

UV-C Light for Grapevine Disease Management

Alexander Wong and Walt Mahaffee



Western
Sustainable Agriculture
Research and Education



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Grape production

- \$6.6 billion farm gate value
- \$18 billion in agritourism



Grape Production is Dependent on Fungicides



95% of yield is attributed to fungicide use



Novel chemistries cost over \$300 million and over a decade to bring to market



Fungicide resistance is emerging faster than chemistries are produced

Grape Powdery Mildew

Grape Powdery Mildew (*Erysiphe necator*)

- Obligate biotroph
- 3-5% incidence can lead to crop rejection
- 89% of active ingredient applied is to manage Powdery mildew



Grape Bunch Rot

Bunch rot or gray mold (*Botrytis* spp.)

- Necrotrophic pathogen
- Botrytis can colonize grape tissues but not cause disease until conditions are favorable
- Grapes account for 50% of the Botryticide market



Concerns with Heavy Reliance on Fungicides



Consumer
demands



Environmental
impacts



Health concerns



Production Costs



Fungicide
resistance

UV-C light to control plant disease

- UV-C: germicidal radiation 200-300nm
- Fungal DNA repair genes are down regulated at night
- Hypothesis: UV-C light in conjunction with fungicides will better manage disease and reduce fungicide resistant populations



Objectives



Examine UV-C efficacy to inhibit powdery mildew and Botrytis under laboratory conditions



Investigate field management of powdery mildew and Botrytis with weekly UV-C exposure

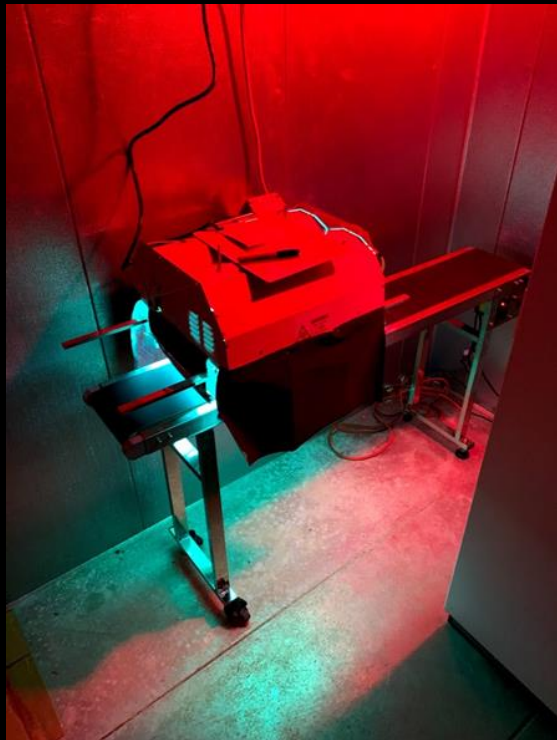
Laboratory UV-C unit

- Greenhouse light housing with two UV-C lamps
- Secured to a conveyor system to control dose



Powdery mildew germination inhibition

- One-hour dark period before exposure to simulate sunset
- Plates incubated, imaged and the hyphal area calculated to estimate growth



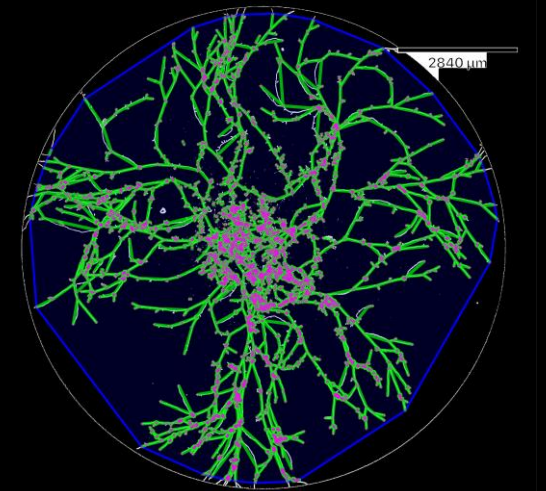
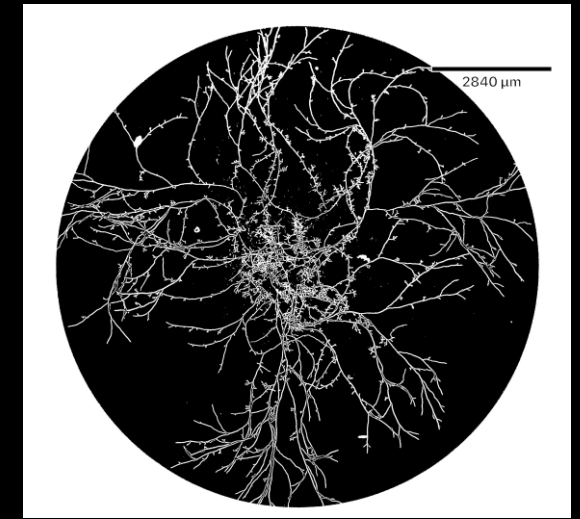
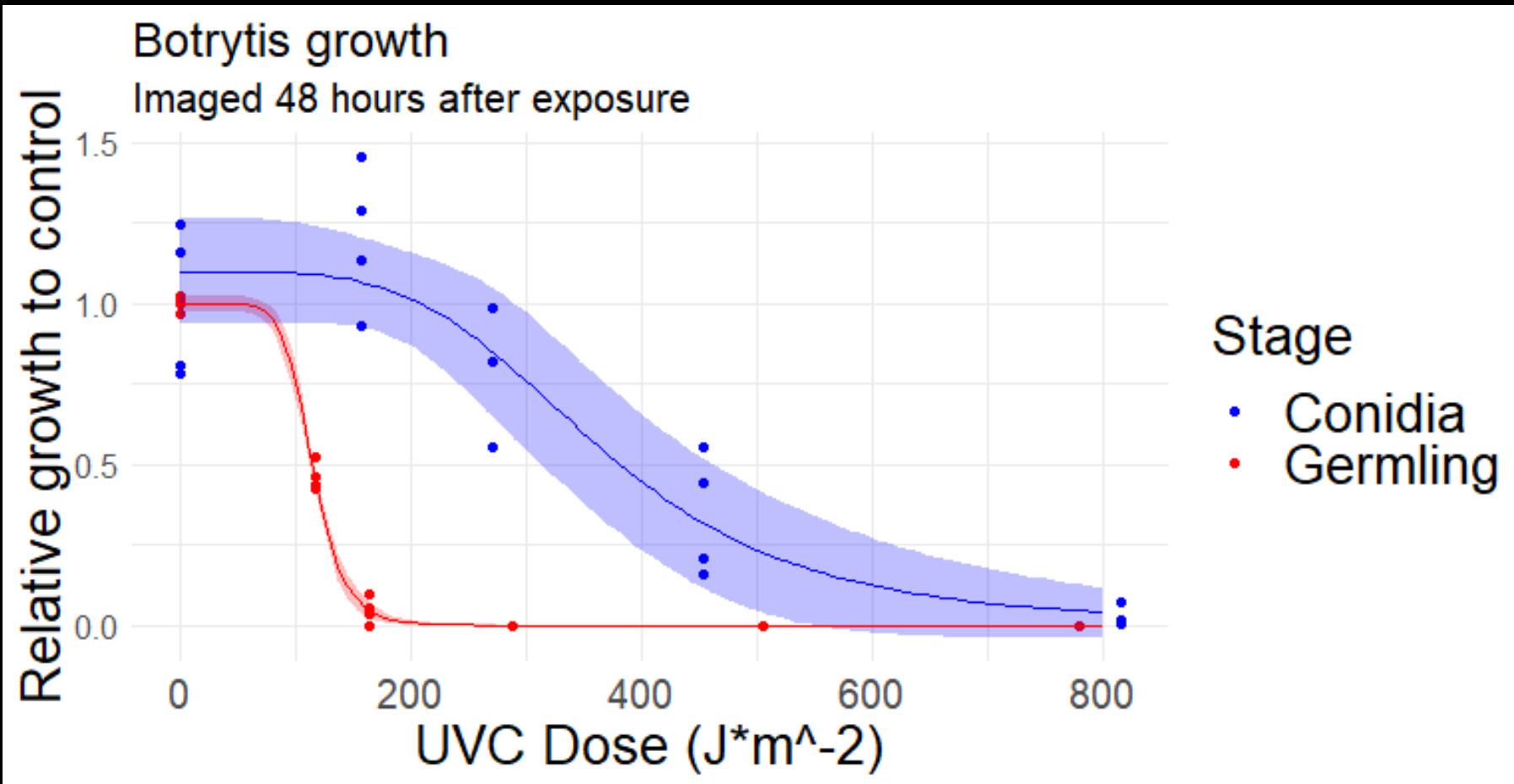
Powdery mildew UVC tolerance varies

