

The grape powdery mildew conundrum: fungicide selection and timing

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Outline

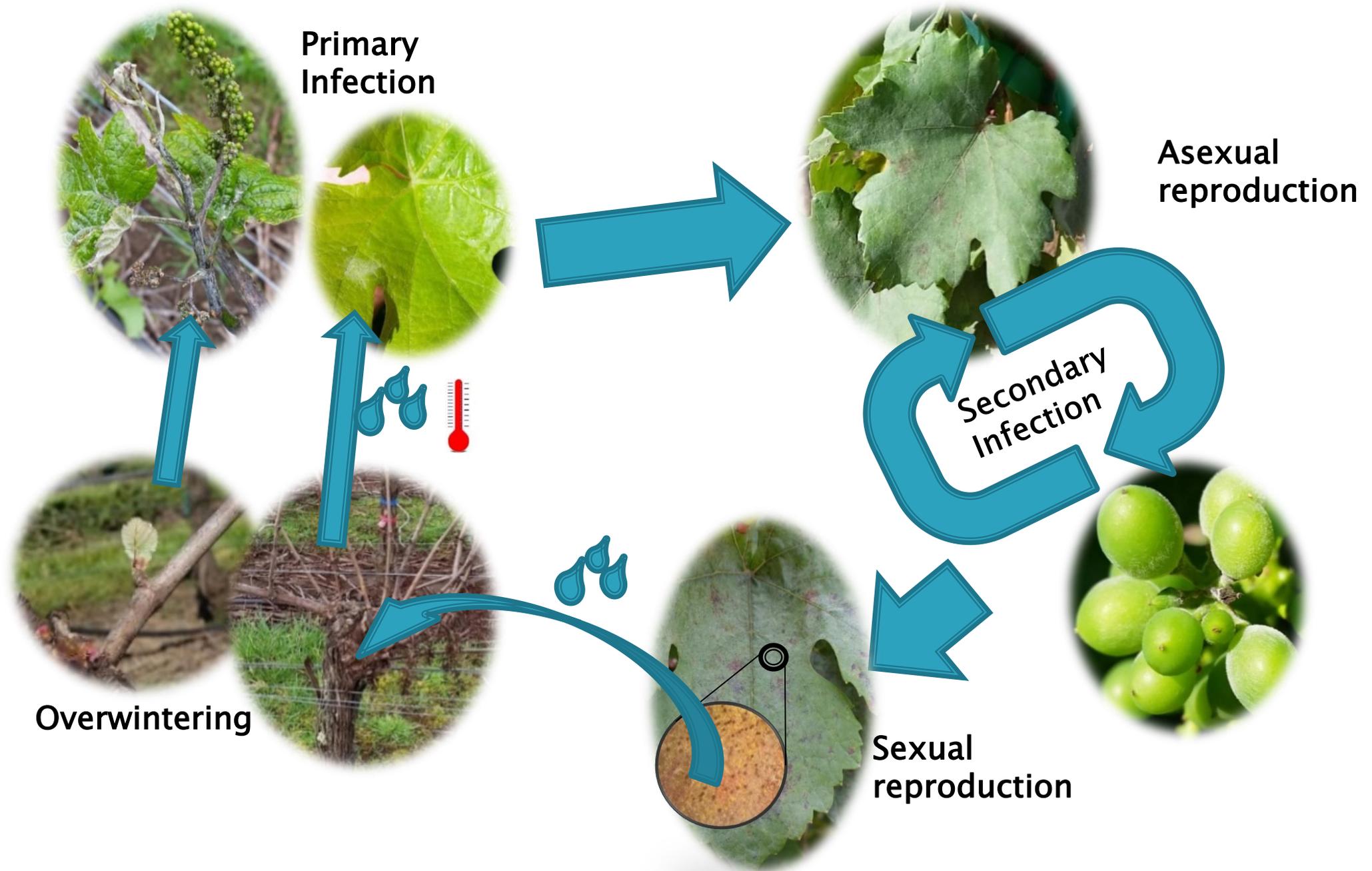
- ▶ Grape powdery mildew
 - Life cycle
 - Management
- ▶ Fungicide application timing
- ▶ Field mobility assessment

Pinot Noir in
the Willamette
Valley, OR



Grape Powdery Mildew (*Erysiphe necator*)





