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# Illuminating Ultraviolet-C Light for Grapevine Powdery Mildew Management

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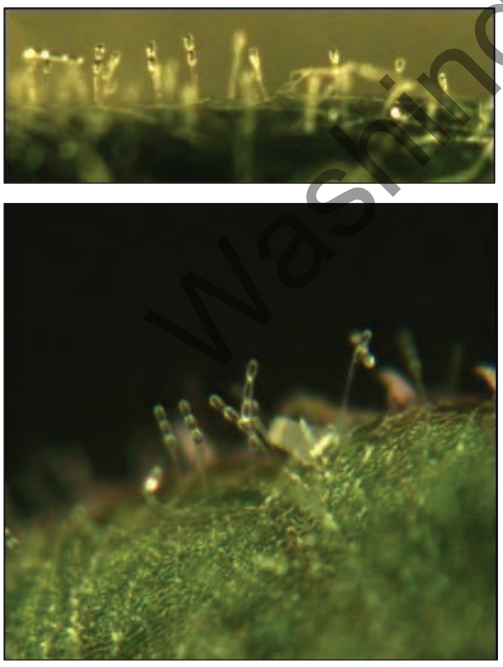
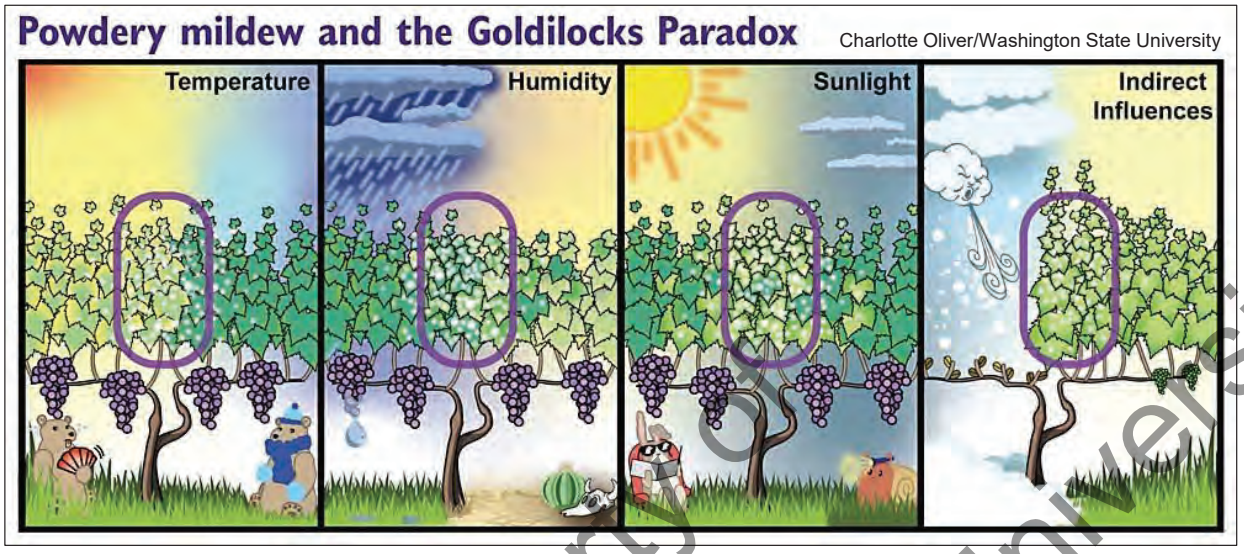
**Grapevine powdery mildew (*Erysiphe necator*) is an obligate biotroph which can colonize the surface of all green tissue.**