- Wide range of tolerance

UV-C ED ₅₀ estimates to inhibit <i>E. necator</i> conidia germination.		
Isolate	ED ₅₀ (J/m ²)	±Std. err
HO1	98	34
RMT2A	114	23
E101	122	11
DY4-2	140	15
SE7A	146	14
S402UTC	155	13
Evpop553	164	29
RC2-2	164	11
STPN667-1	178	18
DDOFS2	187	19
STPN777-1	196	20
RMT1A	205	20
HO3	205	36
CL9-3	212	16
THB	213	19
STPN777-2	219	28
PR7-67	227	13
HO2	233	32
R527ST115-1	234	74
CAT1D1	245	38

Botrytis growth inhibition

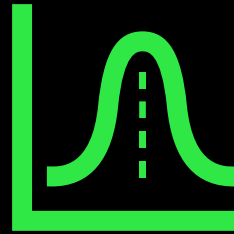
- UVC exposed Botrytis conidia and 24-hour old germlings



Lab study takeaways



The effective doses seen are possible in a field setting



Powdery mildew isolates range in tolerance to UVC



Botrytis tolerance is life stage dependent



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The Corvallis Dragon

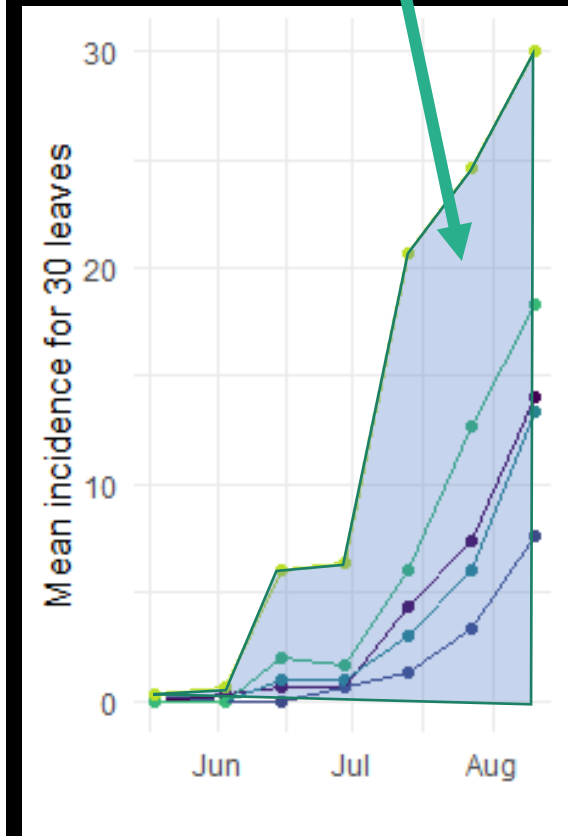
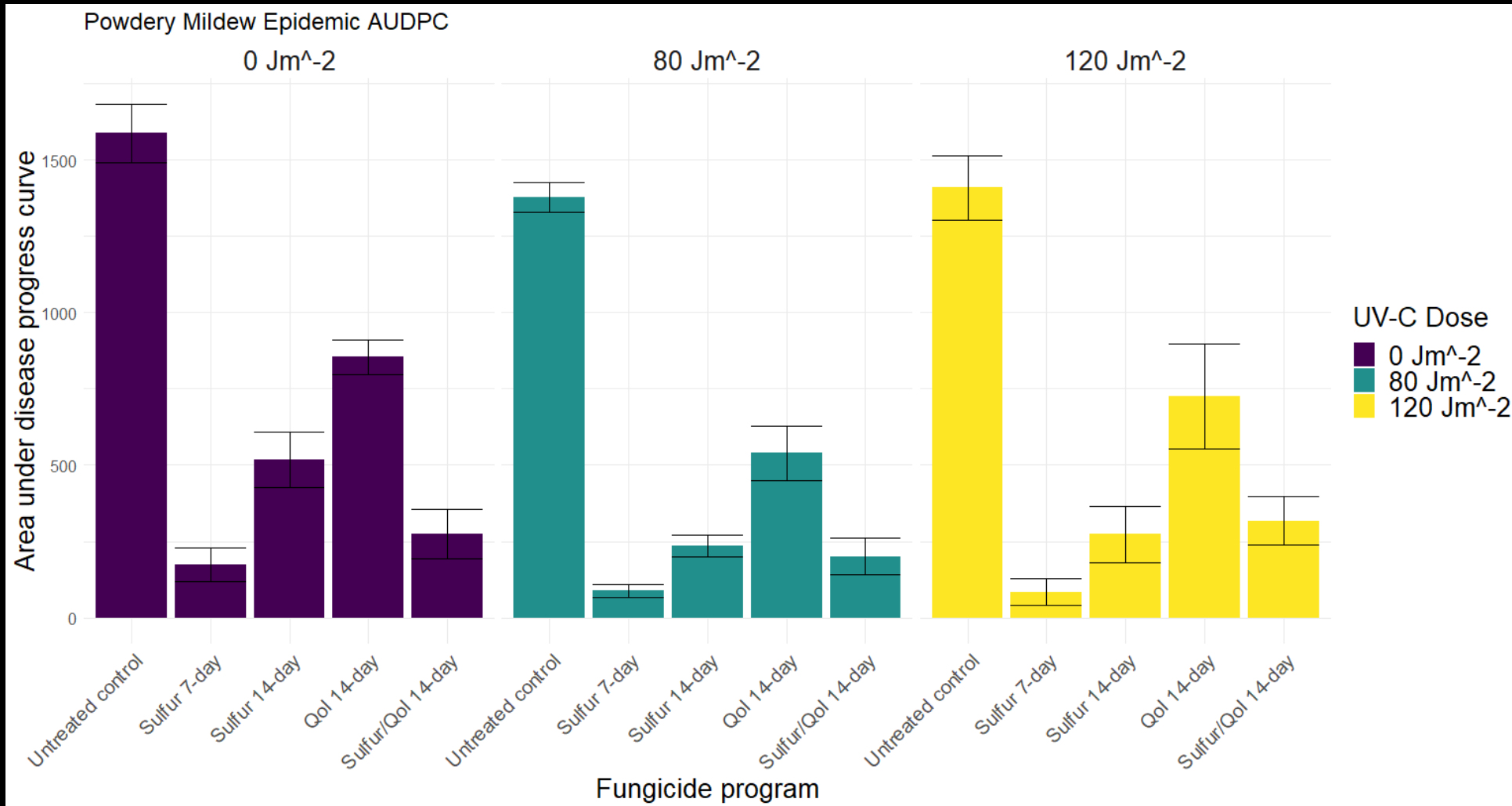
- Tractor mounted array of 254nm OSRAM 55W UV-C lamps
- Irradiate one hour after sunset
- UV-C applied in conjunction with fungicide programs
- Mildew rated and sampled every other week
- Botrytis rated and sampled at harvest