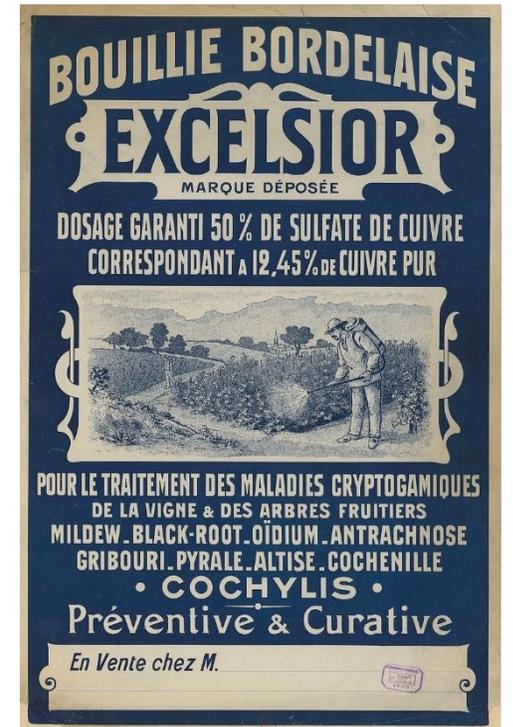
GPM Management

- ▶ Little natural resistance present in *V. vinifera*
- ▶ Fungicides have been used successfully for 150 years
- ▶ Typically applied on a calendar schedule

Sulfur
dusting in
Fresno, CA
1972



Gene Daniels, EPA



Bordeaux mixture c. 1903

Fr.wikipedia

Fungicide Phenological Timing



Primary Infection

Flowering and early cluster development



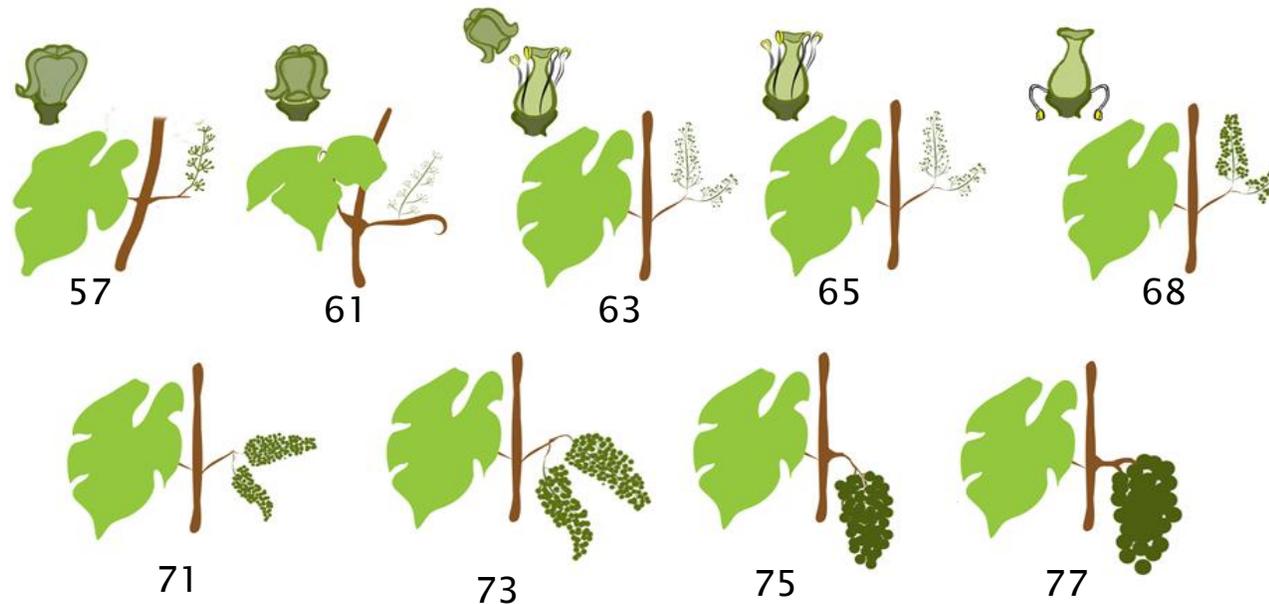
Timing applications to critical fruit development stages increases disease control efficiency



Managing Fruit Infection

▶ Motivations

- We often find disease on inflorescences or clusters
- Various products claim mobility to unprotected tissues



Graphics of the BBCH
phenological scale
(Lorenz et al., 1995)

