Updates from Fire Blight field research at Cornell AgriTech

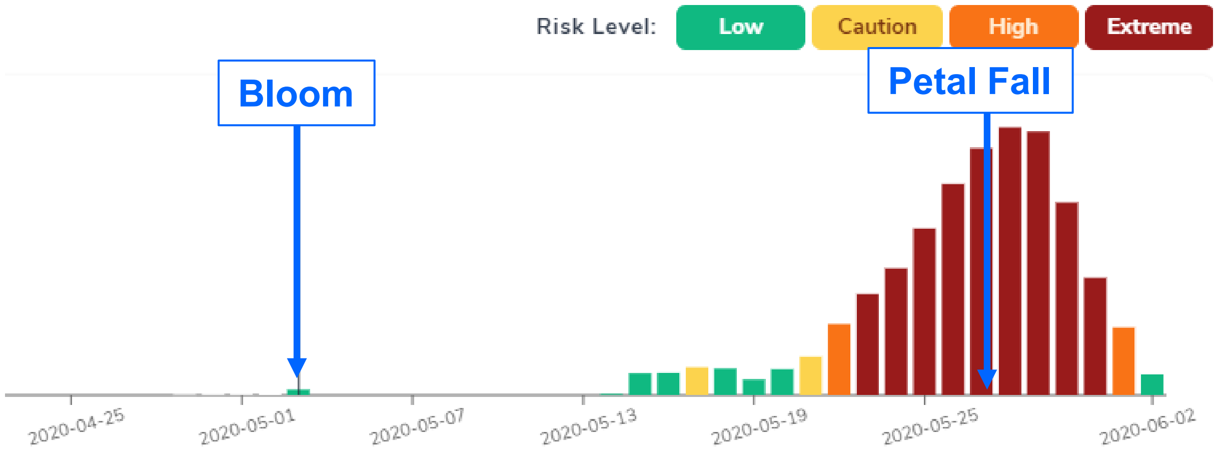
Kerik D. Cox, McKenzie Schessl, & Isabella Yannuzzi
Cornell AgriTech

Plant Pathology and Plant-Microbe Biology Section
School of Integrative Plant Science
Cornell University

Cornell AgriTech
New York State Agricultural Experiment Station

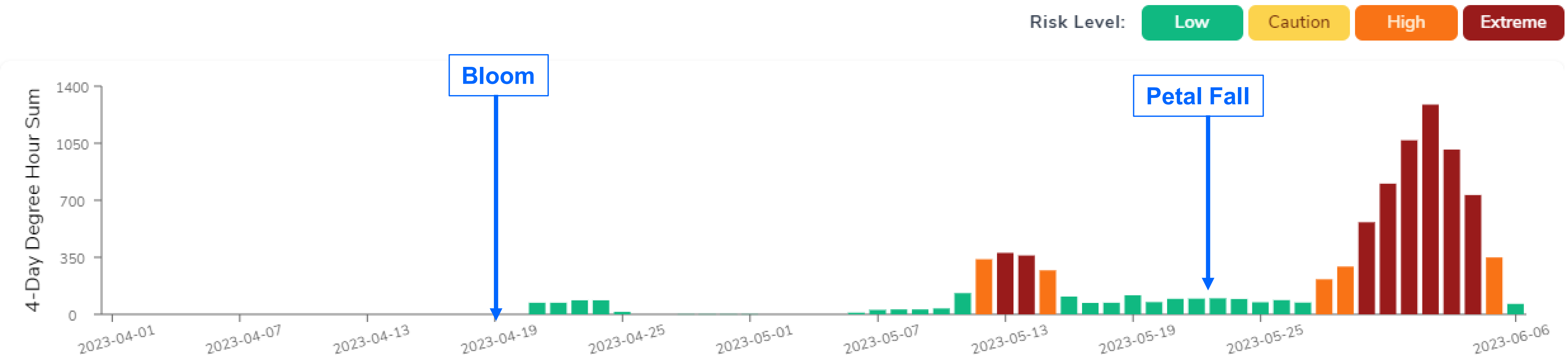
Fire Blight

- High-density tall/super spindle plantings (1000 – 1200/A) = high-value/vigor acreage
- Young productive trees: protracted bloom & vigorous susceptible shoot tissue
- New popular scion varieties susceptible
- Seasons warmer weather from bloom to terminal bud set



Fire Blight WNY 2023

- Cold bloom, warm weather well after petal fall



- Fire blight in young plantings in Sept (following heat wave)

Fire Blight Trials

Pruning practices for fire blight management

Fire Blight Trials at AgriTech

- Orchard sites (RCB design –wide spacing)

  ‘Gala’ trees on B.9 planted in 2000

Blossom Blight Trials

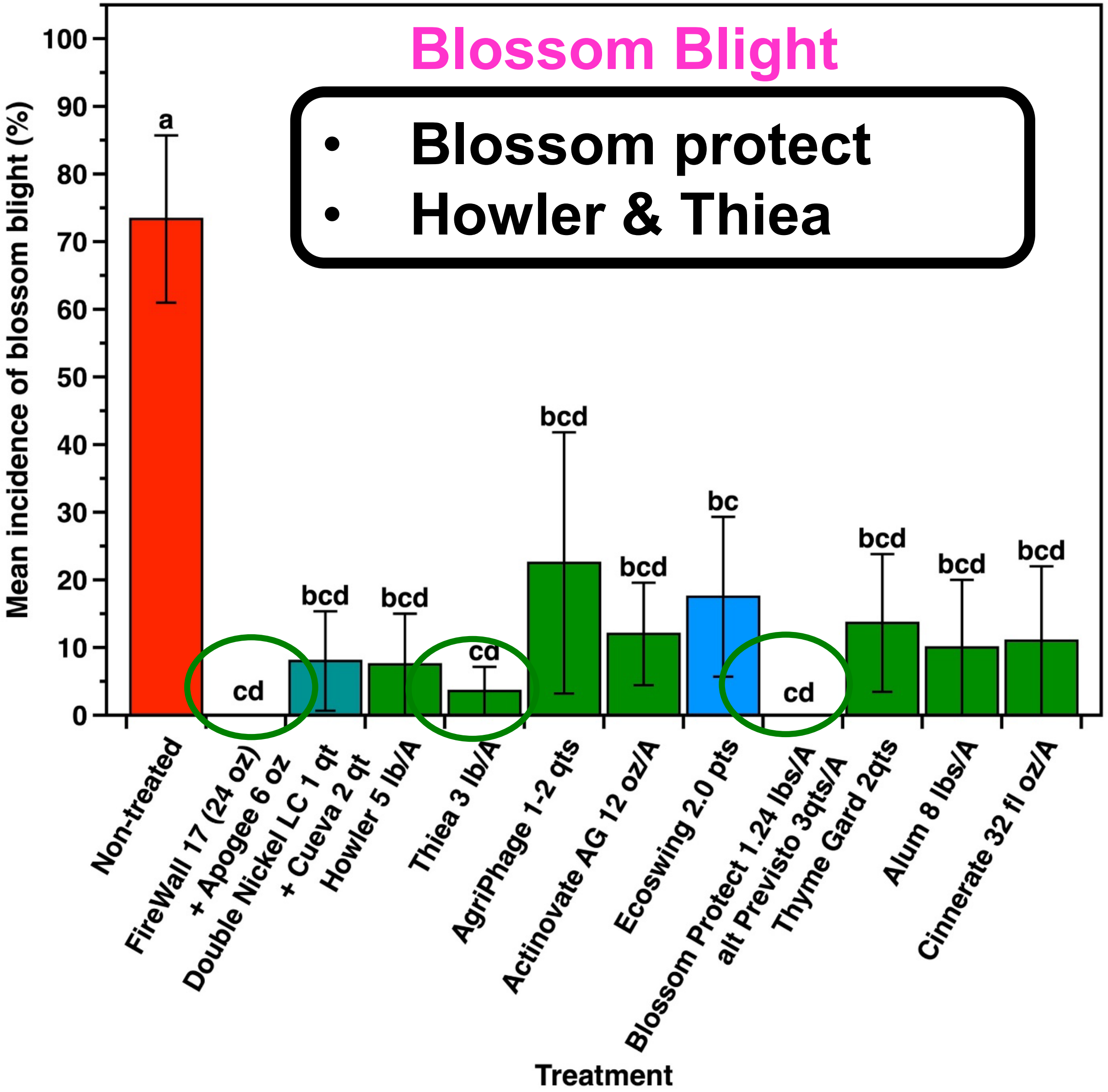
- Blossom blight application timing
  - Pre-bloom timings for biopesticides (SARs)
  - All antibiotics & biopesticides @ 80% bloom (20-40% bloom)
  - (Ea 273 at $1x10^6$ CFUml^{-1}) @ 80% Bloom

