



VINEYARD TEAM

Promoting Sustainable Winegrowing

Prevention and Management of Grape Fungal Diseases Close to Harvest

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Fungal disease of Grapevines

Commonalities

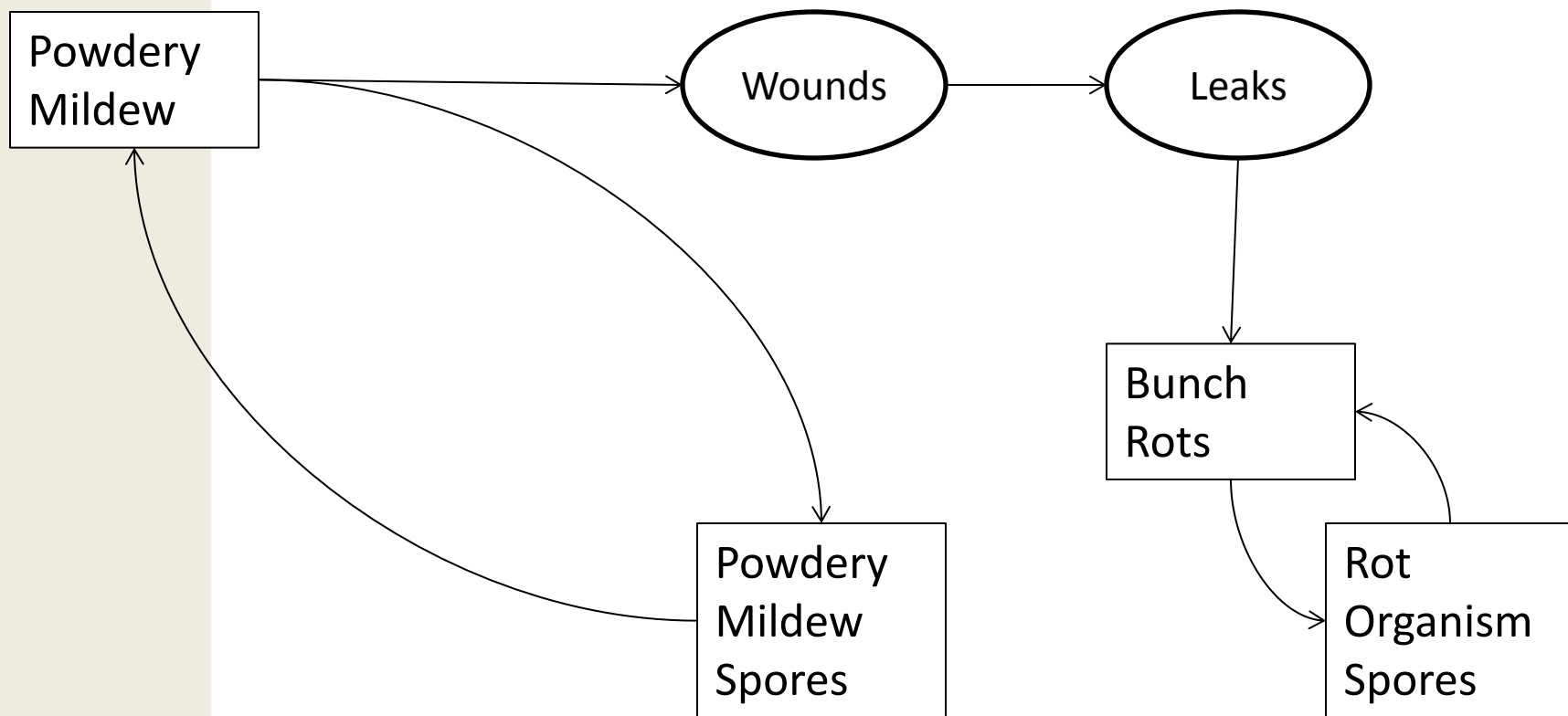
- **Overwintering Inoculum**
 - Mummies
 - Canes/Spurs
 - Trunks/Bark
 - Floor
- **Substrate**
 - Green tissue
 - Juice



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Progression from One to Another





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Cultural Controls

- **Sanitation**
 - Remove infected material from the vineyard
 - Burn it
 - Uneconomical in California production vineyards
 - Air quality issues
 - We need some innovations/techniques/technologies to make this possible



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Cultural Controls

- **Sanitation**
 - **Removal/burning**
 - **Hot spots?**
 - Invest resources in worst area(s)
 - **Small blocks?**
 - At least some areas have reduced spore loads
 - **Small vineyards?**
 - That's why they can do it in France
 - **Different blocks/areas every year?**
 - **Most susceptible varieties?**
 - **Areas upwind?**