2020

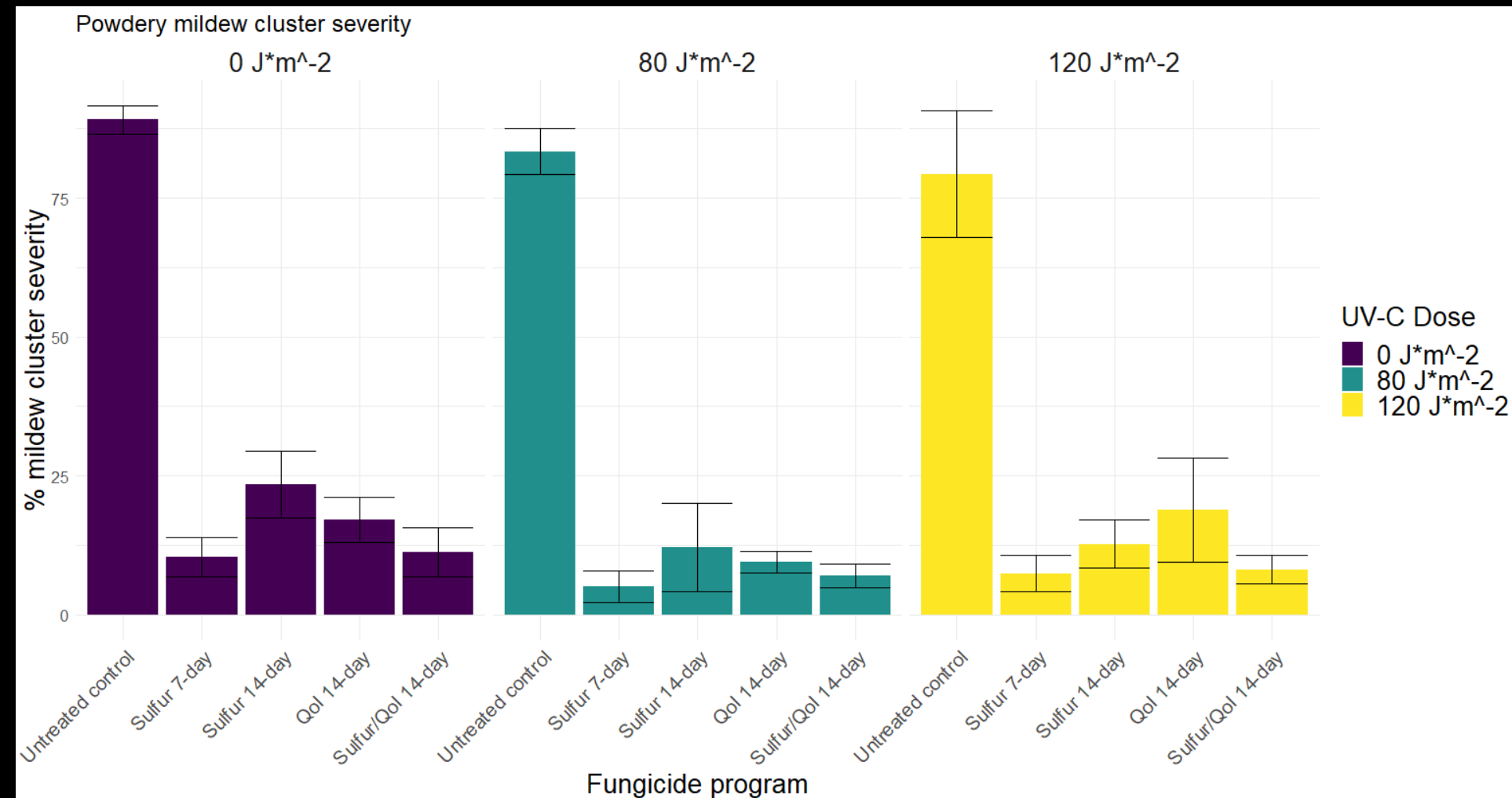
Powdery mildew leaf incidence

Example: area under curve



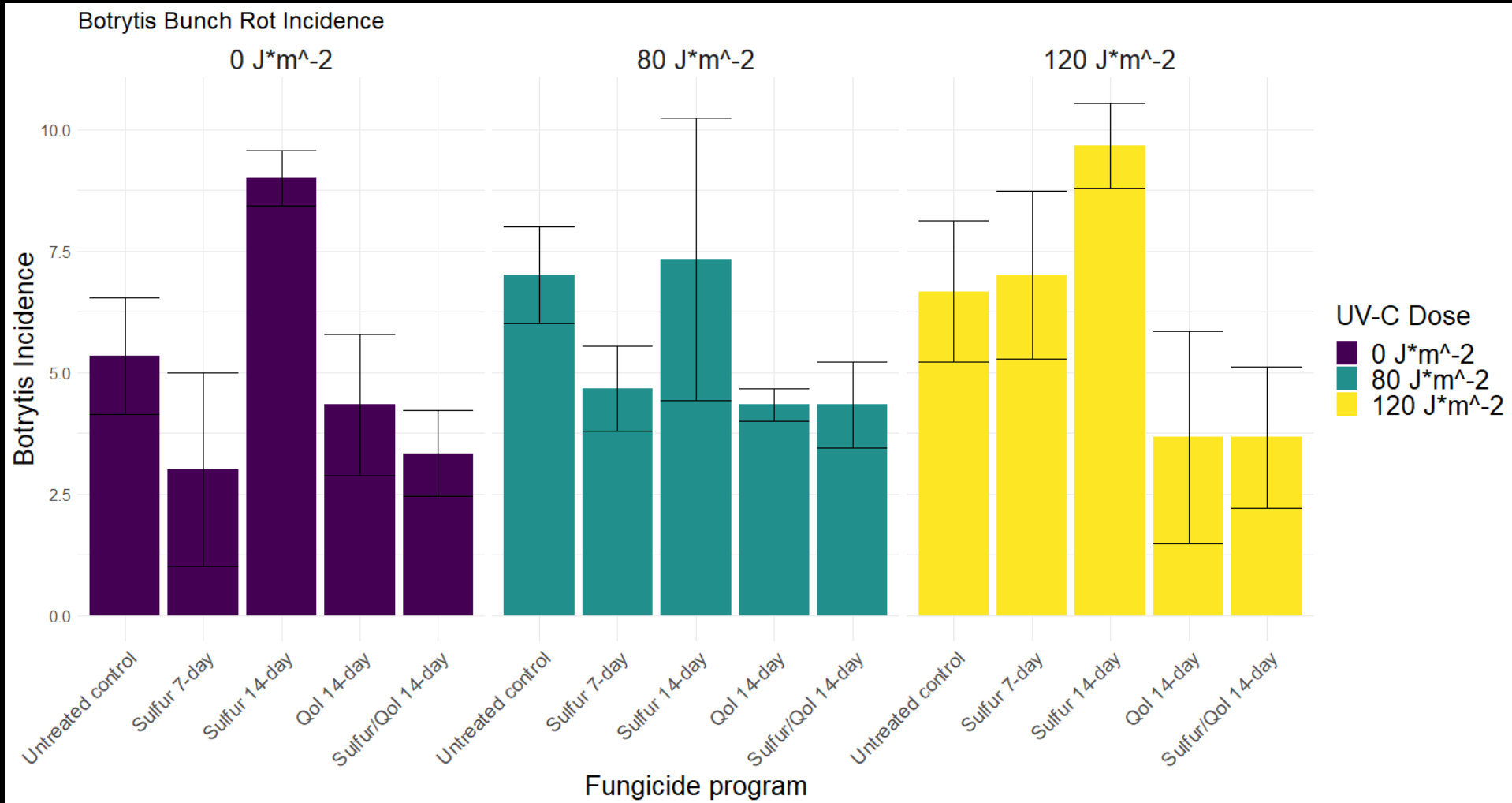