Michelle Moyer/Washington State University

## Powdery mildew is picky, it thrives under specific environmental conditions.




Optimal temperature: **50 – 90° F**

Ideal humidity: **60-90%**

Highly susceptible to **UV damage**

Cold damage can lead to **excess shoot growth**

**Good Fruit Grower article**
Good to know: Why some season are worse for powdery mildew.

https://www.goodfruit.com/why-some-seasons-are-worse-for-powdery-mildew/



## Only 4-7 fungicide applications are commonly used in eastern WA, but fungicide resistance can restrict our toolbox.

**Fungicide application period**

**3-6 inch shoot growth**

**3 weeks post fruit set**

**Cluster critical window period for infection**

**2 weeks prebloom**

**3 weeks post fruit set**

Gadoury et al 2003

## Ultraviolet-C (UVC) light is a short, highly energetic wavelength that is germicidal.

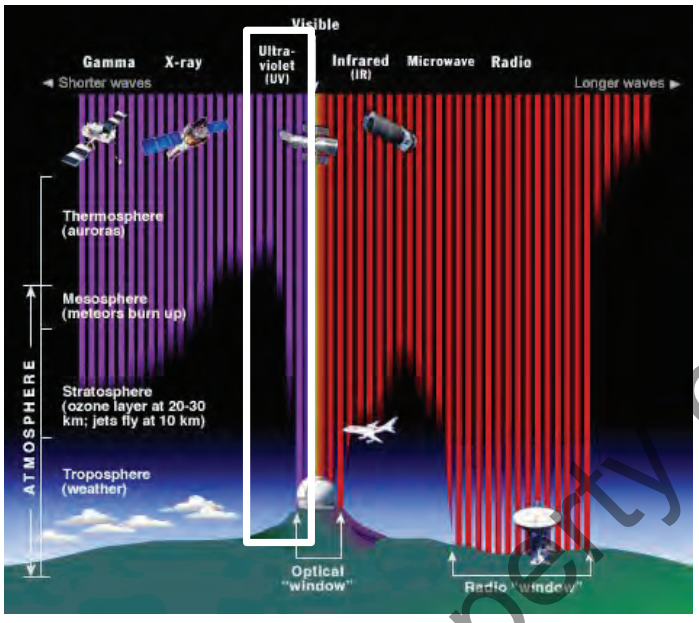
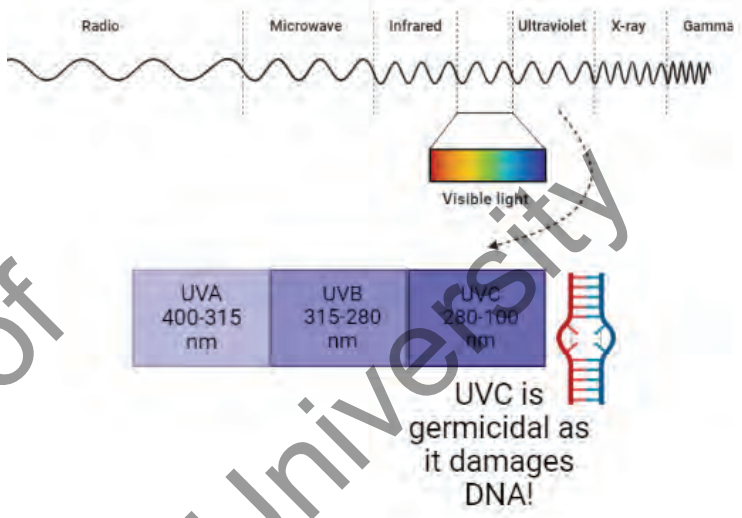