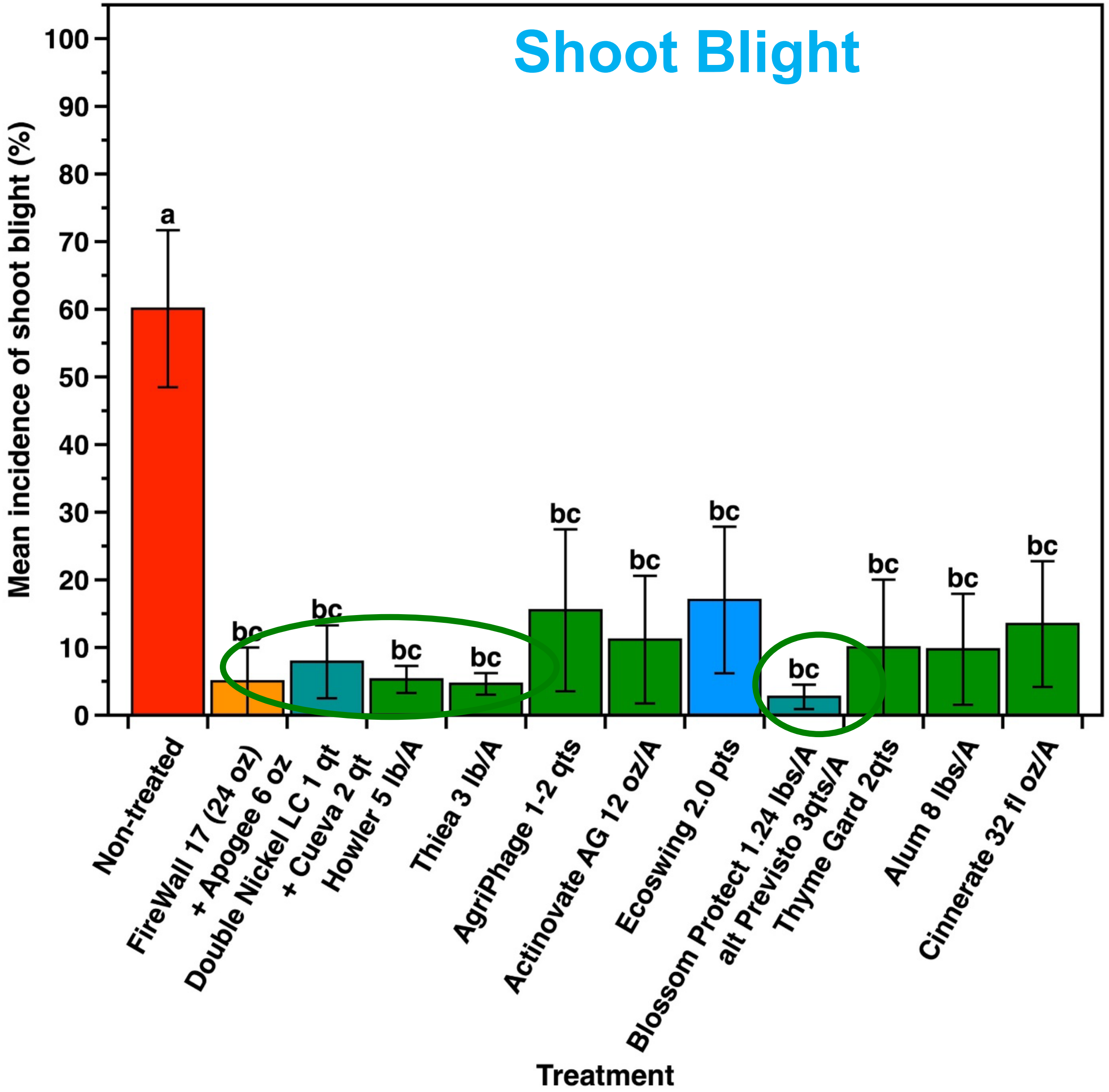
- Blossom blight incidence: percentage of blighted blossoms (5-6 reps)

Shoot blight trials

- Shoot blight application timing
  - Natural infection from blossom blight infections
  - Apogee (PF/1-2”) & SARs (Actigard, Lifegard, Regalia)(2-5 days prior)
- Shoot blight: progression of cankers or percentage of blighted shoots/tree