Cluster Architecture

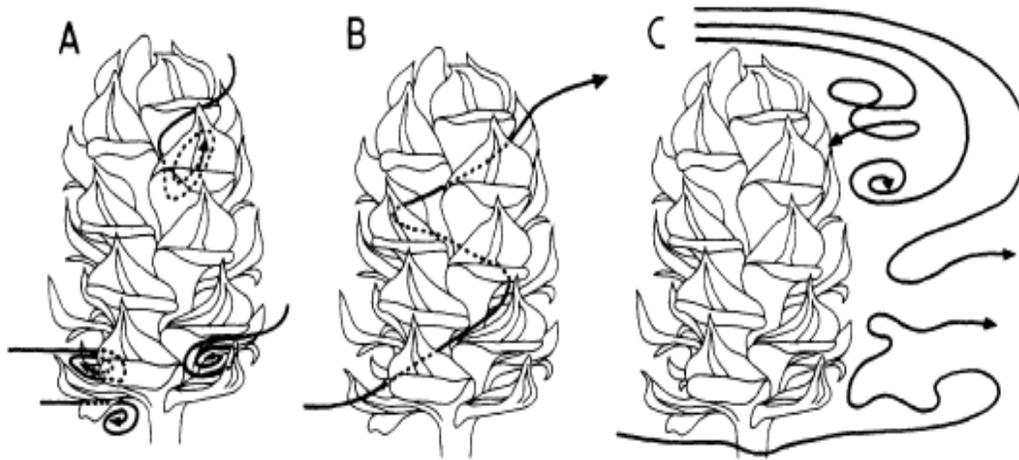


Figure 4. Air turbulence directing pollen into the cone between scale-bracts (A) and over the scale-bracts (B), and eddy formation redirecting airflow onto the leeward side of the cone. Image Credit: K. Niklas (27)



Objective

Determine the most effective fungicide application timing with relation to grape inflorescence phenological stage



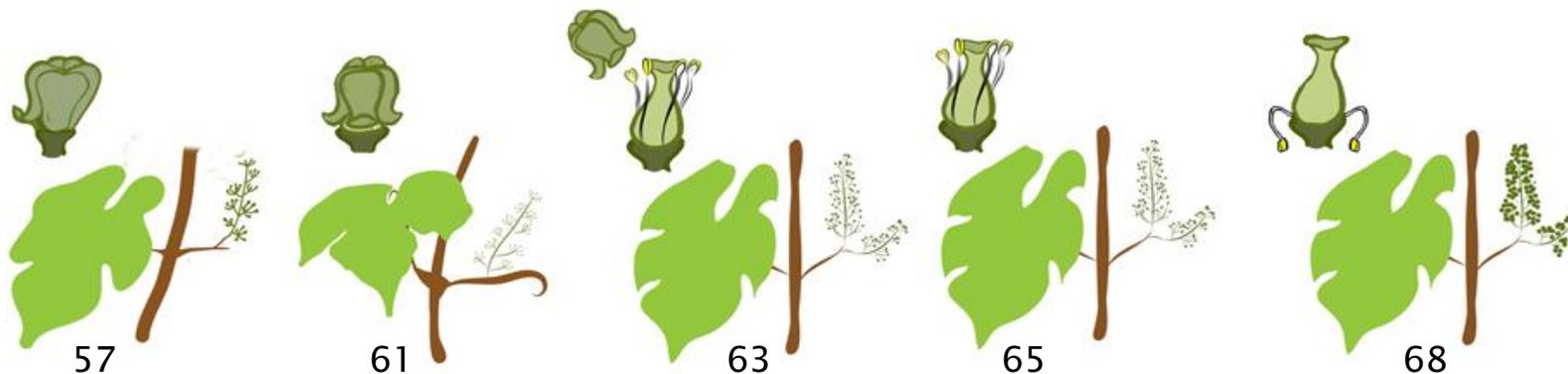
Experimental Design

- ▶ 3x5 factorial
 - 3 flowering stages
 - 5 fungicides
- ▶ Randomized complete block design
- ▶ Weekly leaf incidence assessments
- ▶ Berry incidence assessed prior to veraison

Fungicides

Fungicide	FRAC Group	Activity	Rate per acre
Quinoxifen	13	xylem mobility and volatilization	4 fl oz
Tebuconazole	3	xylem mobile	4 oz
Fluopyram	7	locally systemic	4 fl oz
Trifloxystrobin	11	locally systemic	2 oz
Sulfur	M2	non-systemic, volatilization	3 lb