2020

Powdery mildew cluster severity

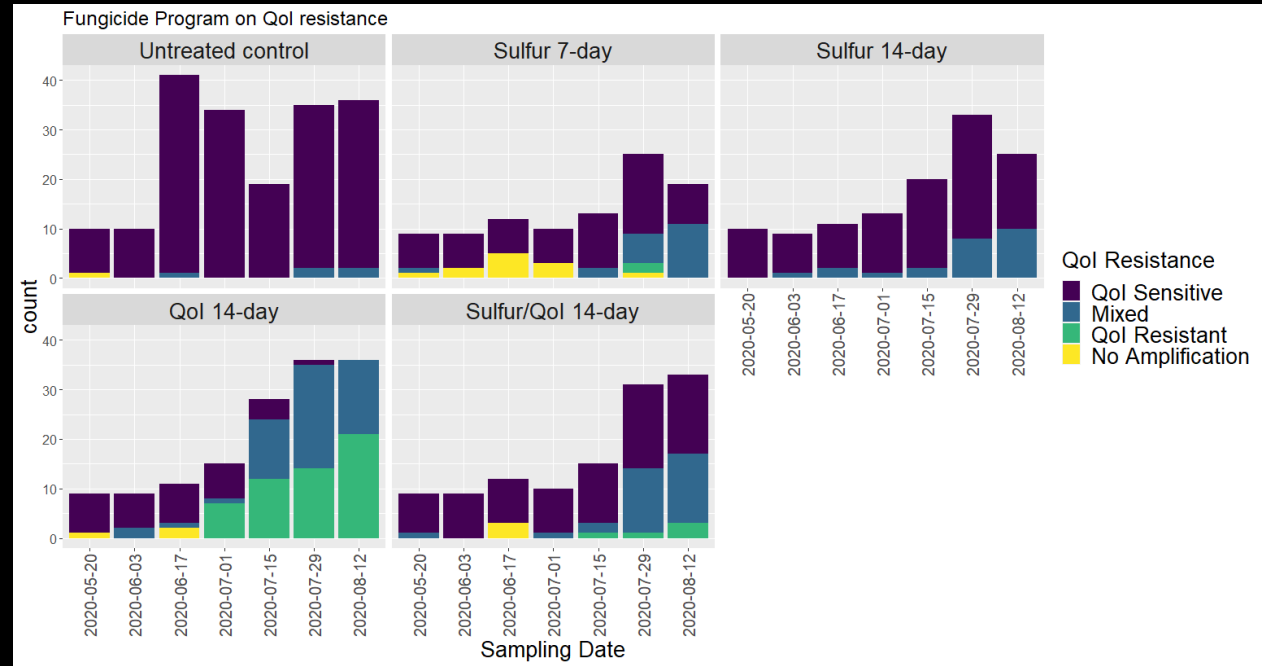
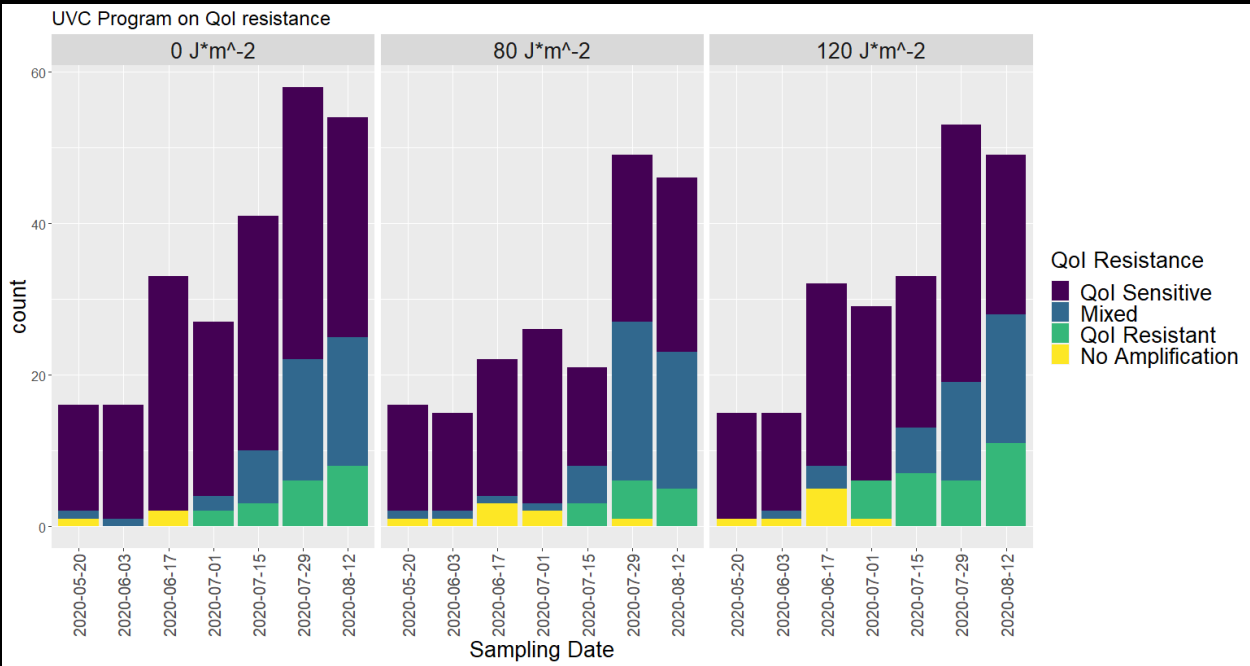