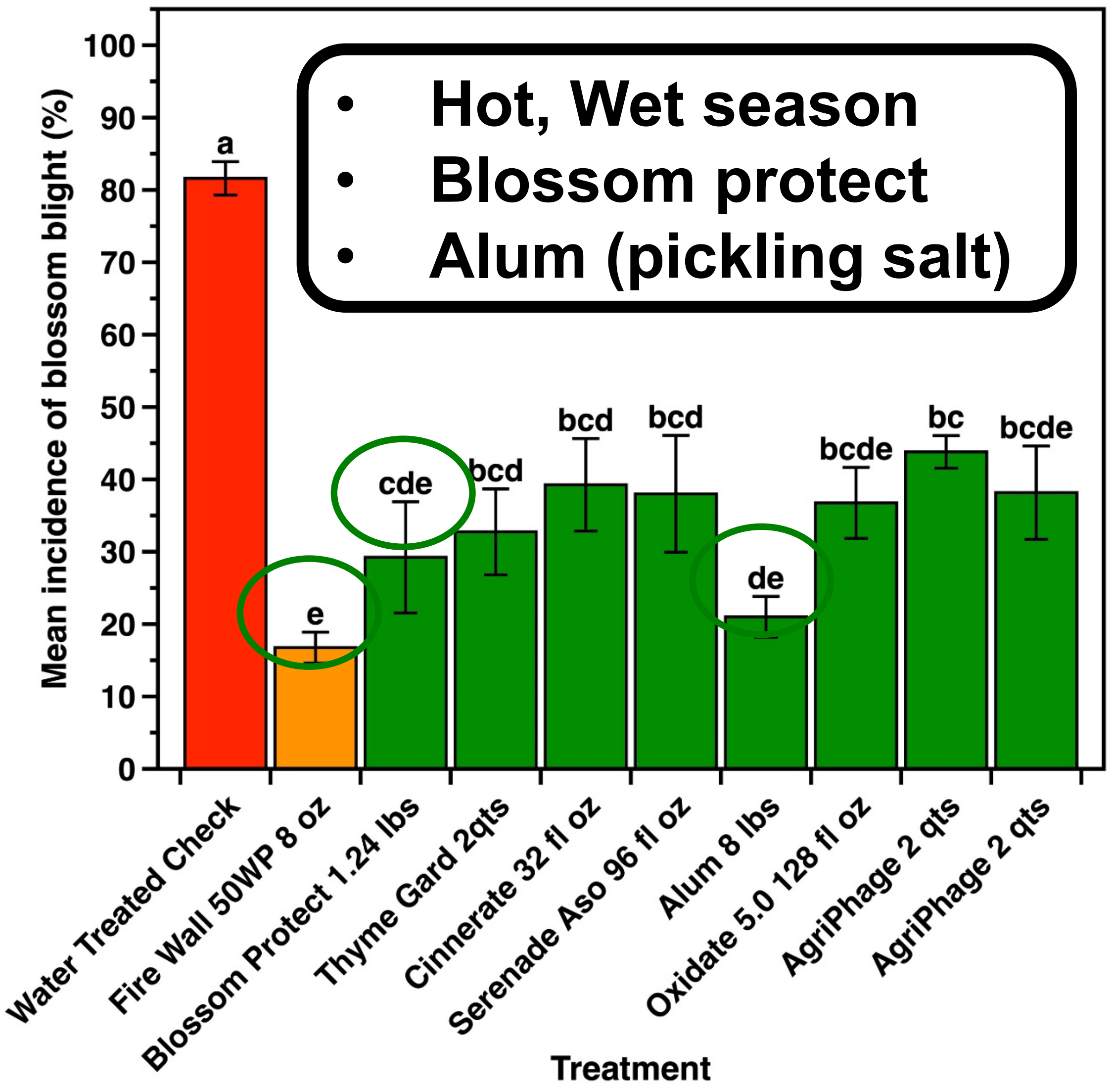
Trials at AgriTech – Biologicals 2021



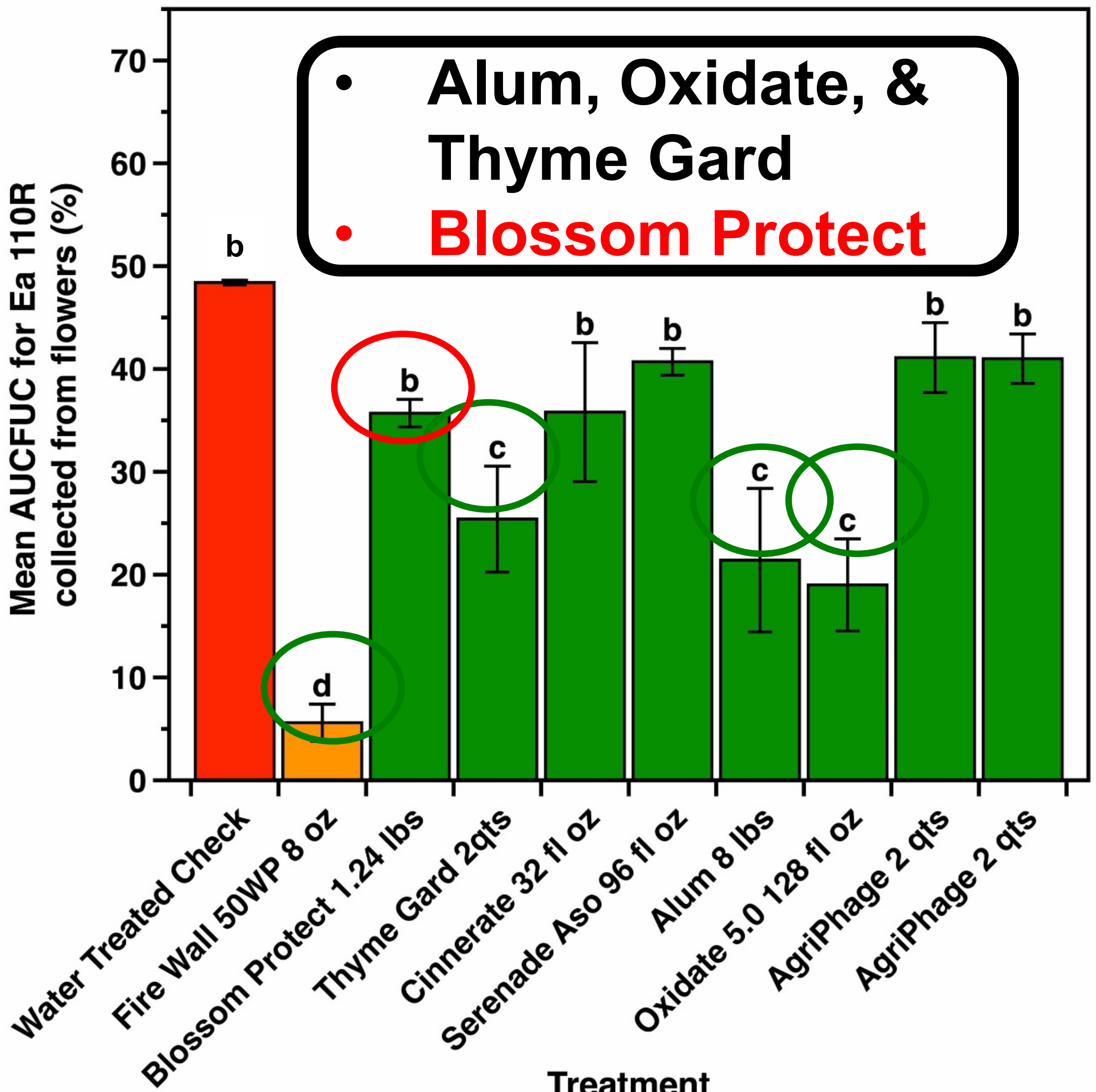