Application Timing



Inflorescence
elongation
BBCH 55

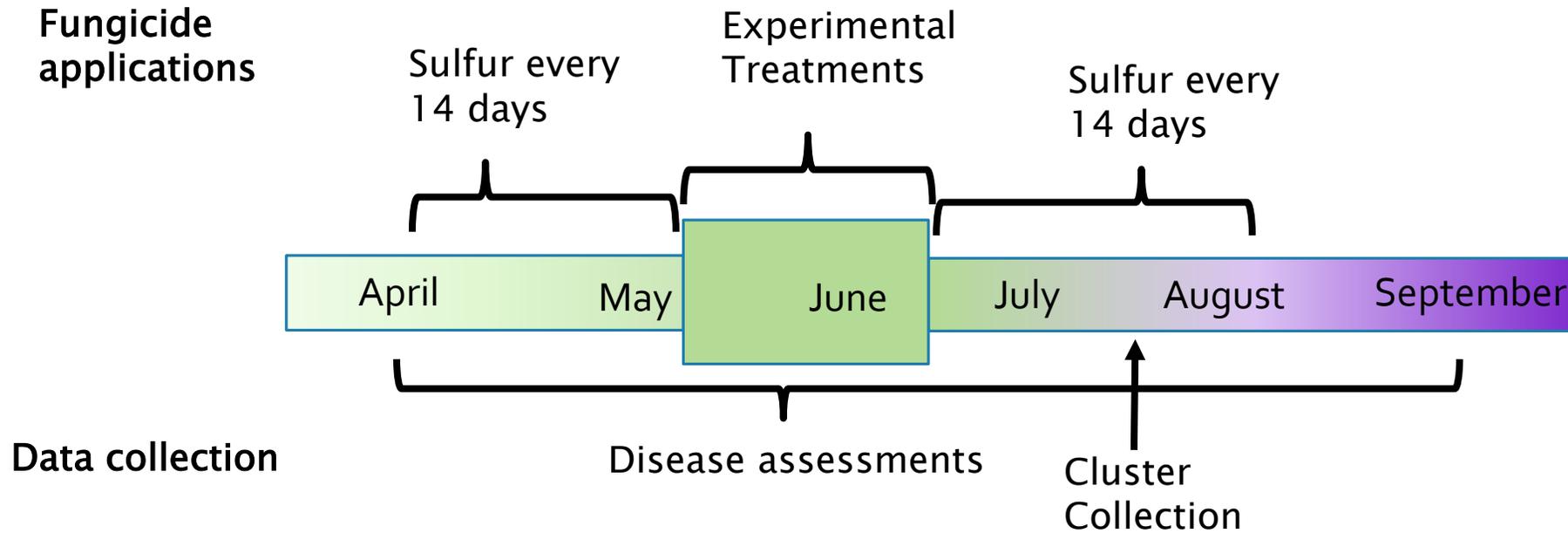


50% Bloom
BBCH 65



Berry set
BBCH 69

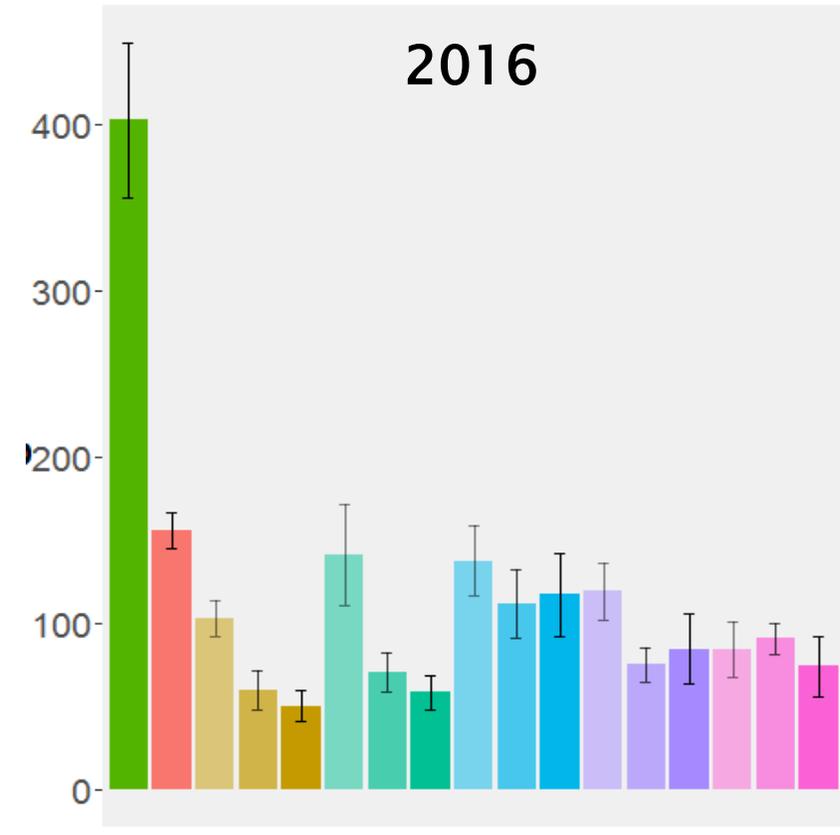
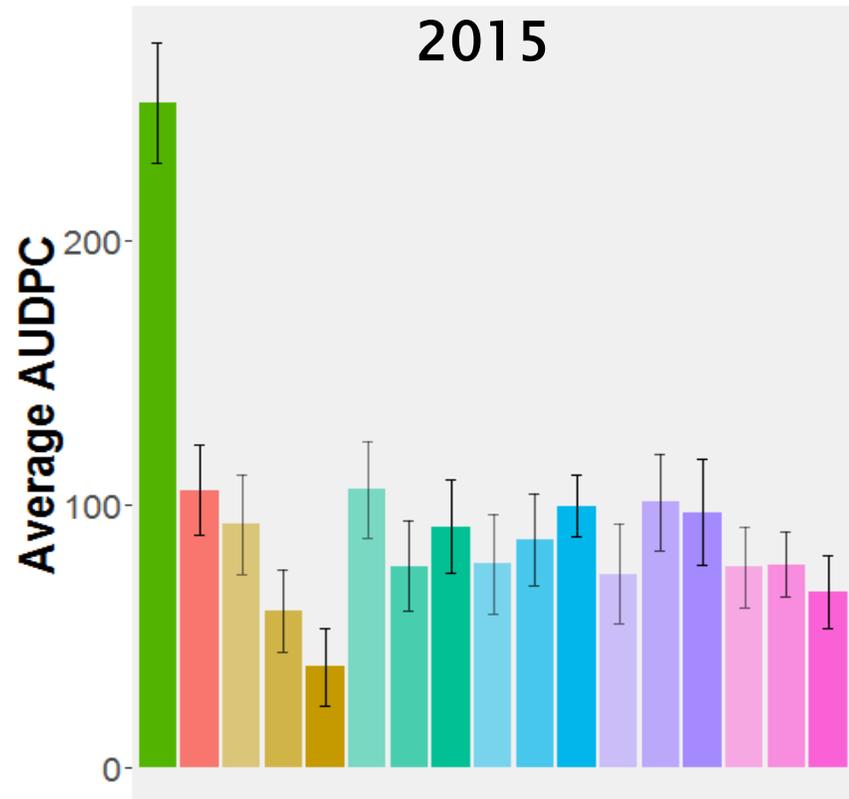
Experiment Timeline