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Environmental Factors

- **Air Flow**
- **Light**
- **Moisture**
- **Humidity**



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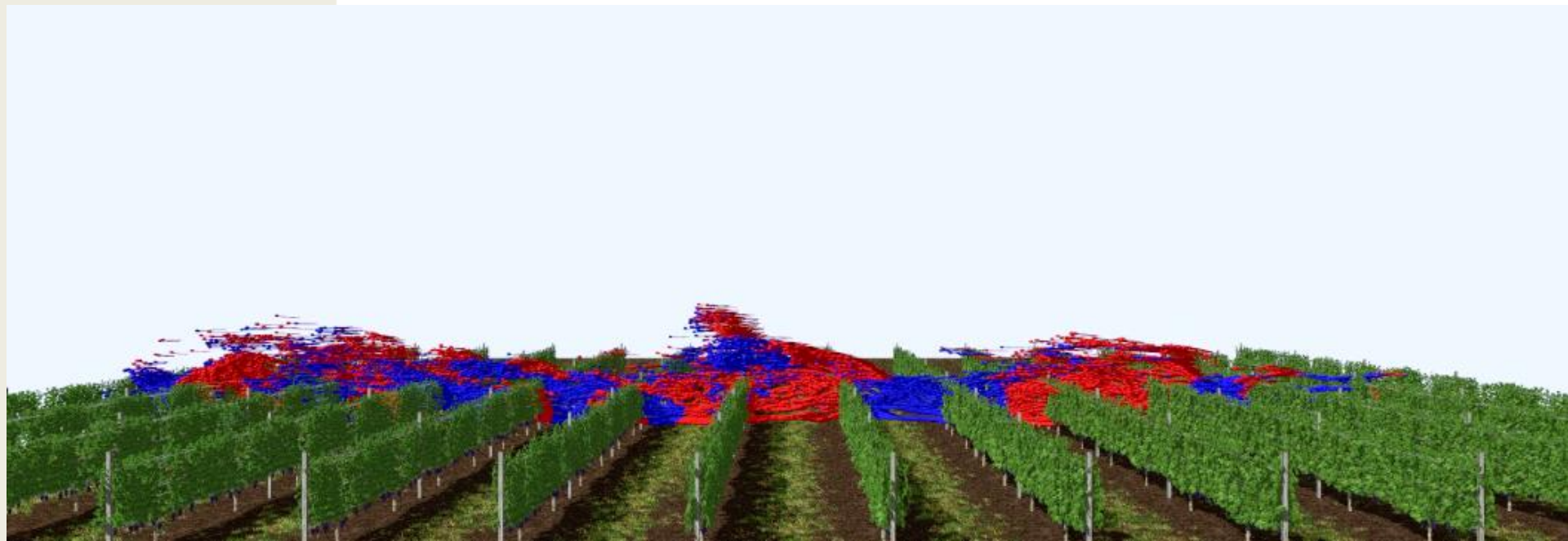
Manipulating Environmental Factors

- **Canopy Management**
- **Irrigation Management**
- **Fertility Management**



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Consider treating downwind as well as infected area





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Powdery Mildew

- **Even “inconspicuous” PM infections are associated with increased severity of Botrytis at harvest**
- **And therefore, wine spoilage organisms**



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Dangers of Losing Control

Year 1

Treatment	Final Spore Load*	Spring Discharge of Overwintering Spore Load**	Spring Spore Load Compared to Final Spore Load Previous Year
A- Stop sprays at Labor day	1,300	260	-
B- Stop sprays in August	5,300	1,060	80% of A
C- Stop sprays in July	28,700	5,740	108% of B, 441% of A

*Chasmothecia
(#/Kg of Bark)

**Assuming 20%

Chardonnay, New York state. Wilcox 2017.



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Dangers of Losing Control

Year 2

Treatment	PM Severity
A-"Weak spray program"	11%
B-"Weak spray program"	22%
C-"Weak spray program"	48%

Same Vines as Year 1



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Canopy Management: All about timing

- **The Experiment**
 - Chardonnay, New York state
 - Clusters inoculated with PM
 - No fungicides
- **Treatments**
 - Leaf removal 2 weeks after boom (Early)
 - Leaf removal 5 weeks after bloom (Late)
 - 1 leaf removed above and below cluster (Light)
 - 2 leaves removed above and below cluster (Heavy)
 - Control- no leaves removed



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Canopy Management: All about timing

- **Results**
 - **Both Light and Heavy leafing Early**
 - Lower severity than control
 - **Both Light and heavy leafing Late**
 - Same severity as control

(Austin & Wilcox 2011)