Trials at AgriTech – Biologicals 2022

Blossom Blight

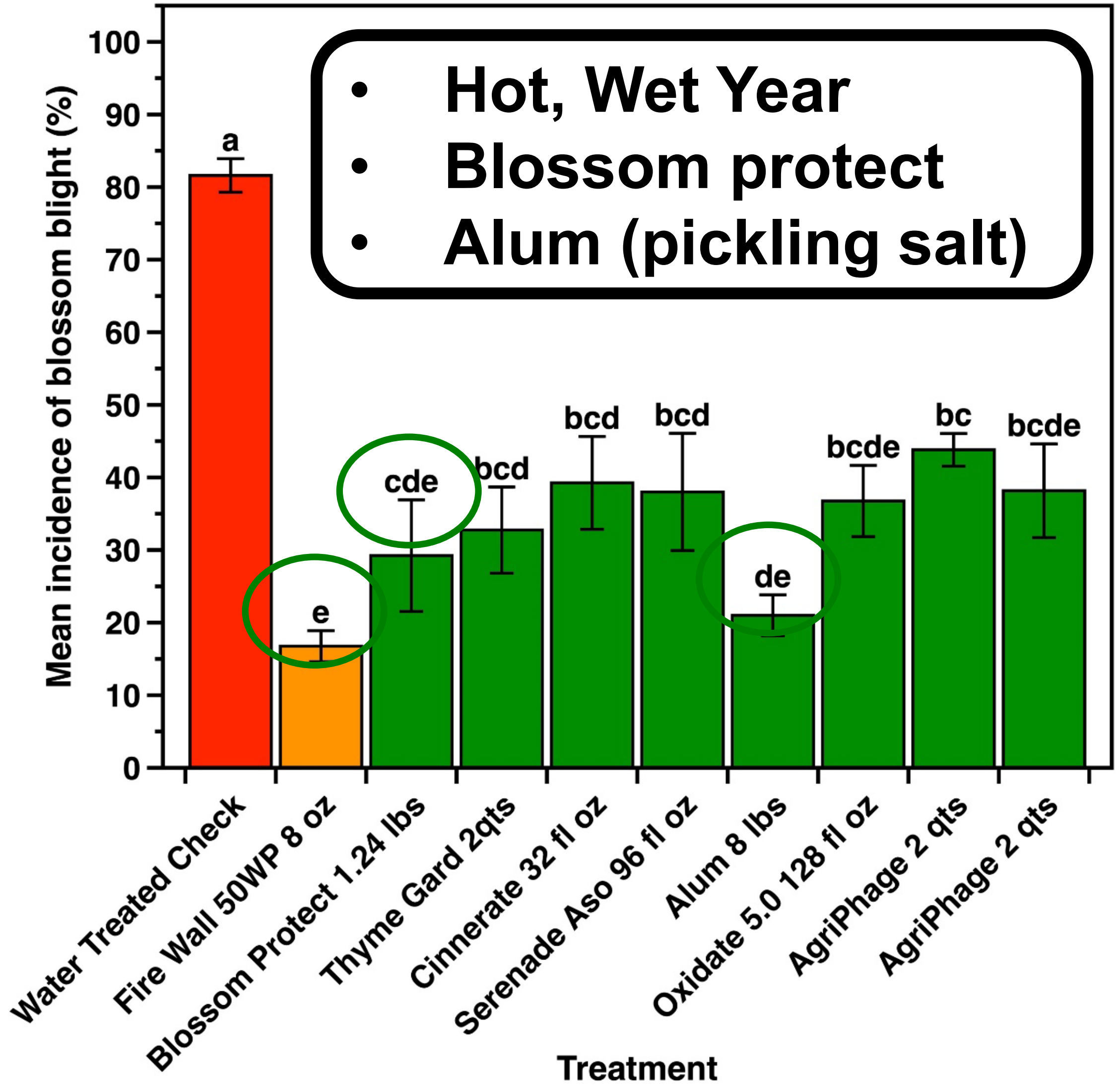


Blossom Populations

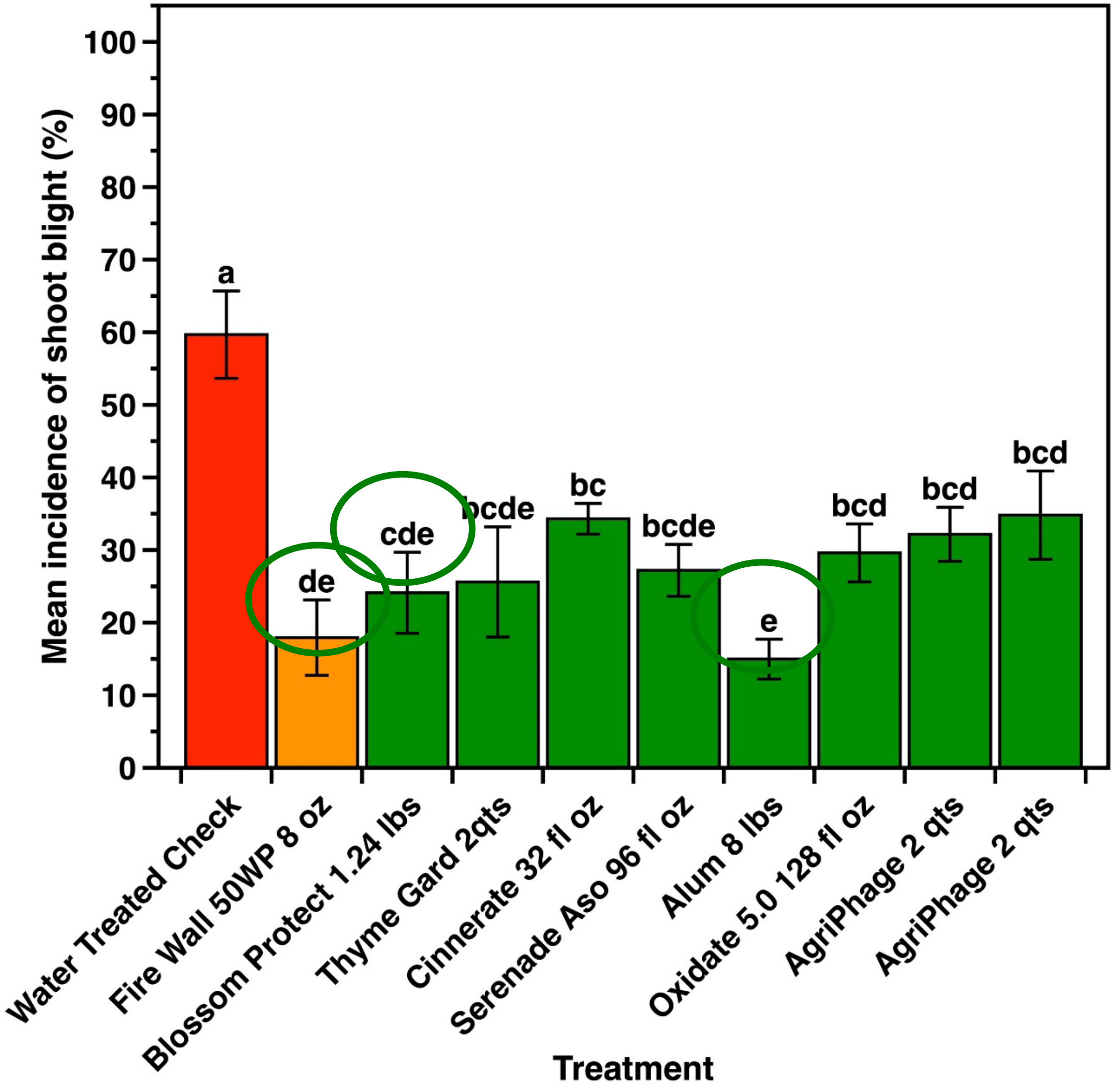