Image credit: Nasa.gov

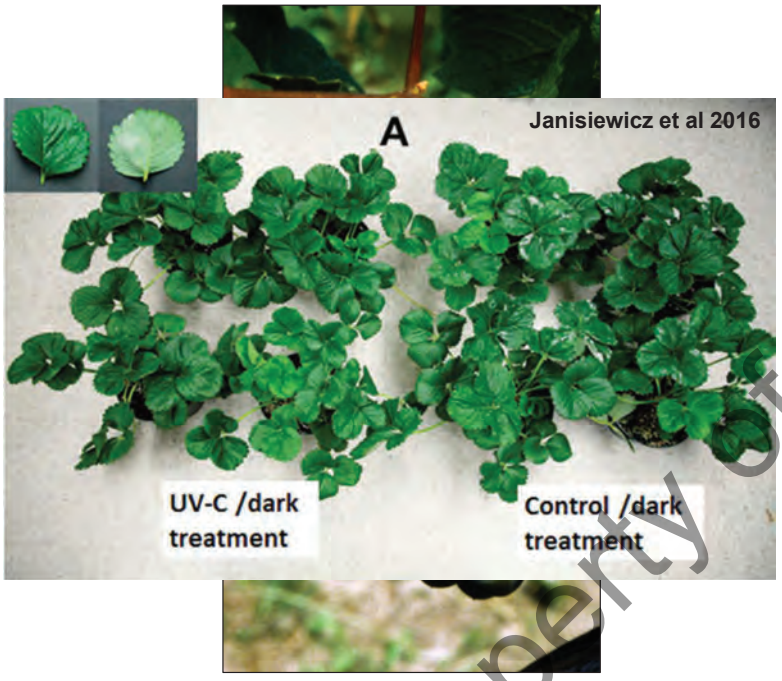


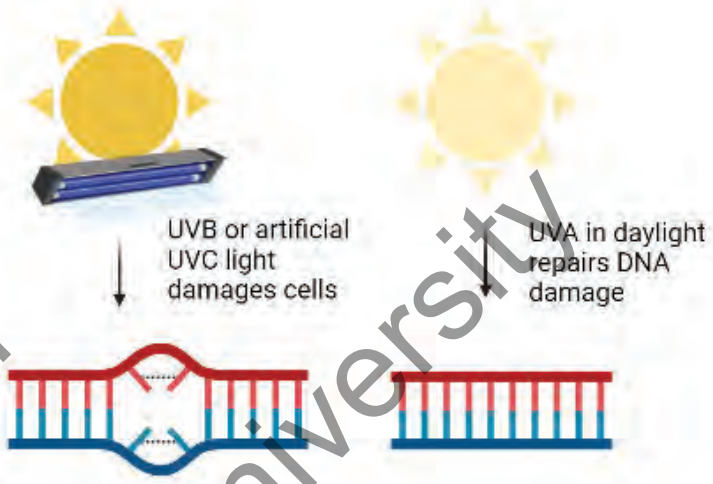



## UVC light is an old technology where recent break through in pathogen biology has led to pre-harvest adaption.


David Gadoury/Cornell University

## Night application = lower dose to kill pathogen and does not harm plant




Thompson and Sancar 2002; Suthaparan et al 2014



## The questions to a non-chemical approach.

How can UVC light treatments integrate best into Eastern WA for grapevine powdery mildew management?

Does UVC light treatments negatively effect berry quality?

Different nighttime application intervals of UVC light at 200 J/m$^2$ was applied throughout the season and was compared to a standard fungicide program in Eastern WA for powdery mildew control.

## Season long UVC treatments were compared against a full spray control and an unsprayed control.

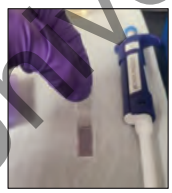
| 2020 Treatments | 2021 Treatments | 2022 Treatments |
|---|---|---|
| **UVC 1x per week** (200 J/m$^2$) | **UVC 2x per week** (200 J/m$^2$) | **UVC 2x per week** (200 J/m$^2$) |
| **UVC Bi-weekly** (200 J/m$^2$) | **UVC 1x per week** (200 J/m$^2$) | **UVC 1x per week** (200 J/m$^2$) |
| **Full Spray**:<br>**May 8** – Sulfur (4 lbs)<br>**May 14** – Sulfur (4 lbs)<br>**May 21** – Vivando + Sulfur (2lbs)<br>**June 4** – Quintec + Cinnerate<br>**June 18** – Torino + Cinnerate<br>**July 2** – Gatten + Cinnerate | **Full Spray**:<br>**May 5** – Sulfur (4 lbs)<br>**May 12** – Sulfur (4lbs) + Cinnerate + Complex<br>**May 19** – Vivando + Complex<br>**June 1** – Quintec + PureSpray Green (0.25%)<br>**June 15** – Torino + PureSpray Green (0.25%) | **Full Spray:**<br>**May 19 –** Sulfur (4lbs)<br>**May 25 –** Sulfur (4 lbs)<br>**June 1 –** Vivando + Complex<br>**June 15** – Quintec + Sulfur (2 lbs) + Complex<br>**June 29** – Torino + PureSpray Green (0.25%)<br>**July 13** – Aprovia + Complex |
| **Unsprayed** | **Unsprayed** | **Unsprayed** |