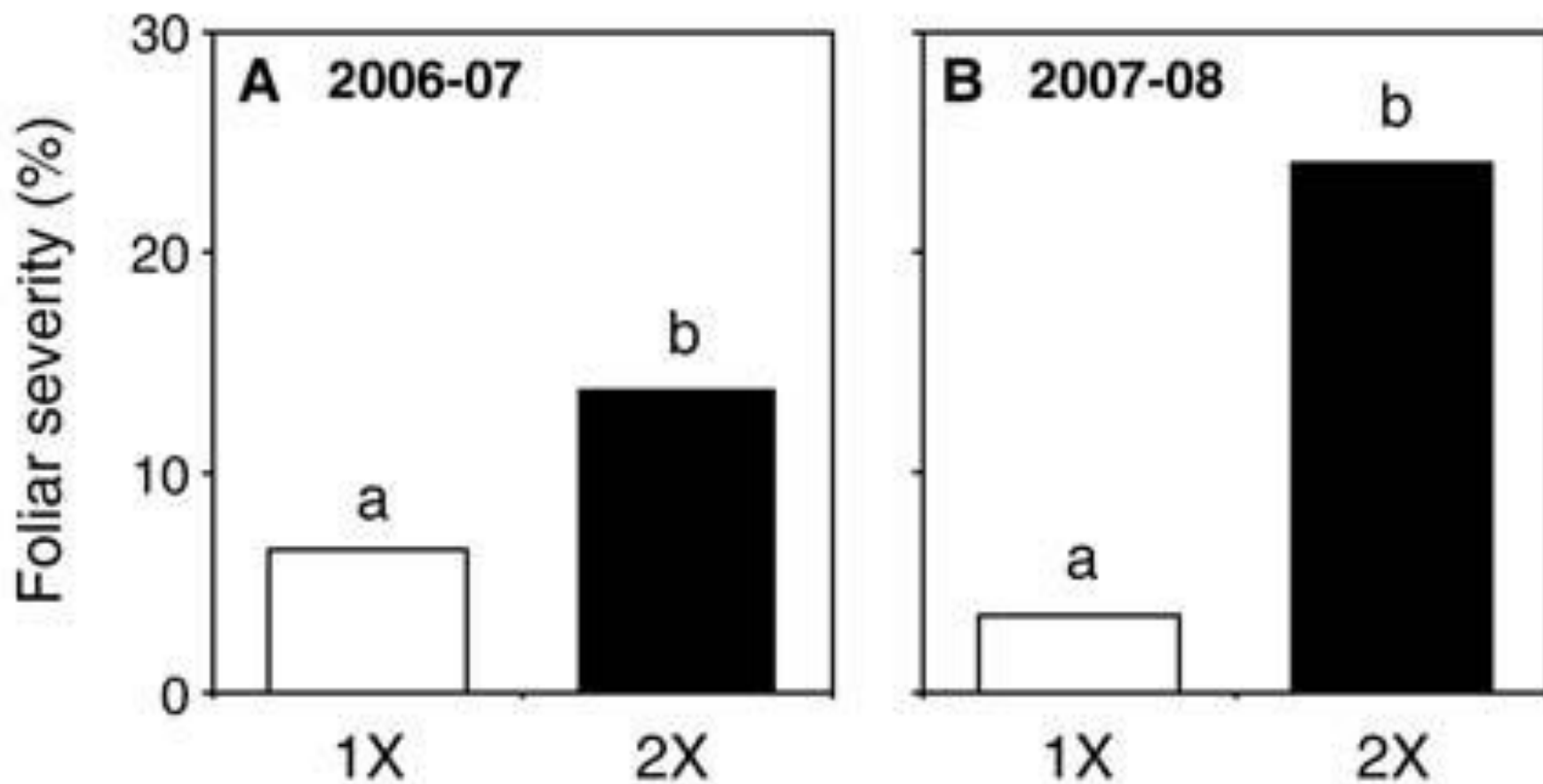
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Effect of Irrigation on PM Severity

1X = 4L/hr

2X = 8L/hr.

12 hours per week, 12 weeks





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Downy Mildew

(Plasmopara viticola)

- **Damage and Symptoms**
 - Attacks any green tissue on the vine.
 - Destroys tissue in a few days.
 - Symptoms include large yellow spots on the tops of leaves, called “oil spots,” and white, cottony (“downy”) colonies on the undersides.
 - Infections also attack shoots, shoot tips, petioles, berries, and rachises.



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Downy Mildew

(Plasmopara viticola)



Photo Credit: Mark D. Welch, M.S.