2020

Botrytis Incidence



QoI (FRAC 11) resistance



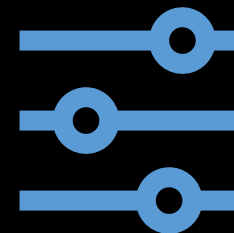
2021 Field Season



UV-C dose and application frequency both increased

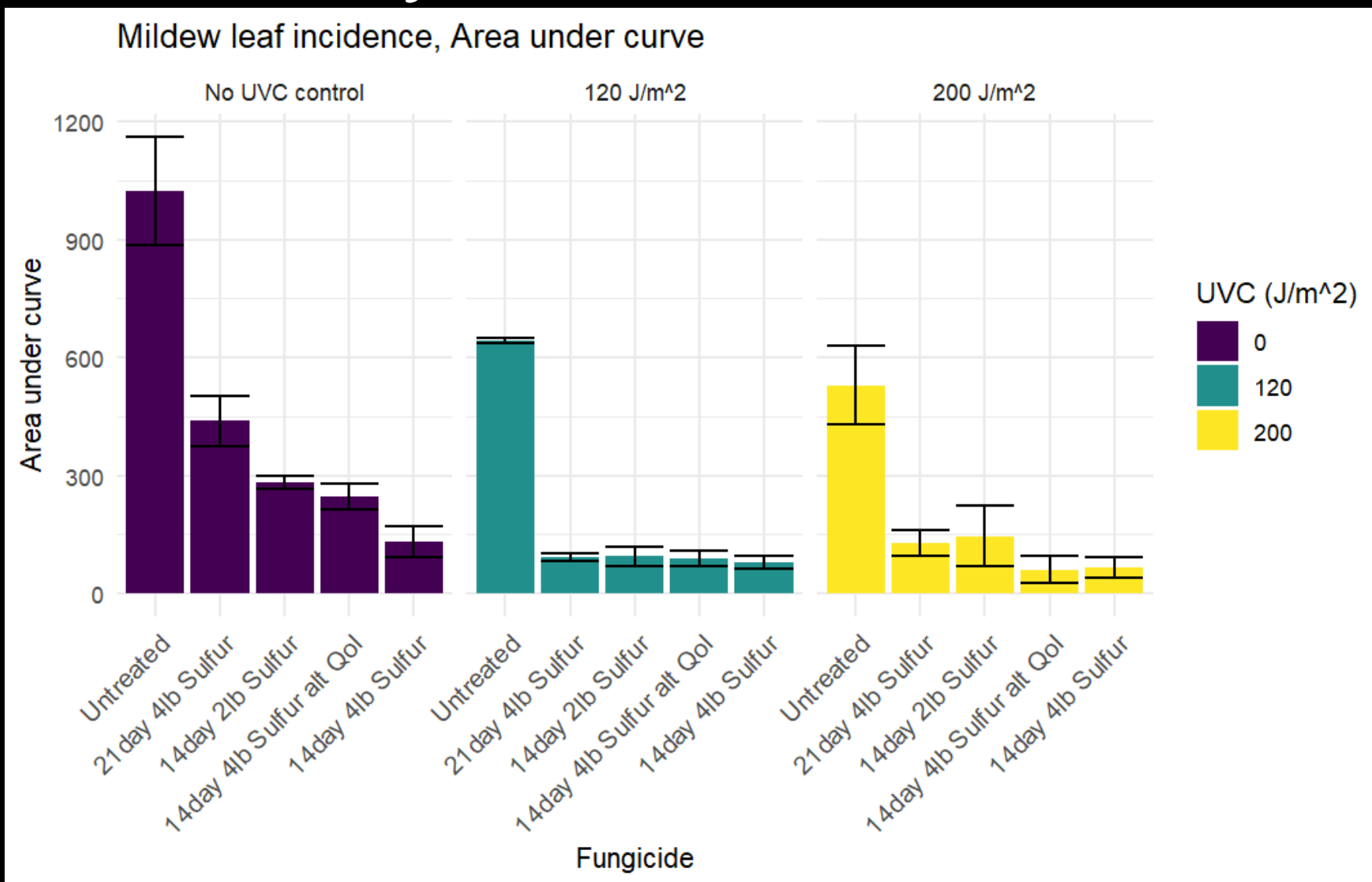


Maintained once a week applications

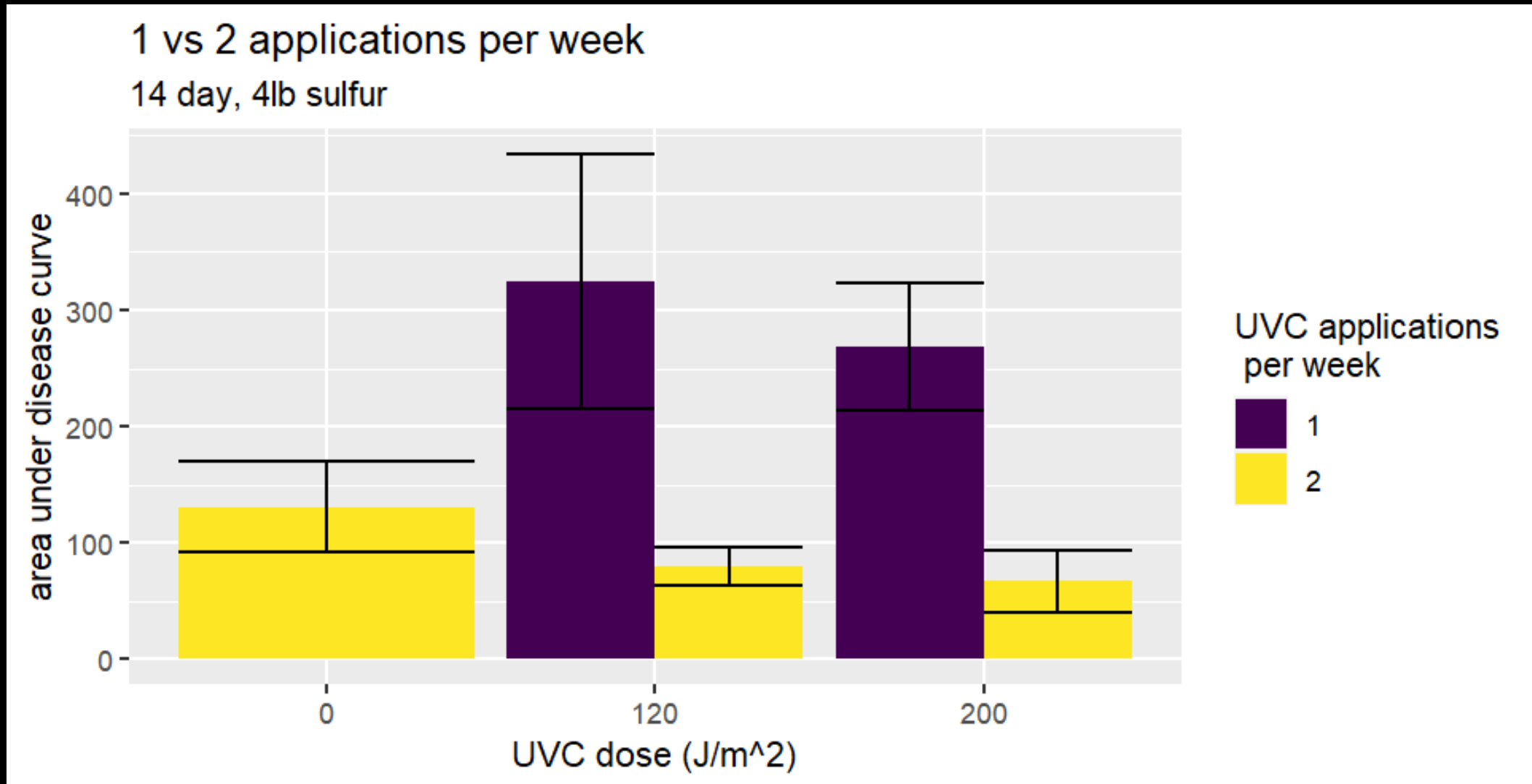


Adjust fungicide programs

Powdery mildew incidence

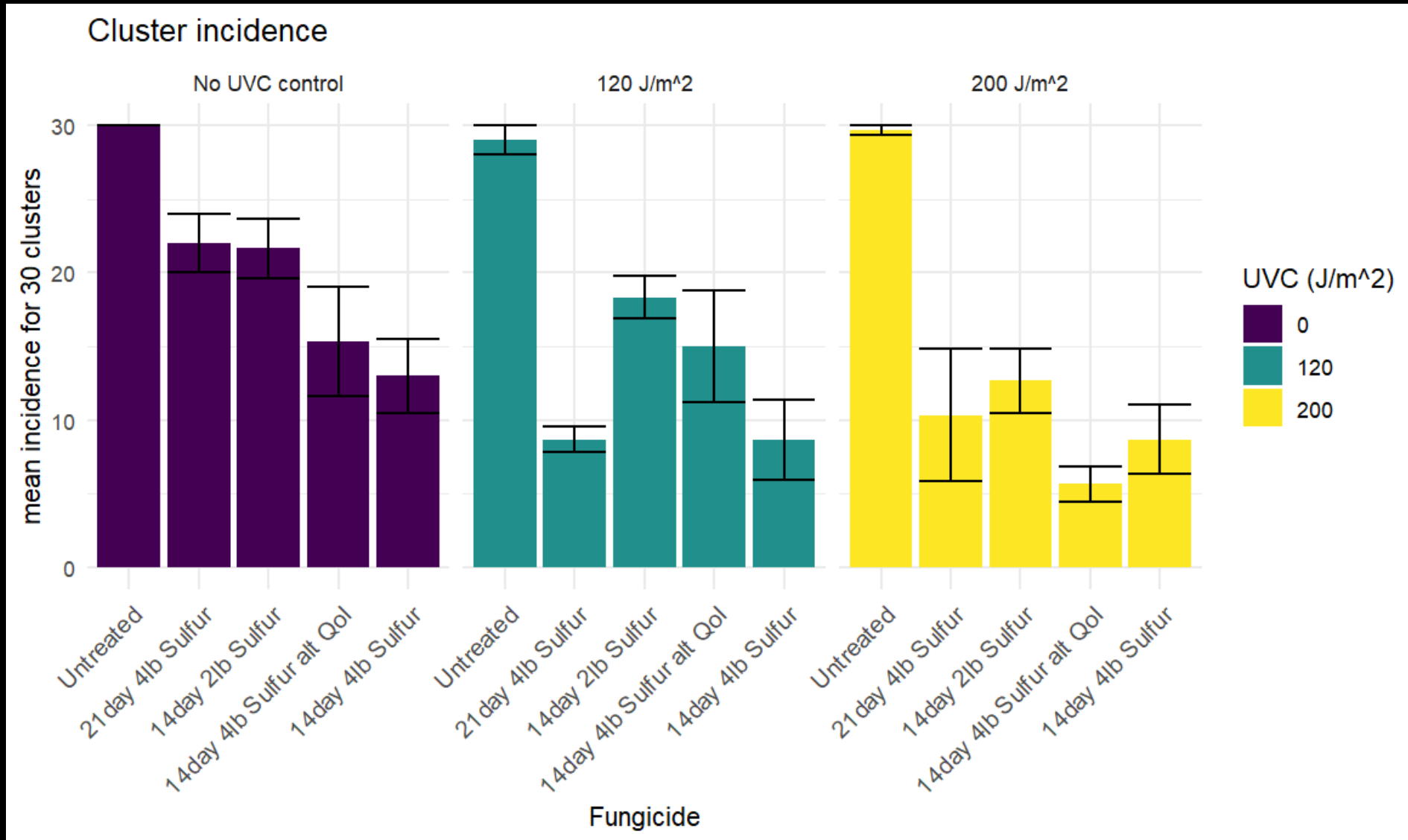


Powdery mildew incidence

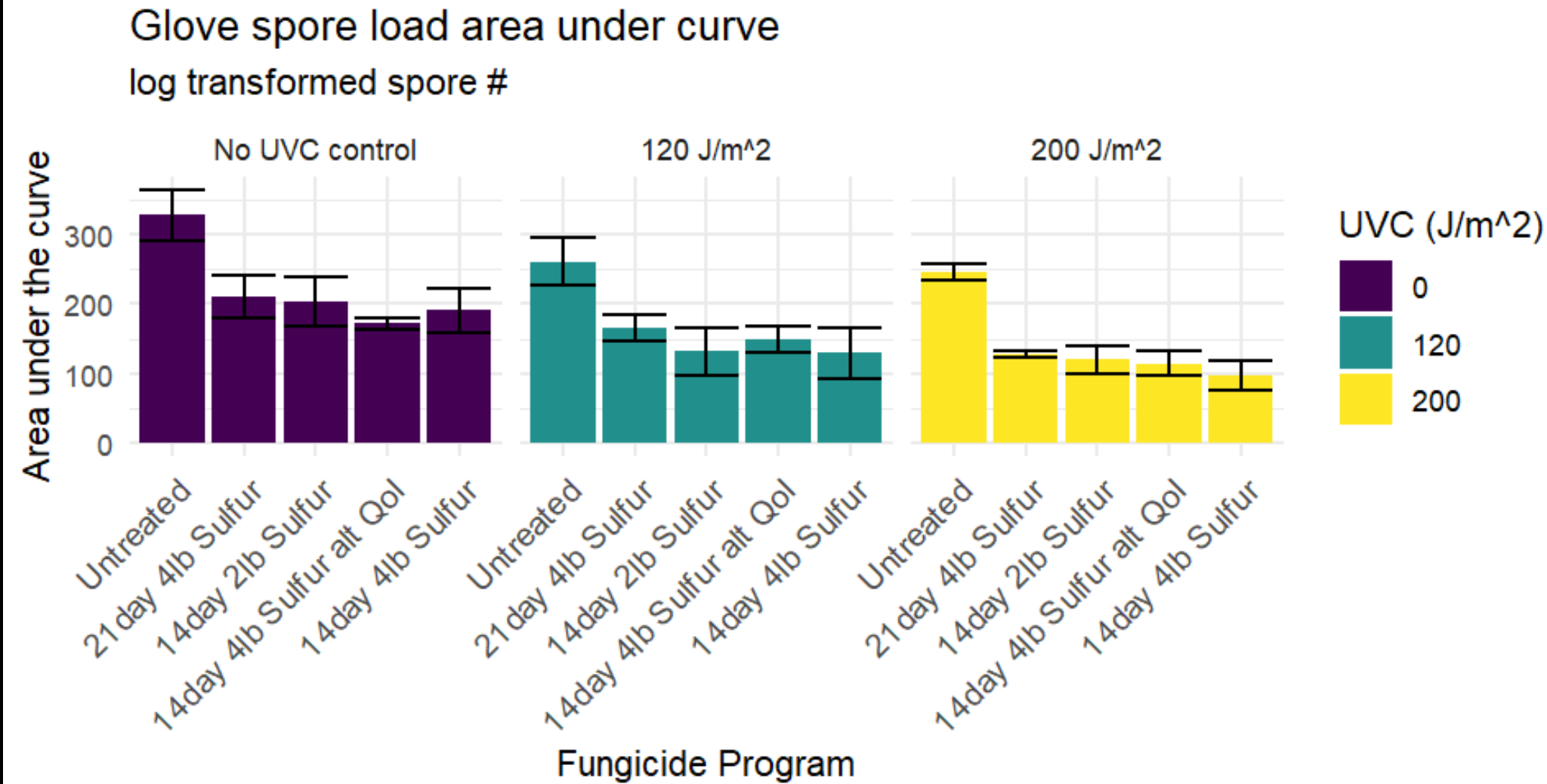


2021