**Application period**

**3-6 in shoot growth**

**3 weeks post fruit set**

**Disease ratings are a percentage of visual powdery mildew per leaf of cluster**



**Basic harvest metrics were collected and berry skin phenolics were measured via Adams-Harbertson method**

Harbertson et al 2003



## Limited canopy management was applied in all years.

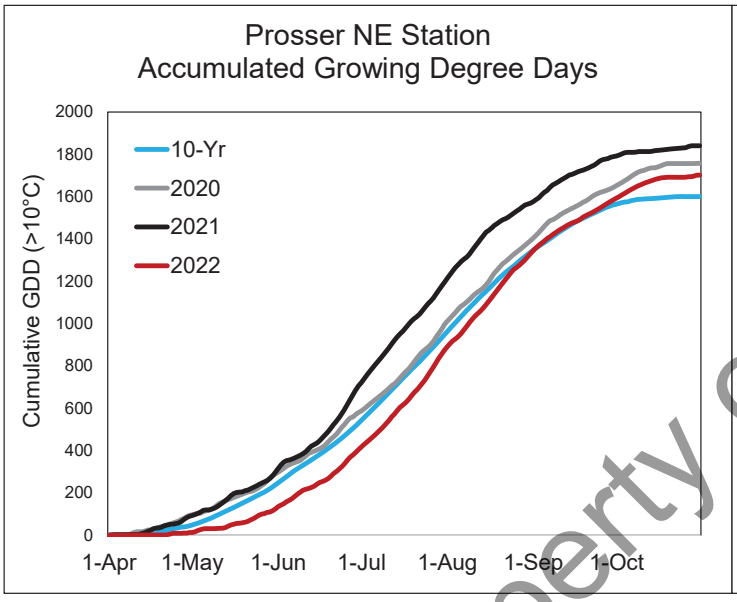
June 17th 2022

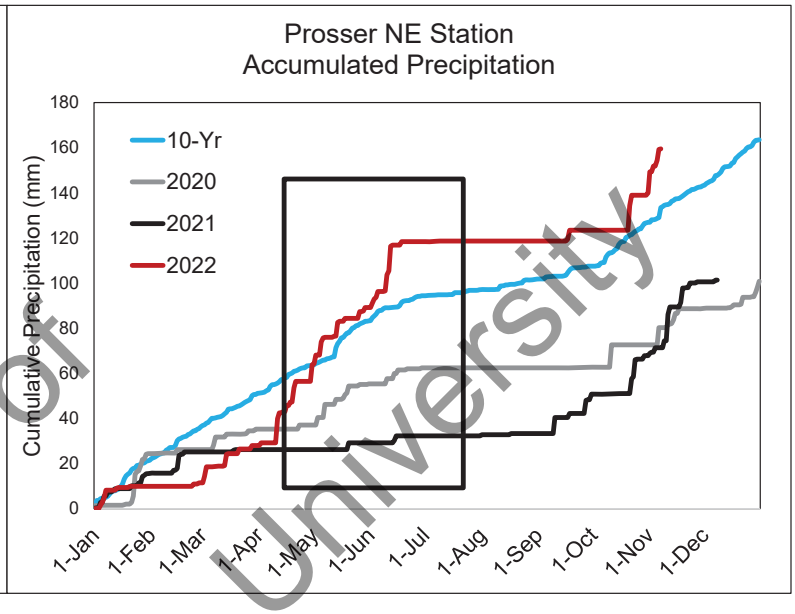
June 29th 2022

July 17th 2022

Full Bloom
June 27th, 2022

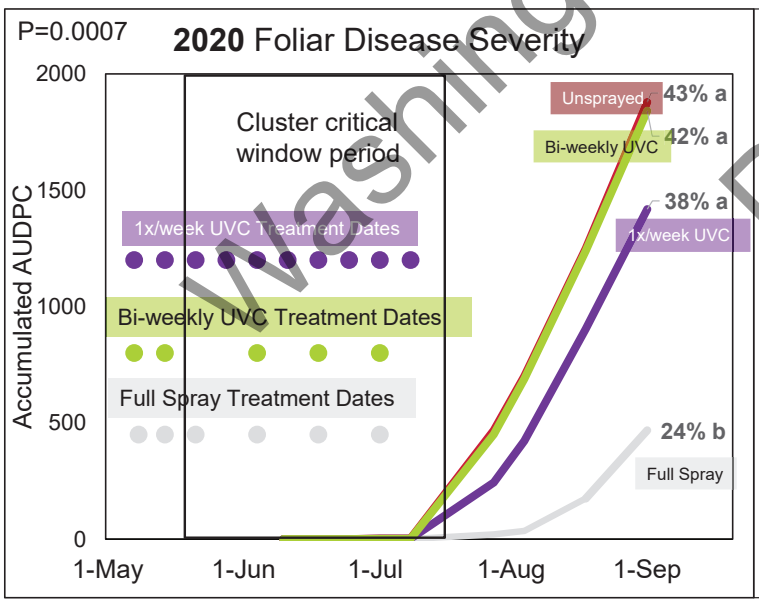
## 2020 & 2021 were low disease pressure years due to warm temps and low precipitation while 2022 was a high pressure year.