Trials at AgriTech – Biologicals 2022

Blossom Blight

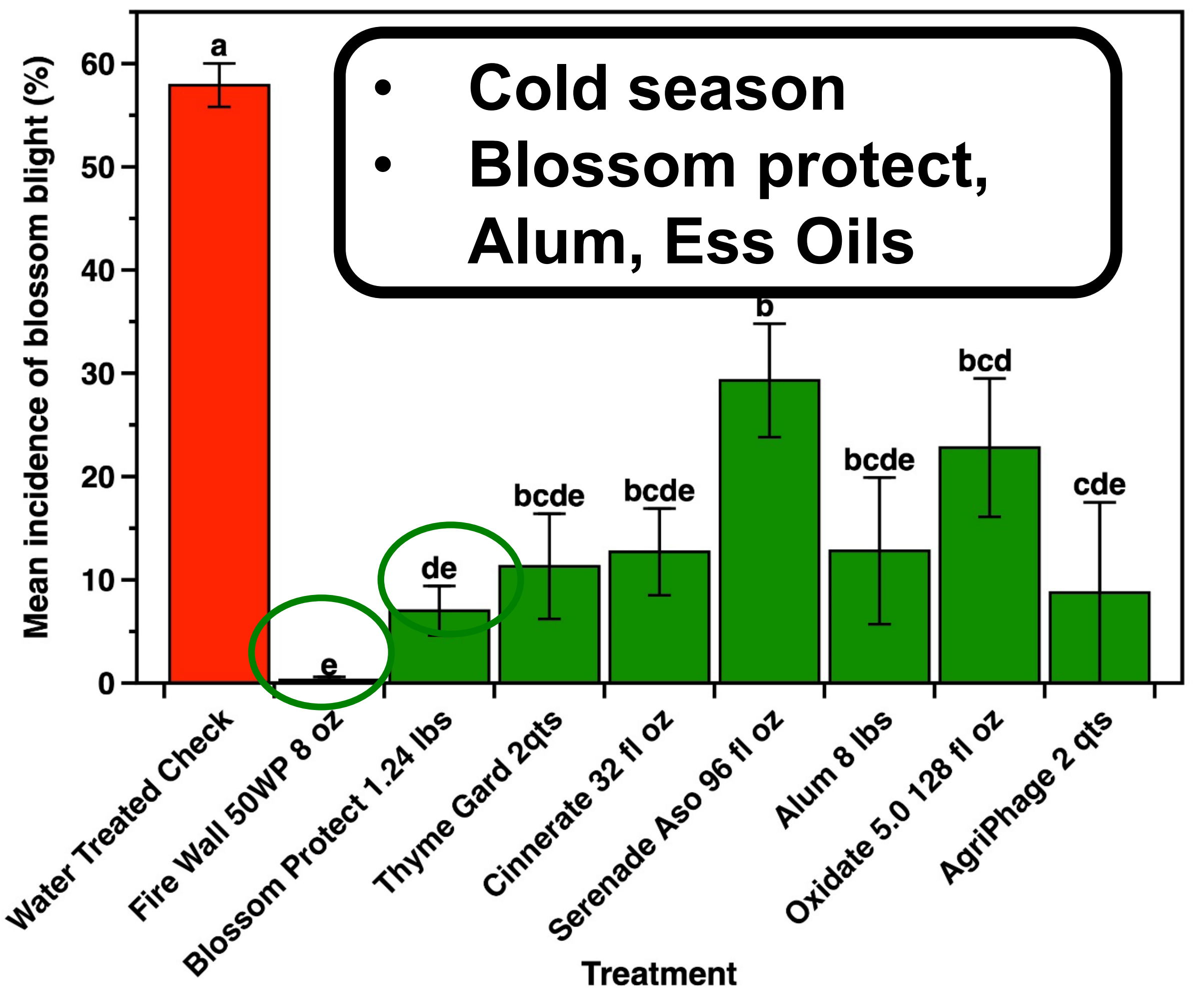


Shoot Blight

