



Fungicide Resistance Management in Vineyards

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Fungicide Resistance: When (and Why) It Matters

Pesticides, including fungicides, are often categorized as “site specific” or “multi-site”, describing how they interact with the target organism. Site specific products are typically just that – they disrupt a very specific pathway or function in the target organism. Multi-site products typically disrupt several pathways and functions. Site-specific products are often favored in conventional agriculture due to their reduced impact on off-target organisms. However, because of their specificity, the likelihood that an individual in a population has a mutation that can reduce its sensitivity to that fungicide type is high. When those mutated individuals build up in a population, typically as a result of repeated applications of those same site-specific fungicides, this can result in “field level” control failure of a disease.

Fungicide stewardship is an all-encompassing term that focuses on principles and practices that mitigate field-level disease control failures by reducing the selection pressure and population build-up of resistant pathogens. Other disease control strategies that limit the size of the pathogen population also indirectly reduce the likelihood of a field-level control failure in a disease management program.

Principles of Fungicide Stewardship

Managing Fungicide Use (a.k.a. Your Spray Program)

Fungicide Rotation

If field-level control failures result from repeated selection of resistant individuals in a population, then the first step in reducing the risk of field-level resistance is to stop that selection process. Simply put, this means rotating fungicides between options that impact different pathways in the target pathogen. The Fungicide Resistance Action Committee (www.frac.info) has made this process easier, by providing a simplified code that lets the user know how a fungicide works. This FRAC code is a number that is reported on each fungicide label.

Key activity: Rotate between fungicides that have different FRAC codes to reduce selection pressure on the pathogen and avoid build-up of a resistant population.

Spray Timing and Intervals

Appropriately timing fungicide sprays relative to disease dynamics and environmental constraints indirectly helps manage fungicide resistance by maximizing the potential effects of an existing program. By controlling the number of individuals in a population that can survive and reproduce, good disease control reduces the likelihood that mutant (resistant) individuals will arise in each subsequent generation.

Key Concepts:

- **Timing:** Ensure that sprays are properly timed. Consider pathogen and host biology, environmental conditions, and cultural practices when selecting spray application timing.
- **Intervals:** The spray program and the efficacy of products chosen, should span the key management window for the target disease. This interval of needed efficacy will differ depending on the disease.
- **Target:** Ensure that sprays make it to the target. They should not be removed either through wind-driven drift or rain. Equipment should be properly maintained and calibrated to ensure adequate coverage. Canopy management and other cultural practices should complement spray activities or equipment-specific factors.

Vineyard Management Practices

Vineyard management practices that reduce disease pressure and improve fungicide penetration and coverage generally improve disease control and complement other resistance management activities.

Canopy Management

Start with appropriate vineyard layout, trellis design, and canopy training. Techniques that optimize air movement, reduce leaf wetness, and improve sunlight penetration typically reduce the environmental favorability for disease development. In-season canopy manipulation such as shoot thinning and fruit-zone leaf removal complement these activities and improve spray penetration.

Vineyard Floor Management

Vineyard floor management can have many positive impacts on vineyard growth and development, including: building organic matter, reducing erosion risk, moderating soil temperatures, and limiting excess reflective radiation onto the vine canopy. However, vineyard floor management, whether through the use of planted cover crops or development of resident vegetation, can also impact canopy and fruit disease control in two different ways. First, these crops could compete with grapevines for water, which may limit canopy growth and improve subsequent disease management efforts. Conversely, they also actively transpire, increasing vineyard humidity and moderating air temperature around the vines, thus increasing potential disease pressure. These influences are site-specific, and interact with other factors, such as irrigation strategy and annual precipitation patterns.

FOLLOW THE RULES

R – Rotate when using fungicides in high-risk groups

U – Use labeled rates – don't cut!

L – Limit the total number of applications of any one specific high-risk fungicide within a growing season. Preferably, a high-risk product or fungicide group is only used once; twice at the most (if separated by other fungicides that target the same disease).

E – Educate yourself about fungicide activity and FRAC groups

S – Select additional fungicides that are multi-site.

*Adapted from J. Adaskaveg,
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Sprayer Calibration and Optimization

A functional and optimized sprayer is foundational to any pest management program that uses pesticides that are applied to the grapevine canopy. If the product cannot get to where it needs to go, then efforts related to spray design and appropriate timing do not matter.

There are numerous existing documents, literature, and curriculum available on proper sprayer maintenance, calibration, and vineyard or orchard optimization. Fundamentally, these resources discuss how different sprayers should work, and techniques that can be used to adjust for application based on canopy architecture. These resources help optimize sprayers for maximum spray coverage and deposition to the canopy and, by doing so, they can also reduce spray drift. A list of key available educational materials on sprayer calibration and optimization is available in the Resources section of this factsheet.

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Resources

Fungicide Resistance Videos

- FRAME – Fungicide Resistance – What is it and how does it occur? (YouTube Video).
https://www.youtube.com/watch?v=AvluVPj_cB4
- FRAC and CropLife – Fungicide Resistance Management (YouTube Video).
<https://www.youtube.com/watch?v=Fw8VXz2SUGs&feature=youtu.be>

Fungicide Resistance Action Committee - <https://www.frac.info>

- Fungicide Resistance Management webpage:
<https://www.frac.info/fungicide-resistance-management>
- FRAC Annual Poster Download (for common fungicides and their FRAC codes): <https://www.frac.info/knowledge-database/knowledge-database>

Fungicide Resistance Management Trade Articles, Scientific Articles and Books

- Ishii, H. and D.W. Hollomon (eds). 2015. Fungicide Resistance in Plant Pathogens. Springer Nature.
<https://doi.org/10.1007/978-4-431-55642-8>
- Staub, T. and D. Sozzi. 1984. Fungicide Resistance. Plant Disease 68:1026-1031.
https://www.apsnet.org/publications/PlantDisease/BackIssues/Documents/1984Articles/PlantDisease68n12_1026.pdf

Sprayer Calibration and Optimization Resources

- Sprayers 101 (Website): <https://sprayers101.com/>. A go-to resource for understanding all things sprayers. The “Airblast 101” topic area is particularly relevant for specialty crop producers.
- Ozkan, E., and E. Gil. 2022. Sprayers for Effective Pesticide Application in Orchards and Vineyards. FABE-533. The Ohio State University. Online:
<https://ohioline.osu.edu/factsheet/fabe-533>
- Ozkan, E. 2022. Best Practices for Effective Spraying in Orchards and Vineyards. FABE-539. The Ohio State University. Online: <https://ohioline.osu.edu/factsheet/fabe-539>
- Hoheisel, G.A., L.R. Khot, M.M. Moyer, S. Castagnoli. 2021. Six Steps to Calibrate and Optimize Airblast Sprayers for Orchards and Vineyards #NW749. PNW Extension Publishing. Online: <https://pubs.extension.wsu.edu/six-steps-to-calibrate-and-optimize-airblast-sprayers-for-orchards-and-vineyards>
- McCoy, M., G.A. Hoheisel and M.M. Moyer. 2021. Spray Nozzle Demonstration Curriculum #ECO10e. Washington State University. Online: <https://pubs.extension.wsu.edu/spray-nozzle-demonstration-curriculum>
- Warneke, B., J.W. Pscheidt, R. Rosetta, and L. Nackley. 2019. Sensor Sprayers for Specialty Crop Production PNW#727. PNW Extension Publishing. Online:
<https://extension.oregonstate.edu/catalog/pub/pnw-727-sensor-sprayers-specialty-crop-production>