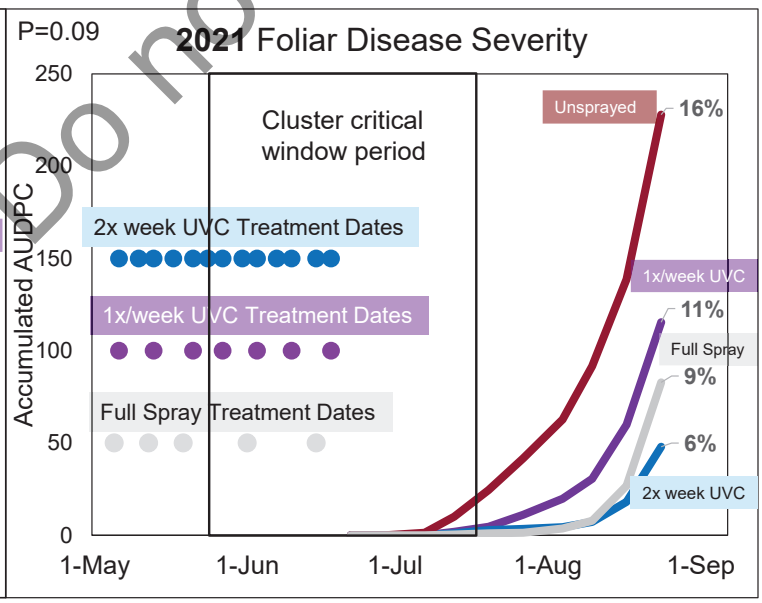




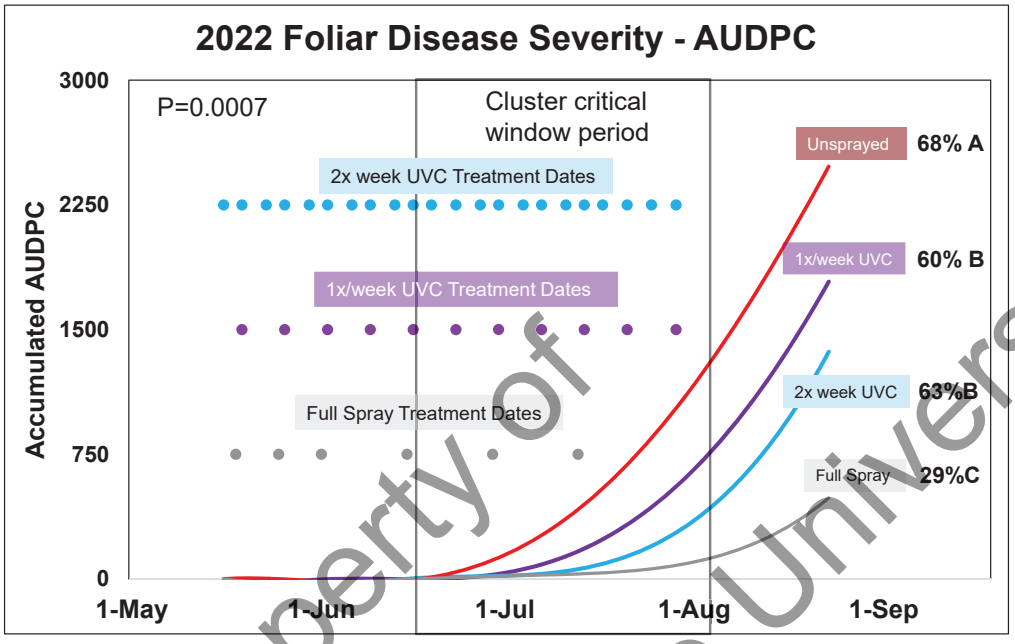

## Tighter UVC intervals typically meant reduced foliar disease severity.



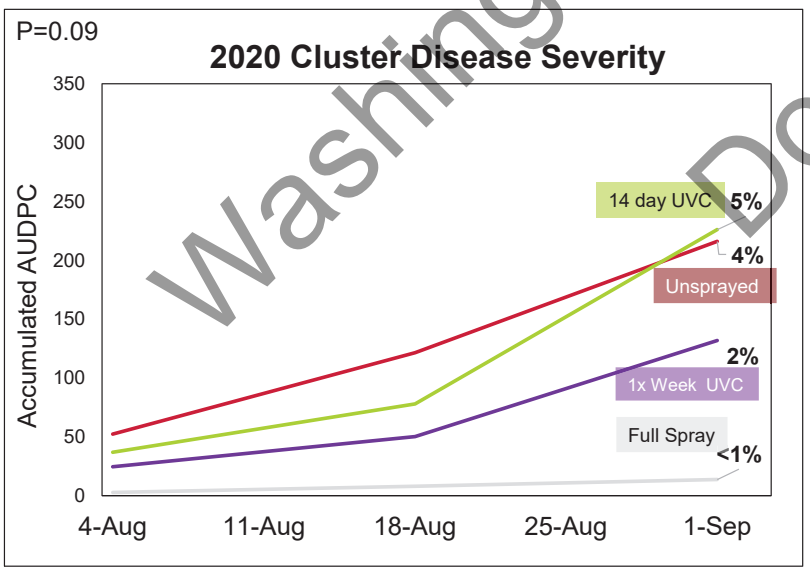

AUDPC, ANOVA, Tukey's HSD

## In 2022, both UVC treatments foliar disease severity was significantly lower than the unsprayed control.





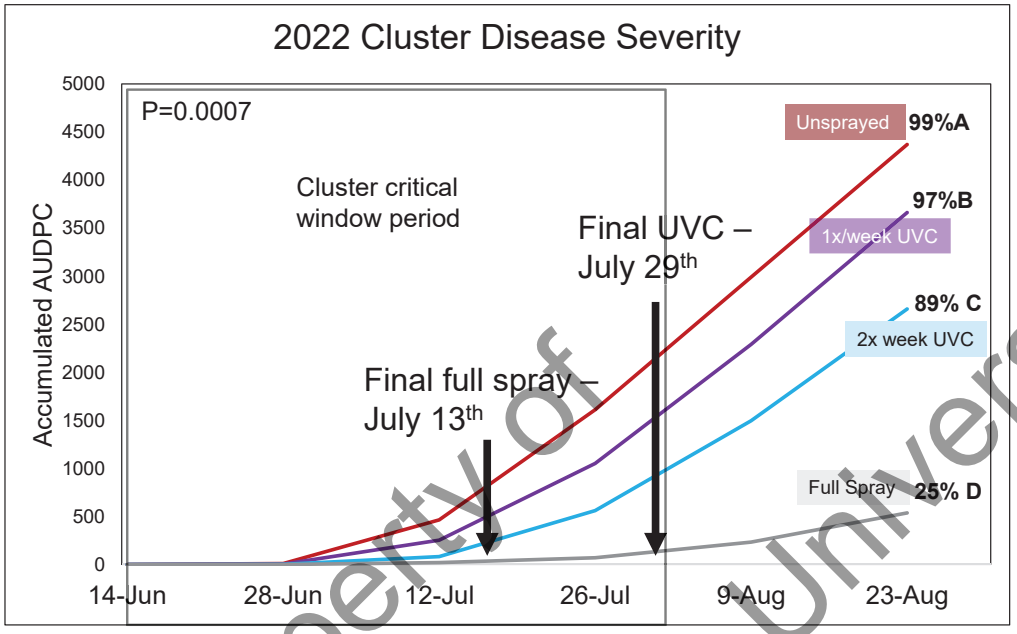

## Cluster disease severity was low in 2020 and 2021, regardless of treatments.




**No cluster disease in 2021!**

AUDPC, ANOVA, Tukey's HSD