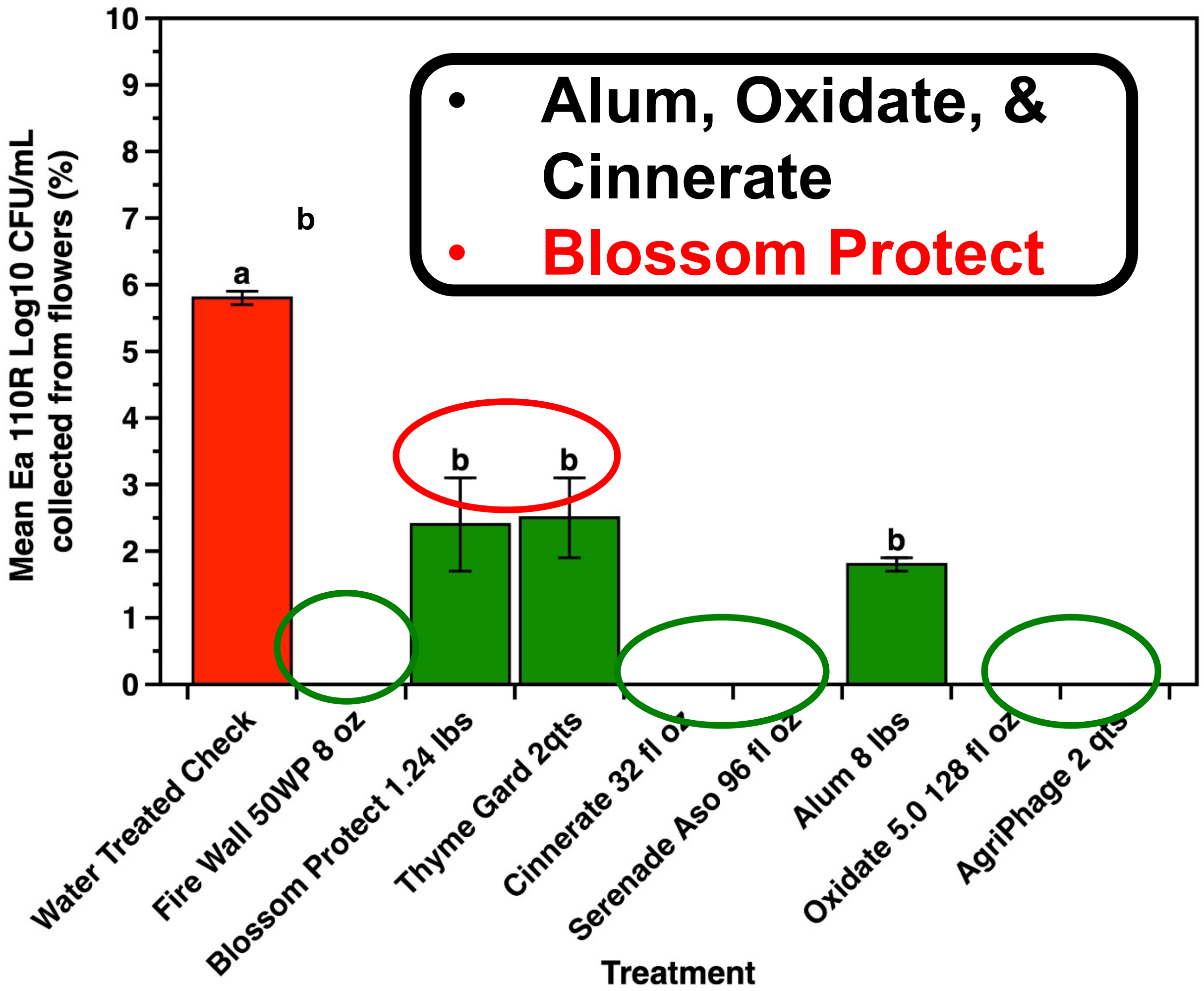


Trials at AgriTech – Biologicals 2023

Blossom Blight

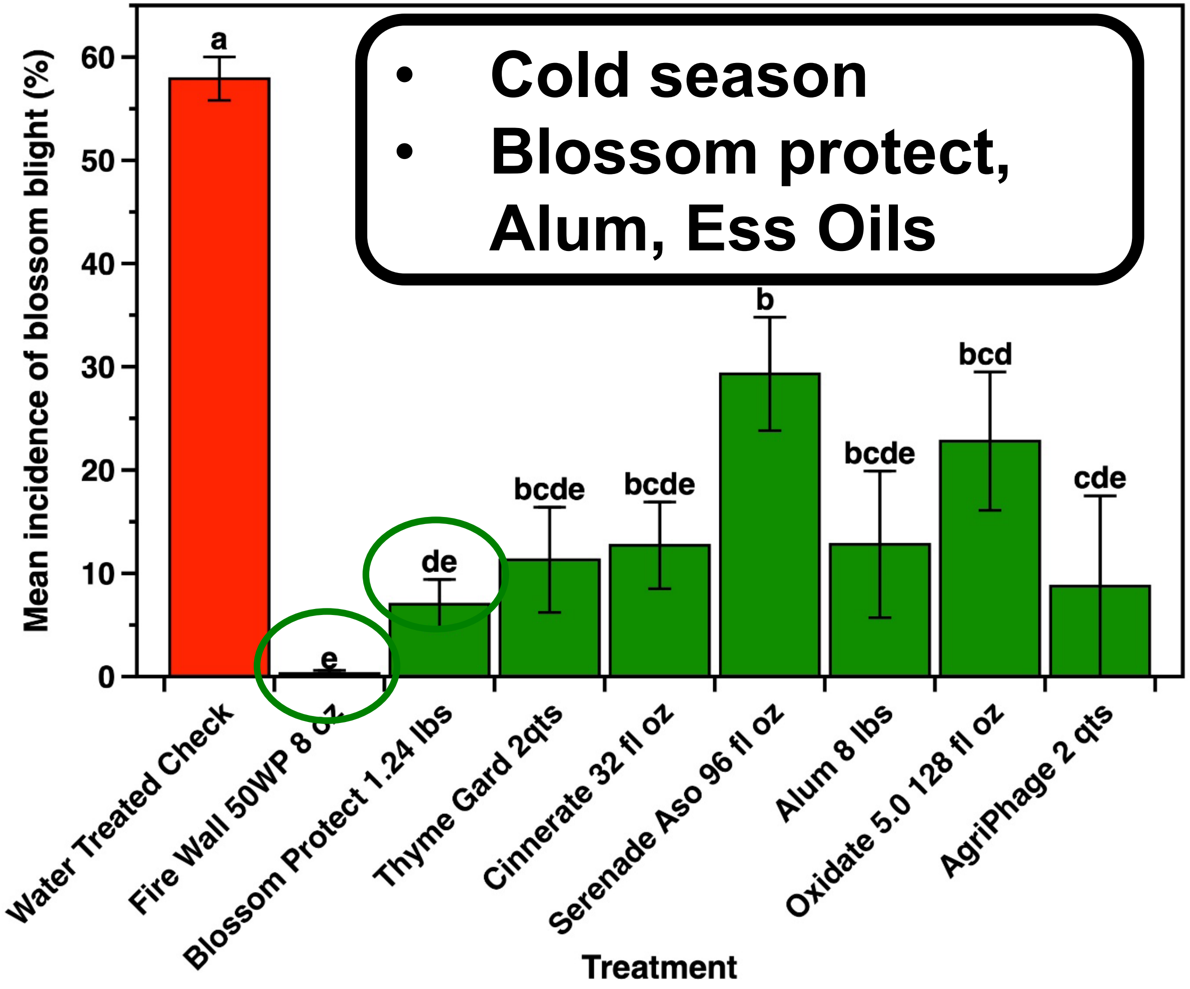


Blossom Populations