Results

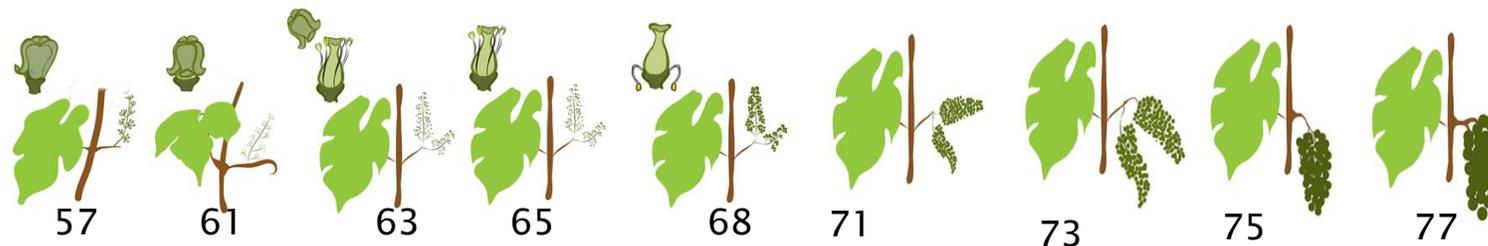


Leaf Disease Development

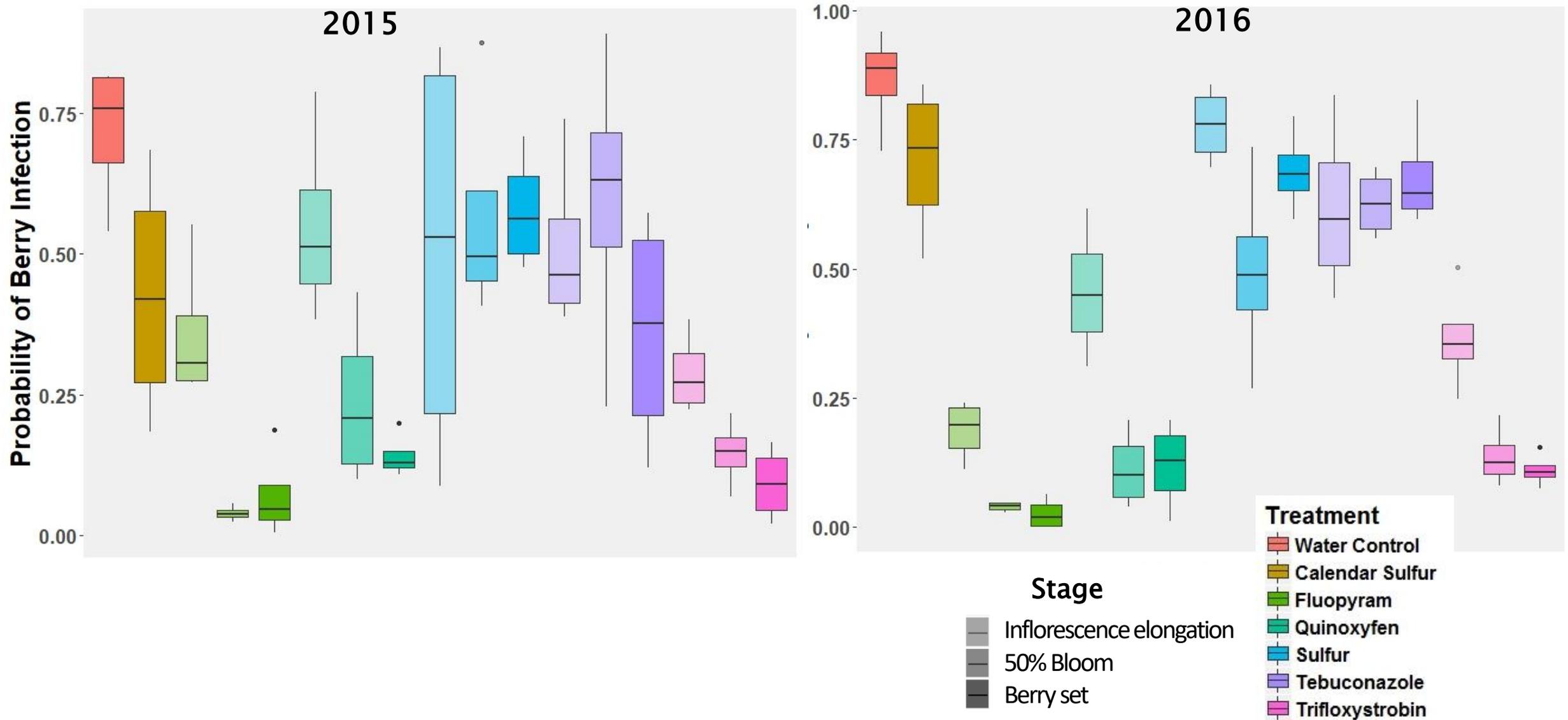


Treatment

Treatment

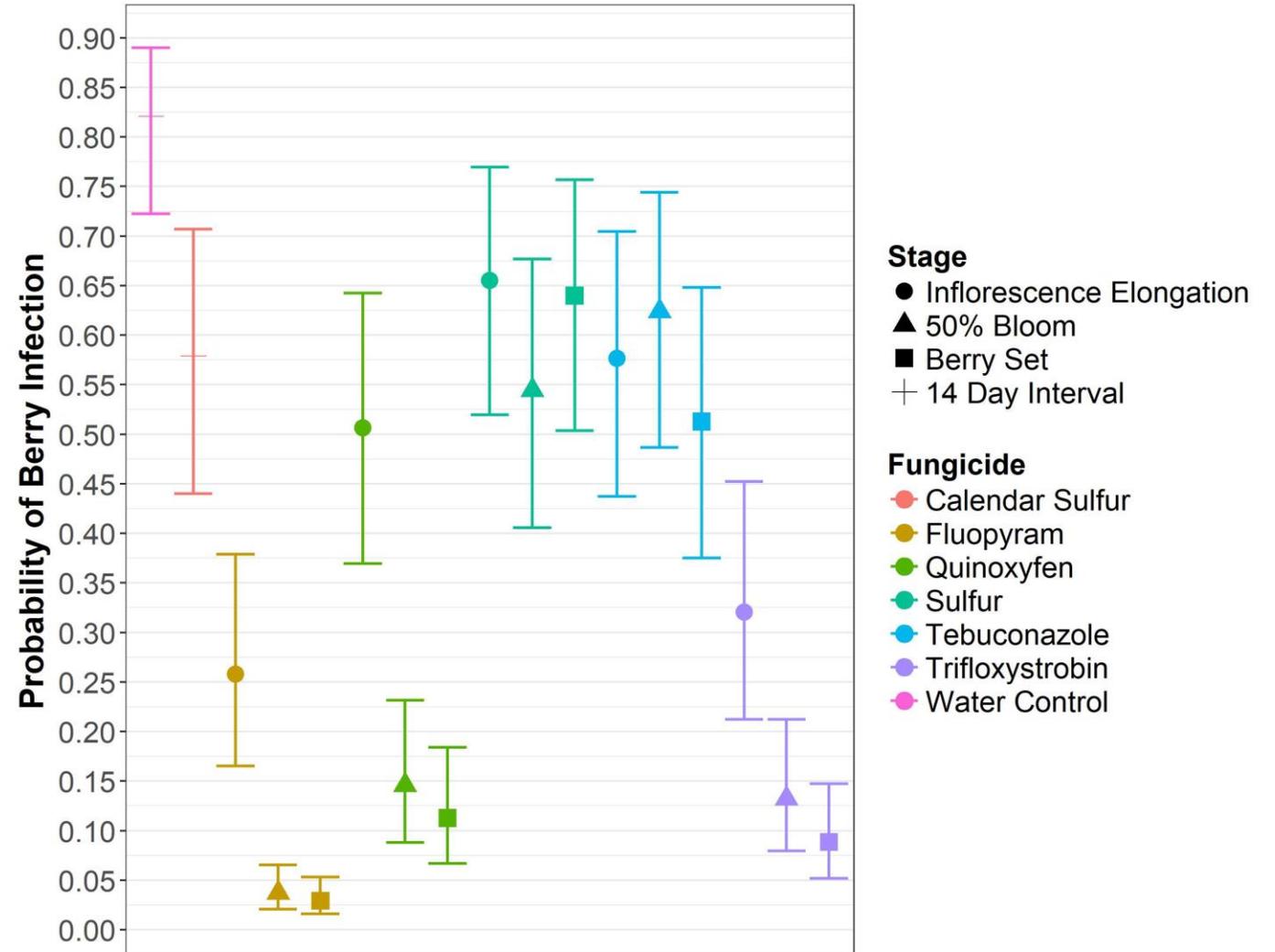


