin resistance presence and persistence
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In 2015, we found wide spread Strobilurin (QoI) resistance in Oregon, and subsequently in California and Washington when we surveyed viticulture regions in those states, it probably seemed like the sky might be falling. Then when we showed that greater than 70% of the QoI resistant population was tolerant to very high doses of DMI (higher than can be legally applied); it really seemed like the sky would fall. However, there was a silver lining. We kept all the DNA from all the inoculum monitoring (spore trapping) we had been doing since 2007.

We analyzed all those samples for presence of the genetic mutation responsible for the QoI resistance and found some interesting results. First, we weren't able to detect QoI resistance before 2013. Second, we detected QoI resistance at least two years prior to growers reporting management problems. This means we had a tool to monitor resistance development which could be useful for warning growers of resistance developing.

Another remarkable finding was that the number and frequency of detecting resistant spores was much lower than the wild-type spores even when QoIs were being used in the vineyard, and we found far more resistant colonies than wild-type on leaves.

These results indicated that there might be a fitness cost to the mutation causing QoI resistance. Given that the mutation alters a protein involved in fungi producing energy, it makes sense that the fungus would not grow as well. This should also mean that moving away from using QoIs should allow the wild-type to out-compete the QoI resistant isolates, and eventually QoIs would become effective management tools again. Sarah Lowder, a PhD student, also made another discovery this past winter - Chasmothecia (the mildew overwintering structure) of QoI resistant populations do not survive as long as wild-type populations. This is more good news.

Now the big question is how to determine how long we need to rotate away from using chemistries with resistance and how to determine when we can use them again. That will be the future work of three graduate students in the lab.

Sarah is going to be working on how to rapidly and efficiently monitor for resistance. She has already made significant advances in this area. Sarah's work this summer shows that we can swab worker gloves after manipulating the canopy (e.g. shoot thinning, lifting wires, leaf pulling, dropping crop, etc.) and get estimates on the presence of mildew and its resistance. These results are similar to spending hours scouring for mildew colonies. Sarah also developed a simple procedure to test for potential resistance by collecting bark in the winter. Simply grab bark off several vines and stuff it into a mason jar, add ice cold bottled water, shake, then decant through mosquito netting. The material adhering to the net can then be processed using our molecular assays.

Next, Chelsea Newbold (a new MS student) will be examining how the QoI resistance mutation impacts colony formation and sporulation in relation to various environmental conditions? The big question is can we make predictions about the potential for field failures similar to how we estimate disease risk with the disease forecasting models.

Alex Wong (a new PhD student) will be looking at how fungicide resistance persists and transfers through a population. We need to understand this because resistance to other fungicides will develop, and we will need to know how to manage these resistant populations while they are still in the minority.

Since you might be wondering, here is the results of our 2018 survey for QoI (G143A) resistance. These data are thanks to funding from Oregon Wine Board, American Vineyard Foundation, and Washington Winegrowers Association. It is also a product of numerous folks in each region taking the time to send in samples. If you would like to send sample, please contact us walt.mahaffee@ars.usda.gov and we will send you kits and instructions.

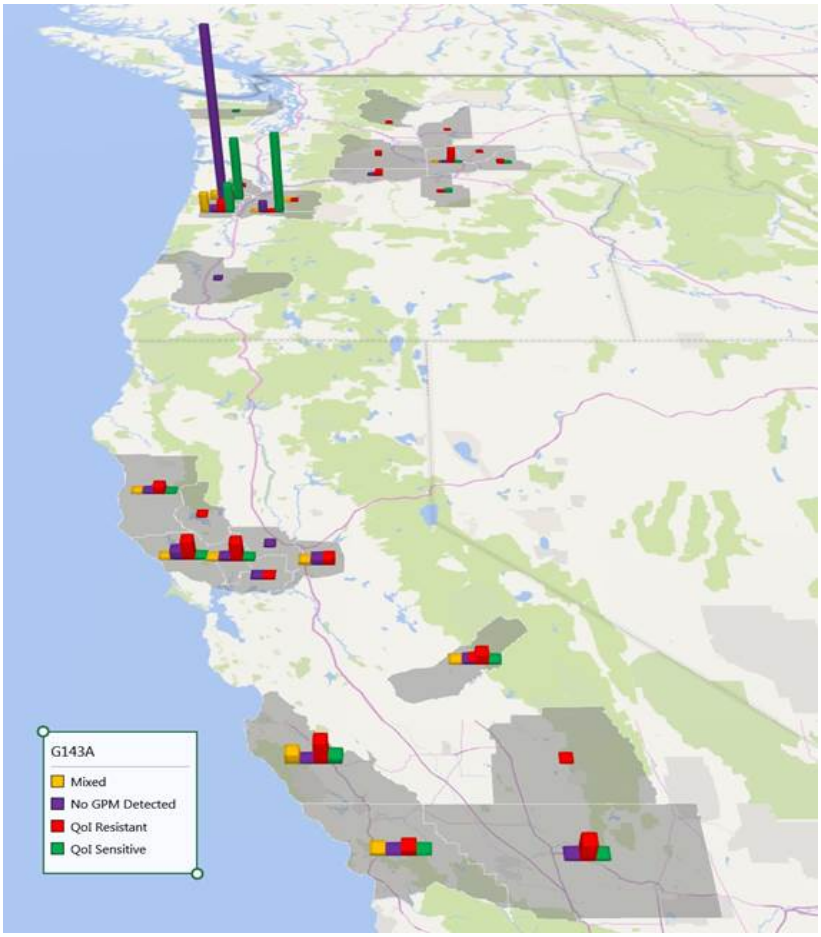

Figure 1. Sample frequency categorized as containing only grape powdery mildew with wild-type genotype (QoI sensitive – green), the G143A mutation for resistance (QoI Resistant - red), sample having both wild-type and resistant genotypes (yellow) and no GPM detected (purple) in the sample. Several Oregon vineyards are scouted on a bi-weekly basis with extensive swab sampling leading to numerous no detection of mildew – that is good news – since no mildew was found with the early scouting either.