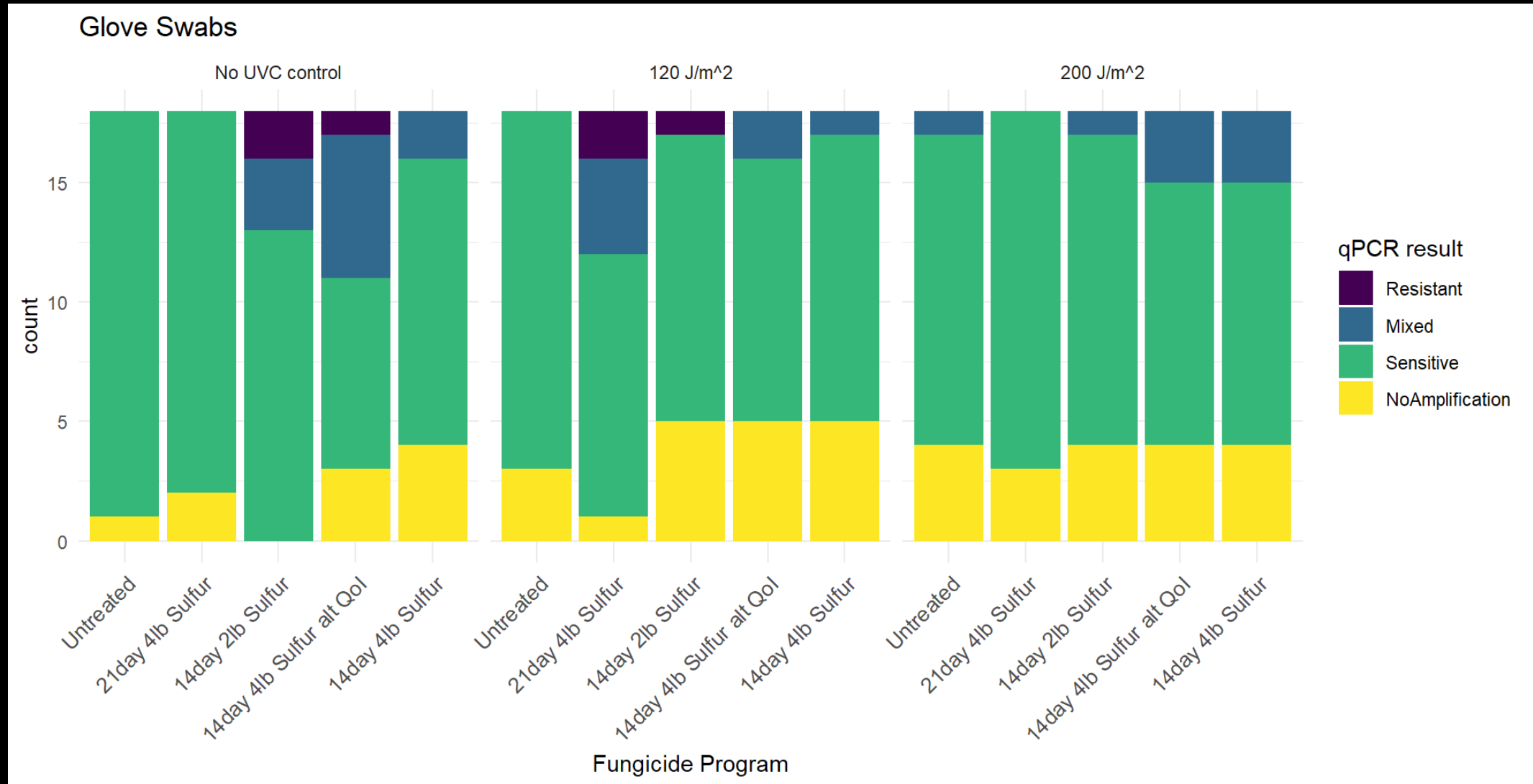
Cluster mildew incidence



Inoculum detection

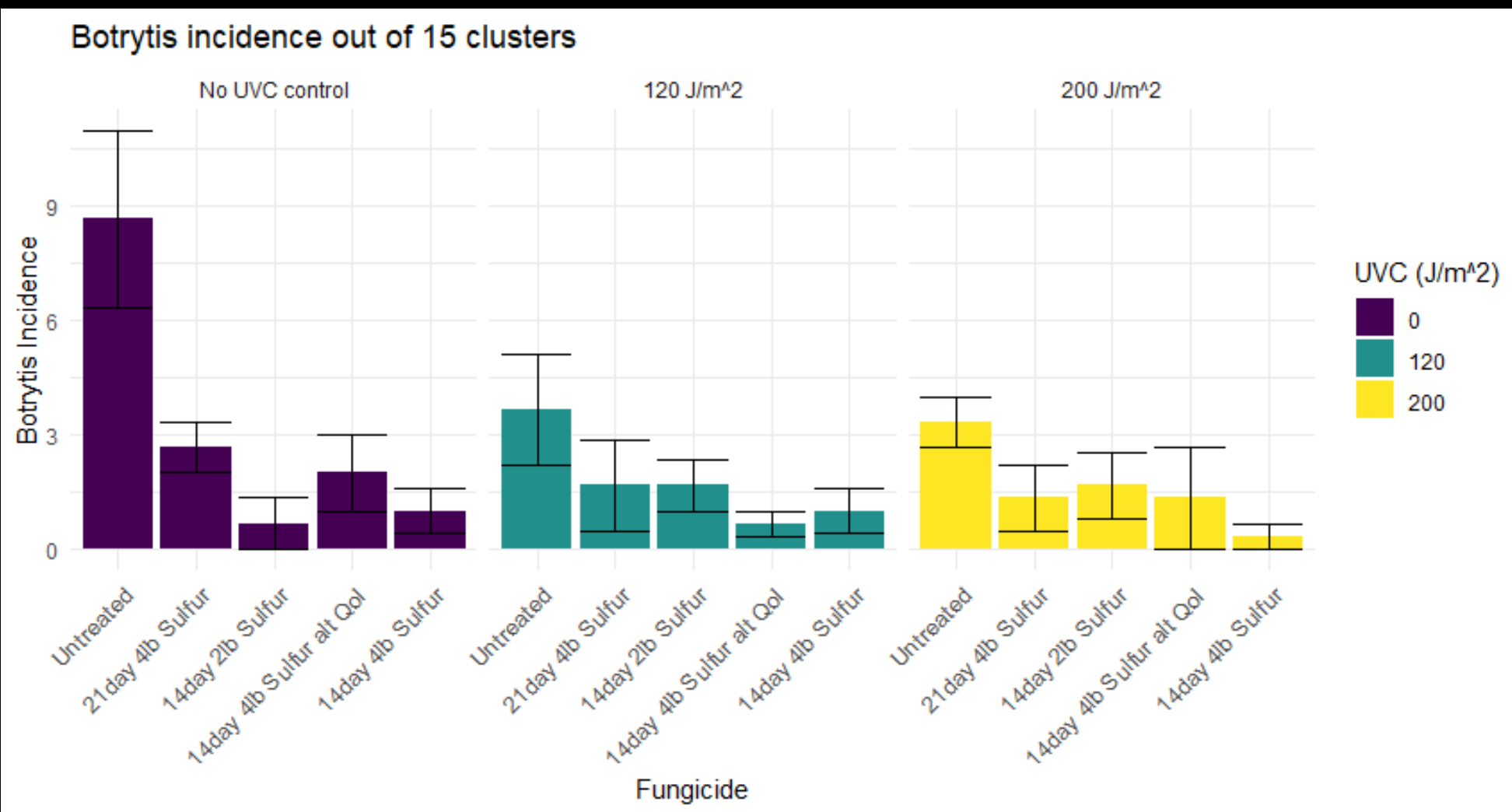


G143A – glove swabs



2021

Cluster Botrytis Incidence



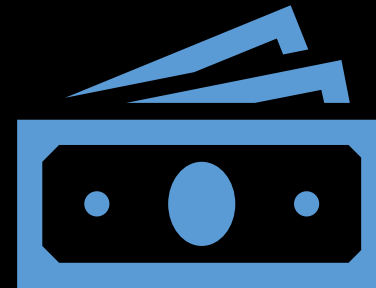
Fruit Chemistry

- Whole berry homogenate
- Brix, pH, anthocyanin, and phenolics
- No significant differences across UV-C treatments in 2020 or 2021

Conclusions



UV-C may contribute to the management
of powdery mildew



Needs to be feasible for
commercial vineyards

Autonomous UVC Robot

- In collaboration with Willamette Valley Vineyards and SAGA robotics
- An autonomous robotic platform for application of UVC in a vineyard
- Planned to be used in 2022



Acknowledgements

The entire foliar pathology lab:

Technicians: Carly Allen, Hannah Soukup,
Tara Neill

Grad students: Sarah Lowder, Chelsea
Newbold, Kate Baldino

Undergrads: Jessy Brown, Kale'a
Galbreath, Dani Scutero, Iris Garber,
Savanah Espinosa, Destiny Perkins,
Kiersten Brophy, Lexi DeFord

David Gadoury and Michelle Moyer

Saga Robotics

David Markel, Jim Bernau, Willamette
Valley Vineyards

Matt Vanella

Kelly O'Neil

Funding by Western SARE



Survey and future implementation

- Please take part in this quick (1-2 min) anonymous survey
- Required research goal of WSARE
- If interested in participating in future implementation trials, please leave your contact info