Berry Disease Development



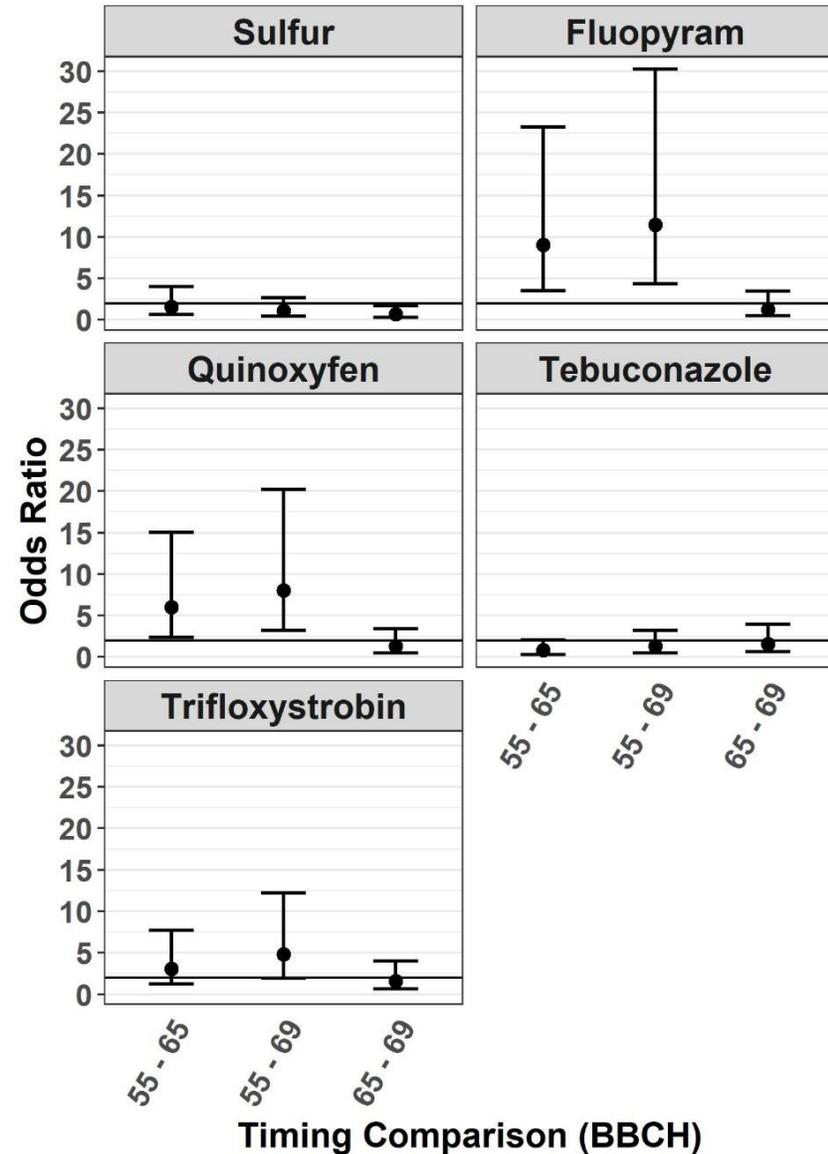
Berry Disease Development Averaged Across Years

- Bars are 95% confidence intervals
- Points are the mean probability of berry infection



Timing – Odds Comparison

- ▶ The bold horizontal line is at 1, indicating no difference between the two timings compared
- ▶ In general later timings were more effective