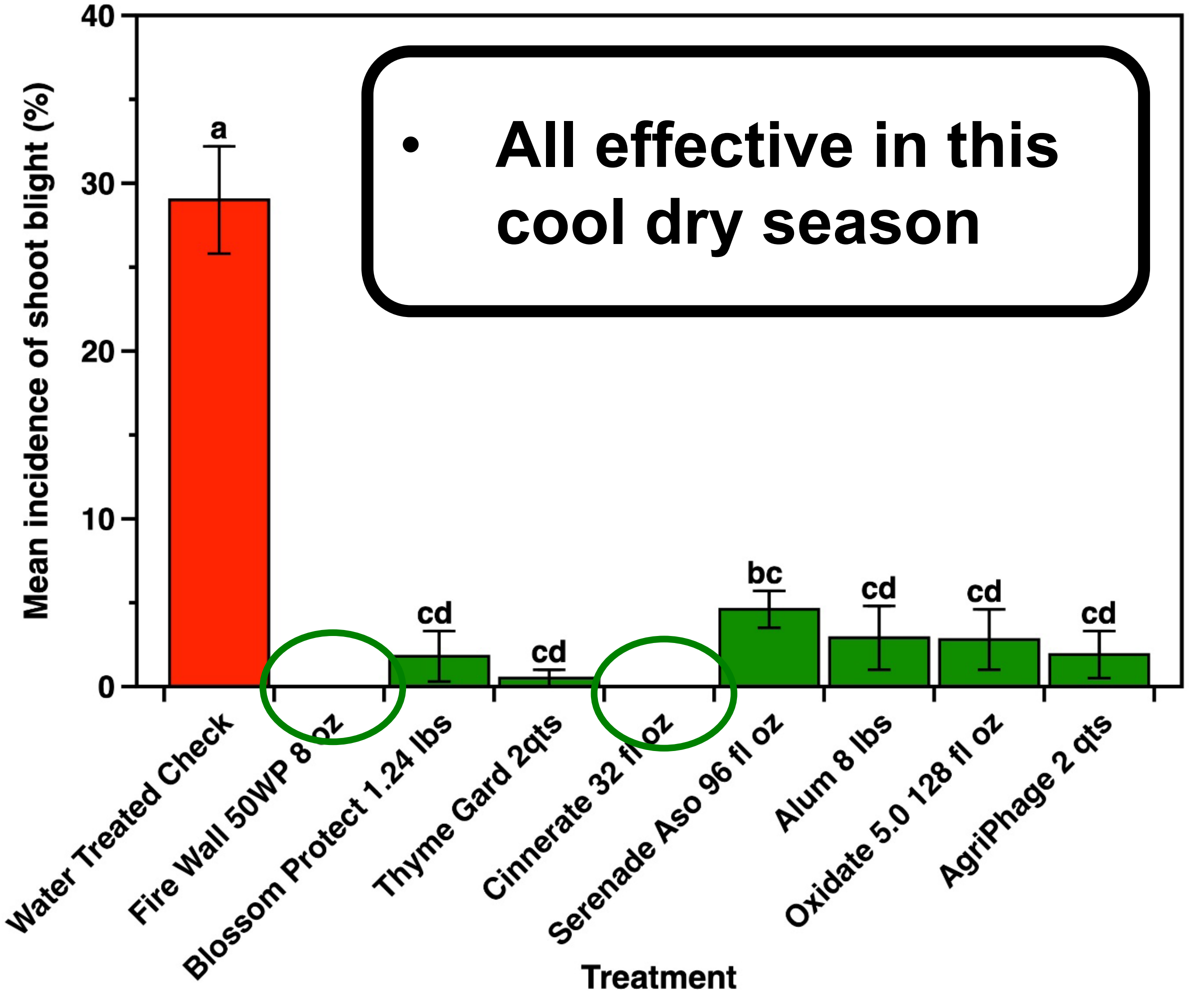


Trials at AgriTech – Biologicals 2023

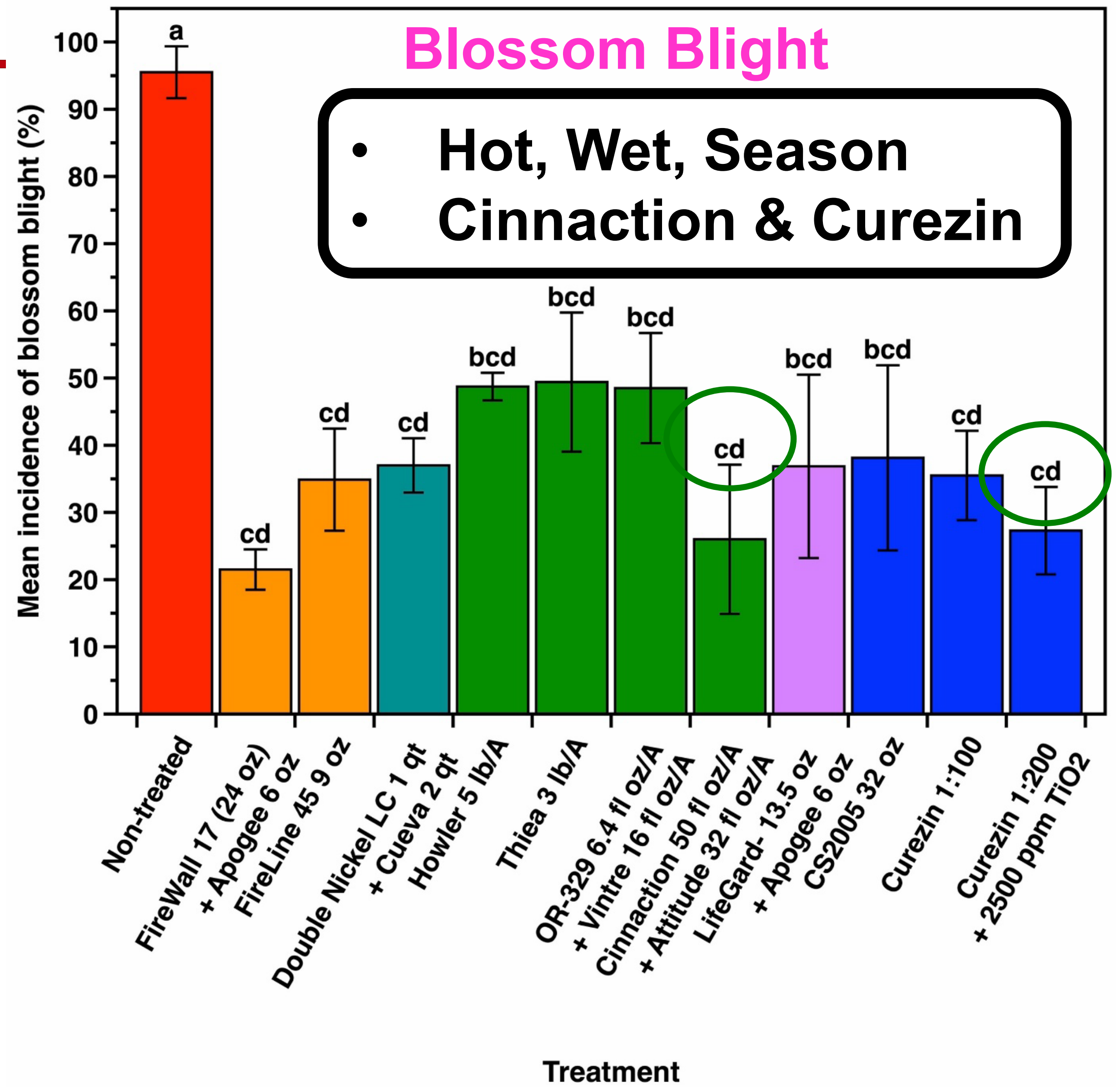
Blossom Blight