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Downy Mildew

(Plasmopara viticola)

- **Life Cycle**
 - **Oospores overwinter in fruit and leaves on the vineyard floor.**
 - **Oospores can be viable for several years.**
 - **Primary infections begin in the spring at 52°F or higher and after a rain event of at least 0.1”.**
 - **Secondary infections of sporangia form after humid nights followed by a rain event.**
 - **Sporangia then release zoospores which move onto or around the vine via wind or rain (splashing).**



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Downy Mildew

(Plasmopara viticola)

- **Life Cycle**
 - Zoospores enter the plant through the stomates.
 - Downy mildew infections spread rapidly after this point.
 - Under ideal conditions the time between generations is 4 to 5 days.
 - Ideal conditions are night and morning temperatures between 65-77°F.
 - Limiting temperatures are below 52°F and above 86°F.
- **MANAGEMENT**
 - See [“Downy Mildew” on UC Statewide IPM Website for specific recommendations.](#)
 - See [Grape Disease Control for 2017 by Wayne Wilcox for recent research on the control of downy mildew with fungicides.](#)



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Bunch Rots- Botrytis

- **Contributing Factors**
 - Orange Tortrix larvae
 - Abrasions on berries
 - Swollen berries
 - Tight clusters
 - Flower trash in the cluster left over from bloom
 - Scars from cap fall
 - Spore load from previous year



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Latent Infections

- In Tissue Since Bloom
- Factors affecting activation
 - Nitrogen
 - *More N = More Botrytis*
 - Relative Humidity
 - *More humid = More Botrytis*
 - Soil Water Status
 - *Wet = More Botrytis*
 - *Dry = Less Botrytis*
 - *If humidity is high enough, infections still occur on water stressed vines*
 - *There are latent infections there, just not activated*

Wilcox 2017



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Sour Rot

- A complex of fungi, yeast, and bacteria
- Botrytis is often found as part of that complex, but not necessarily
 - Organisms found in the complex can include *Botrytis cinerea*, *Aspergillus niger*, *Gluconobacter* spp., *Acetobacter* spp.
- Fruit flies (*Drosophila* spp.) are necessary
- Requires wounds to the berry
 - Can be micro-abrasions which cannot be seen with the naked eye
- Starts at 15° Brix or higher with no observable symptoms until then



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Fungal Diseases of Grapevines

- **Factors you cannot control**
 - **Variety**
 - **Cluster architecture (or can you...?)**
 - **Climate**
 - **Weather**
 - **Spore Load History**



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Fungal Diseases of Grapevines

- **Factors you can control**
 - **Light**
 - **Canopy density**
 - **Irrigation**
 - **Fertilization**
 - **Fungicide selection and rotation**
 - **Fungicide timing**
 - **Scouting frequency and resolution**



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Fungal Diseases of Grapevines

- **Next year's infections are out there now.**
- **Bloom is a critical time.**
- **Leaving diseased material in the vineyard is not good.**
- **Control of Powdery Mildew reduces incidence of Bunch Rots.**



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SOURCES:

- Austin, Craig and Wayne Wilcox. 2011. “Effects of Fruit-Zone Leaf Removal, Training Systems, and Irrigation on the Development of Grapevine Powdery Mildew.” *American Journal of Enology and Viticulture* 62(2): 193-198.
- *Grape Pest Management, 3rd. Edition.* 2013. Larry J. Bettiga, Technical Editor. Oakland, CA: University of California Agriculture and Natural Resources.
 - Bunch Rots
 - Downy Mildew
 - Powdery Mildew
- Greenspan, Mark. August, 2017. “Fungal Disease Management Means Much More Than Spraying.” *Wine Business Monthly*.
- Wilcox, Wayne. 2017. [*Grape Disease Control for 2017.* Geneva, NY: Cornell University.](#)



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RESOURCES

- See [“Downy Mildew” on UC Statewide IPM Website for recommendations.](#)
- See [*Grape Disease Control for 2017* by Wayne Wilcox for recent research on the control of fungal diseases of grapes with fungicides.](#)
- **Vineyard Team Podcasts**
 - [“New Discoveries about Sour Rot Episode 17”](#)
 - [“Fungicide Resistant Mildew Episode 09”](#)
 - [“Fungicide Resistance in Grape: Grower Perspective Episode 6”](#)
 - [“Bunch Rot with Larry Bettiga Episode 1”](#)
 - [“The Goldilocks Principle & Powdery Mildew Management”](#)
 - [“Grape Powdery Mildew Management and Inoculum Monitoring Episode 5”](#)
- **Vineyard Team Technical Articles**
 - [“Downy Mildew \(*Plasmopara viticola*\)”](#)
- **Vineyard Team Online Educational Module**
 - [“Effective Vineyard Spraying”](#)
 - 1 hour DPR(O) available \$20
- **Books**
 - Effective Vineyard Spraying by Andrews Landers \$50



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