## Cluster disease was high in 2022 but UVC did significantly reduced disease compared to the unsprayed control.



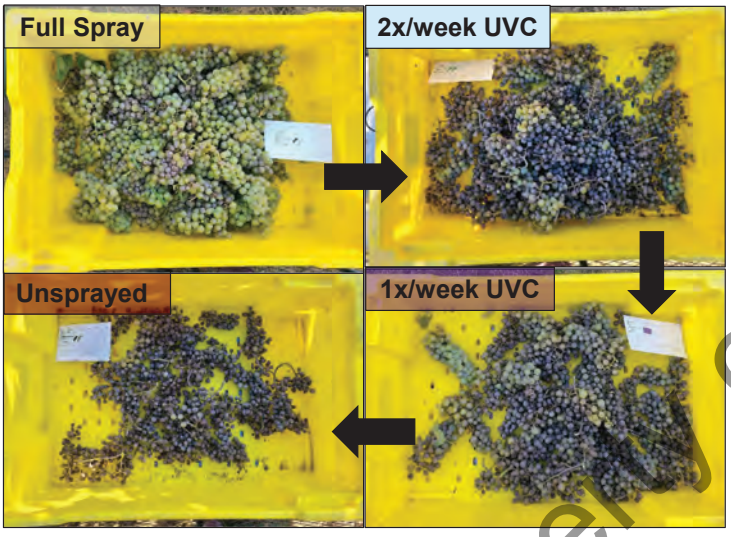


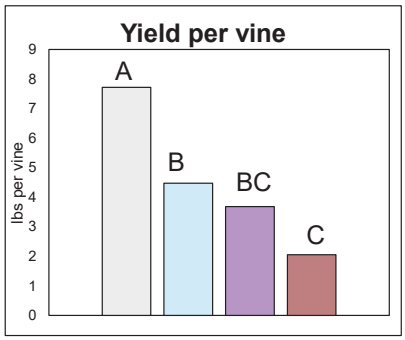

## Yield, berry weight, brix, and pH were effected in 2022 due to the severity of powdery mildew on clusters.

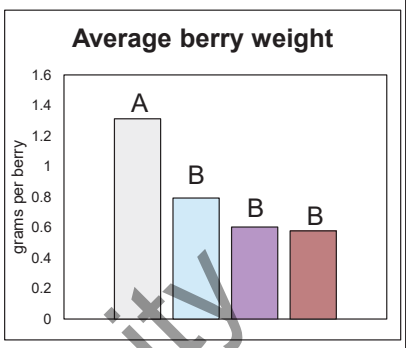
| Quality Metrics Affected in 2020 | | Quality Metrics Affected in 2021 | | Quality Metrics Affected in 2022 | |
|---|---|---|---|---|---|
| ✗ | Yield P=0.31 | ✗ | Yield P=0.26 | ✓ | Yield P=0.002 |
| ✗ | Average Berry Weight P=0.34 | ✗ | Average Berry Weight P=0.70 | ✓ | Average Berry Weight P=0.0001 |
| ✗ | Brix P=0.07 | ✗ | Brix P=0.71 | ✓ | Brix P=0.0001 |
| ✗ | TA P=0.07 | ✗ | TA P=0.68 | ✗ | TA P=0.40 |
| ✗ | pH P=0.36 | ✗ | pH P=0.82 | ✓ | pH P=0.0007 |
| ✓ | Tannins | ✗ | Tannins | ✗ | Tannins |
| ✓ | Phenolics | ✗ | Phenolics | ✗ | Phenolics |

ANOVA, Tukey's HSD

## Quality metrics were affected due to disease severity not UVC treatments. As disease increased yield and berry weight decreased while brix and pH increased.