Field Mobility Assessment

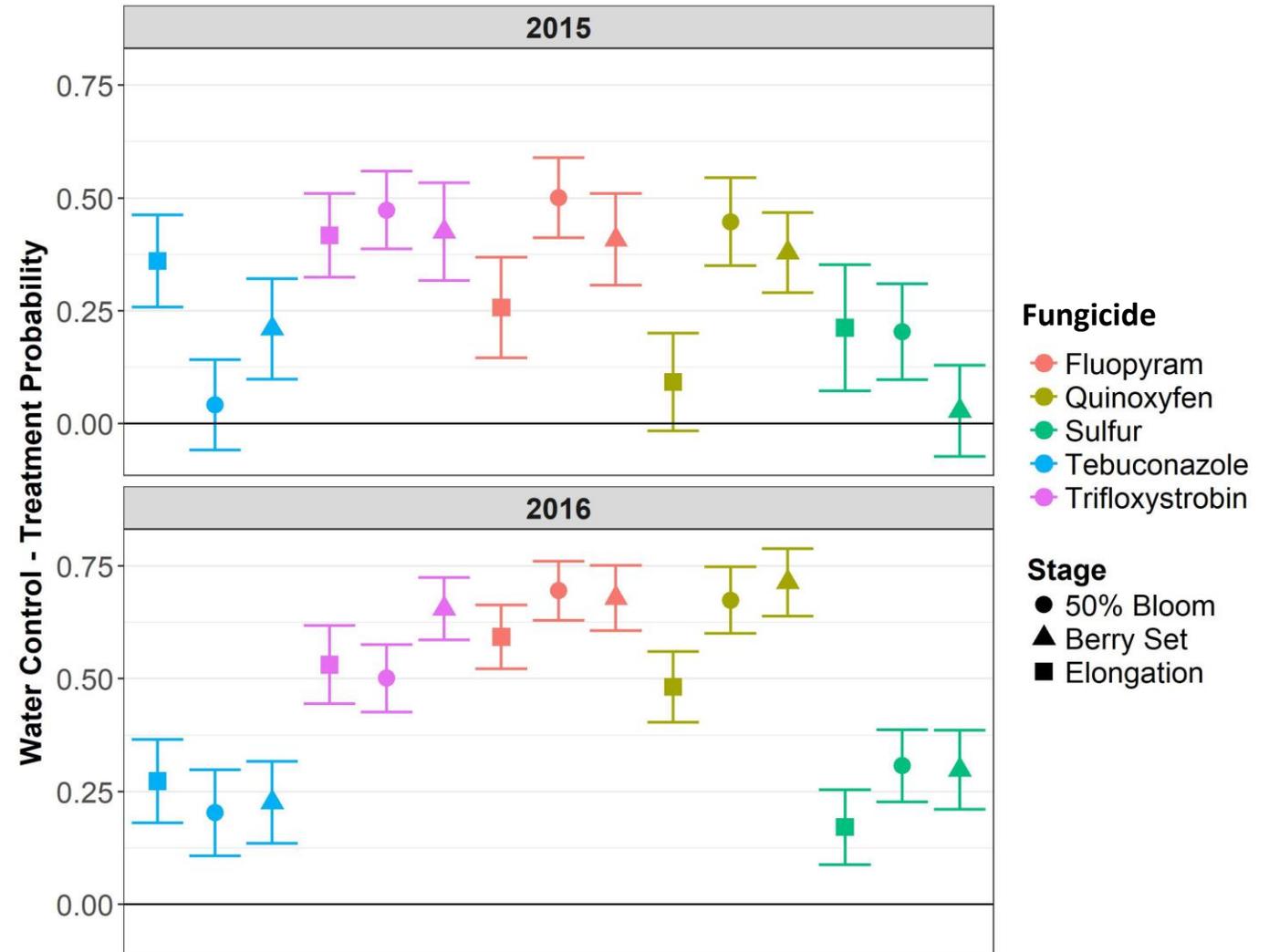
- ▶ 40 clusters per treatment were marked with ribbon
- ▶ During application clusters were covered with plastic bags
- ▶ These clusters were expected to have as much disease as the water control since they received no direct spray



Plastic bags covering clusters during an application

Field Mobility Data

- ▶ Difference in the probability of infection between the water control and the bagged cluster
- ▶ Most of the treatments showed some protective activity
 - Vapor movement



Phenological Experiment Summary

- ▶ Fluopyram, quinoxyfen, and trifloxystrobin were most efficacious when applied later in bloom
- ▶ All five fungicides tested appeared to be mobile in the field
 - Vapor movement

Applegate Valley
Chardonnay,
Southern Oregon



Current Work – Commercial Implementation

- ▶ Using the concepts of fungicide mobility and application timing to efficiently control powdery mildew on grape berries in a commercial setting



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 - Steve Clusky

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 - Ashley Lindsay, Willamette Valley Vineyard



Questions or Comments?



References

- ▶ Lorenz, D. h., Eichhorn, K. w., Bleiholder, H., Klose, R., Meier, U., & Weber, E. (1995). Growth Stages of the Grapevine: Phenological growth stages of the grapevine (*Vitis vinifera* L. ssp. *vinifera*)—Codes and descriptions according to the extended BBCH scale†. *Australian Journal of Grape and Wine Research*, 1(2), 100–103. <https://doi.org/10.1111/j.1755-0238.1995.tb00085.x>