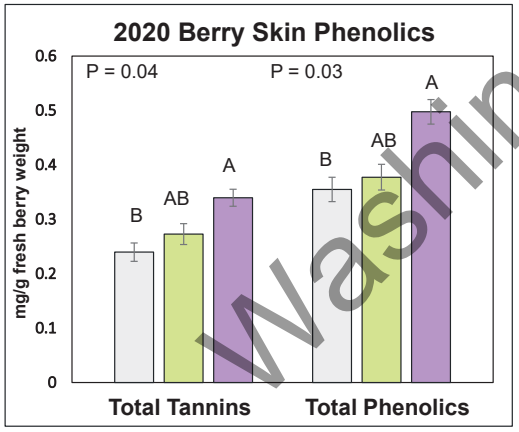

Full Spray | 2x/week UVC | 1x/week UVC | Unsprayed

| Brix | |
|---|---|
| Unsprayed | 27[a] |
| 1x/week UVC | 25[b] |
| 2x/week UVC | 24[b] |
| Full Spray | 22[c] |

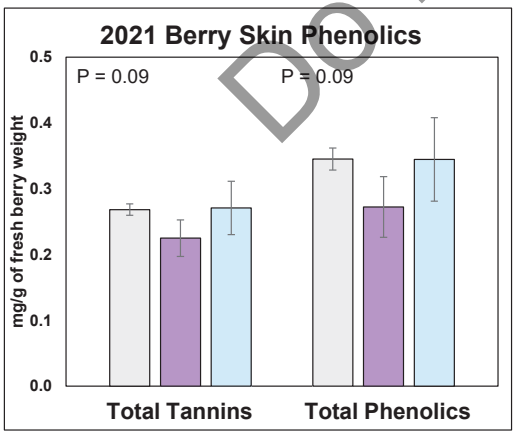
| pH | |
|---|---|
| Unsprayed | 3.8[a] |
| 1x/week UVC | 3.7[ab] |
| 2x/week UVC | 3.5[bc] |
| Full Spray | 3.4[c] |

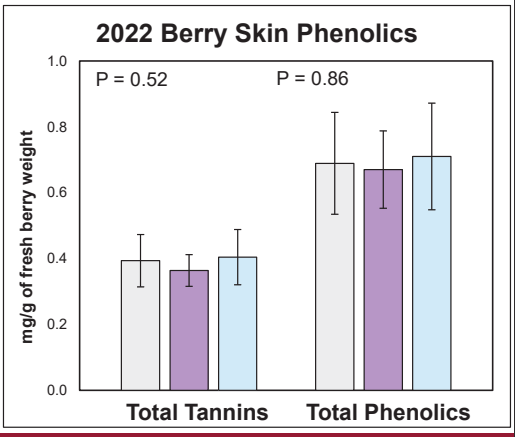


## Tannins and phenolics were inconsistently affected by UVC treatments.




Full Spray | Bi-weekly UVC | 1x/week UVC | 2x/week UVC

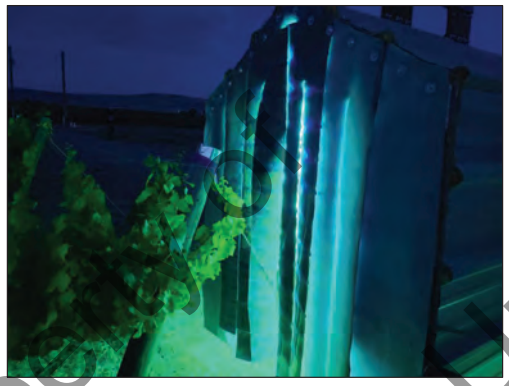



ANOVA, Tukey's HSD

## Take Home

# UVC can be a complementary tool for powdery mildew disease management in Eastern WA.




## With any new adoption to a tool, the potential pros and cons must be addressed.

### Pros

- Can be used in rain and wind
- Immediate reentry to field
- Can fit into sustainability pest management programs

### Cons

- Potential increase to labor and equipment use
- New management tool; barriers to add into current practices
- Unknown effects to beneficial insects in vineyard

## Acknowledgements

### Moyer Lab (WSU)

**Past and Present**

- Maria Mireles
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- Polet Torres
- Dr. Charlotte Oliver
- Dr. Margaret McCoy
- Dr. Katherine East

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- Dr. Michelle Moyer
- Dr. Lav Khot
- Dr. Tom Collins
- Dr. Lisa DeVetter

VineTech Equipment

WA 46°N WINE

Cornell University

**Dr. David Gadoury**

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## Questions?

For additional UVC resources

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