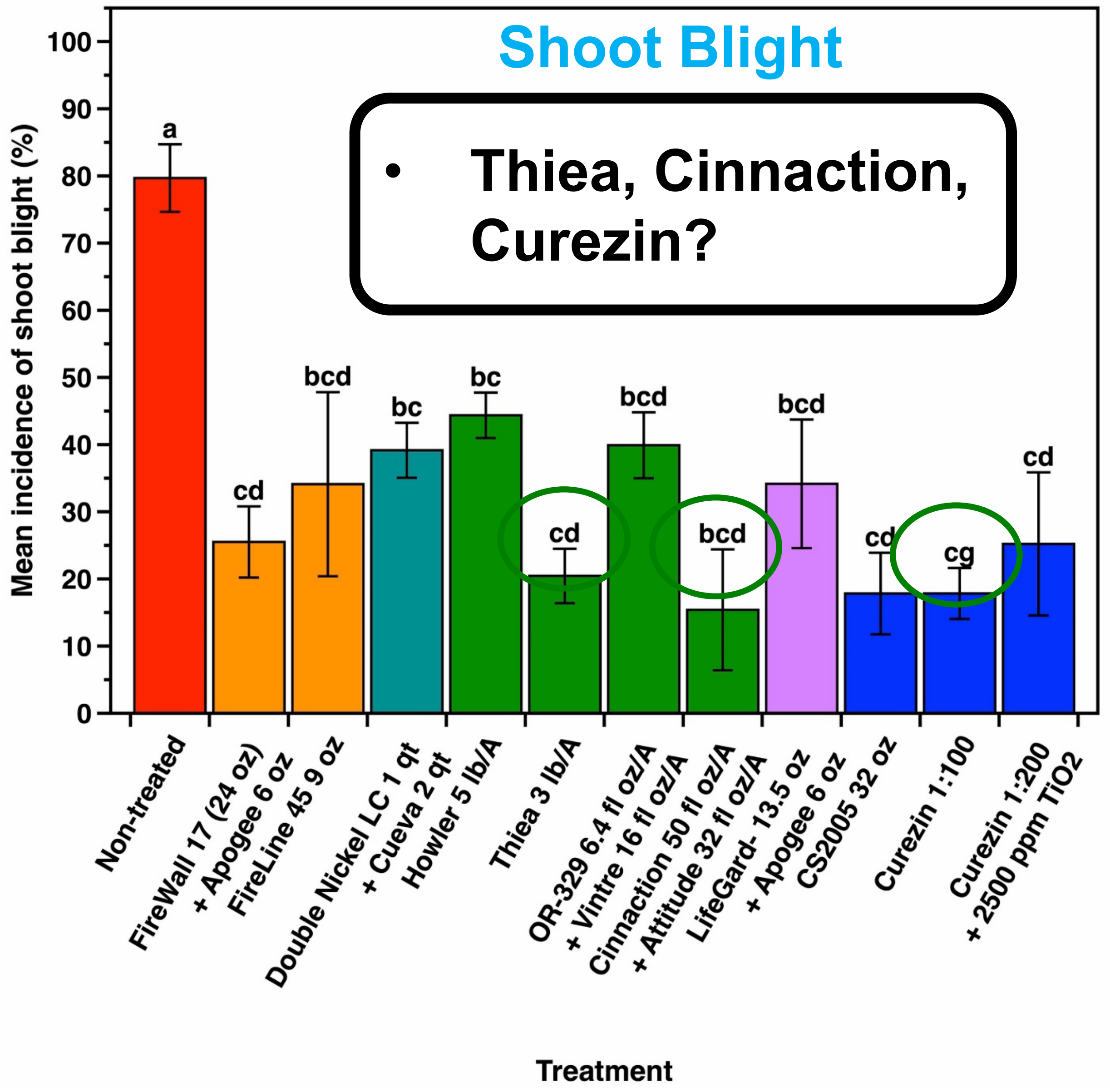


Shoot Blight



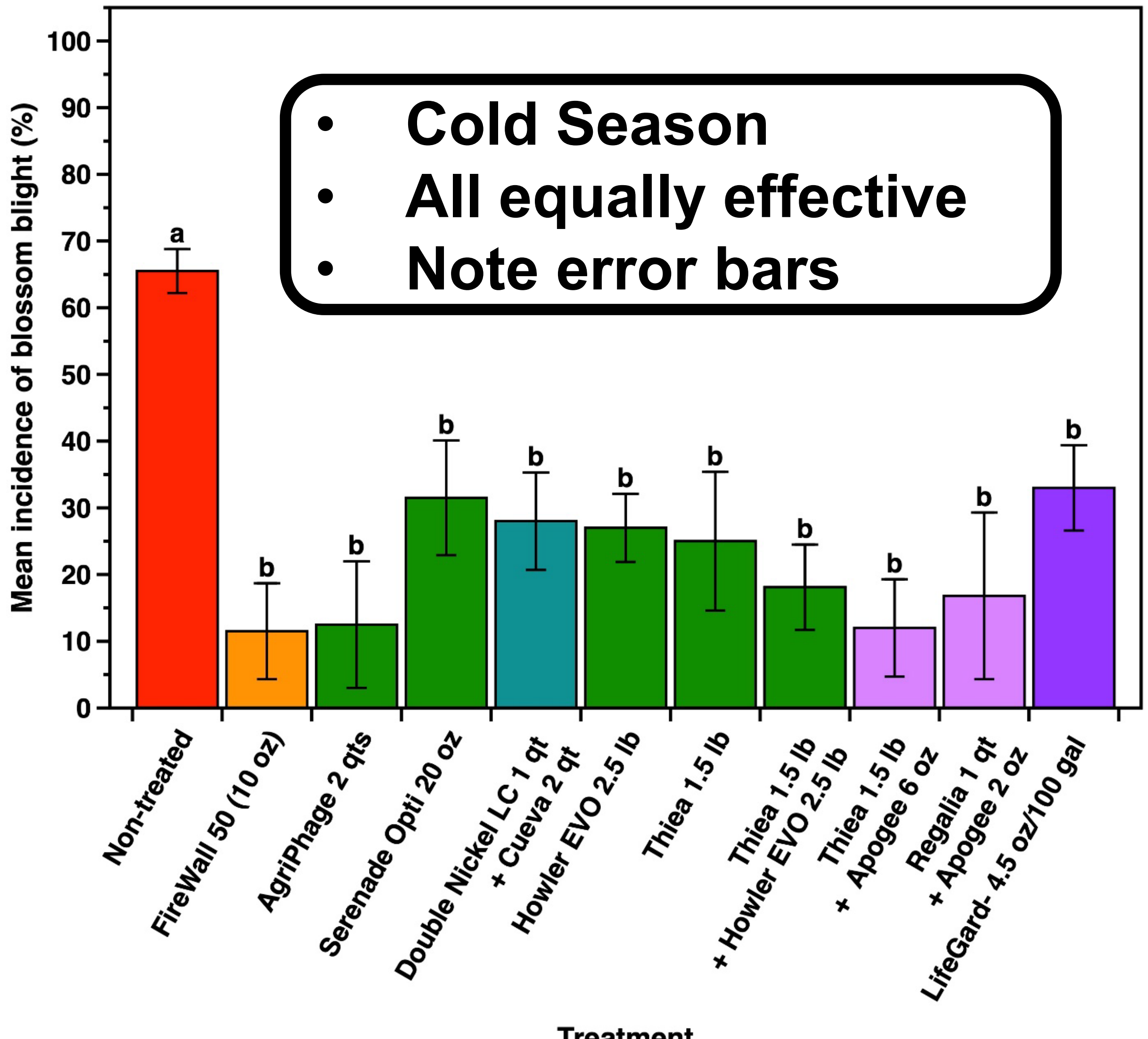
Trials at AgriTech – Assorted 2022



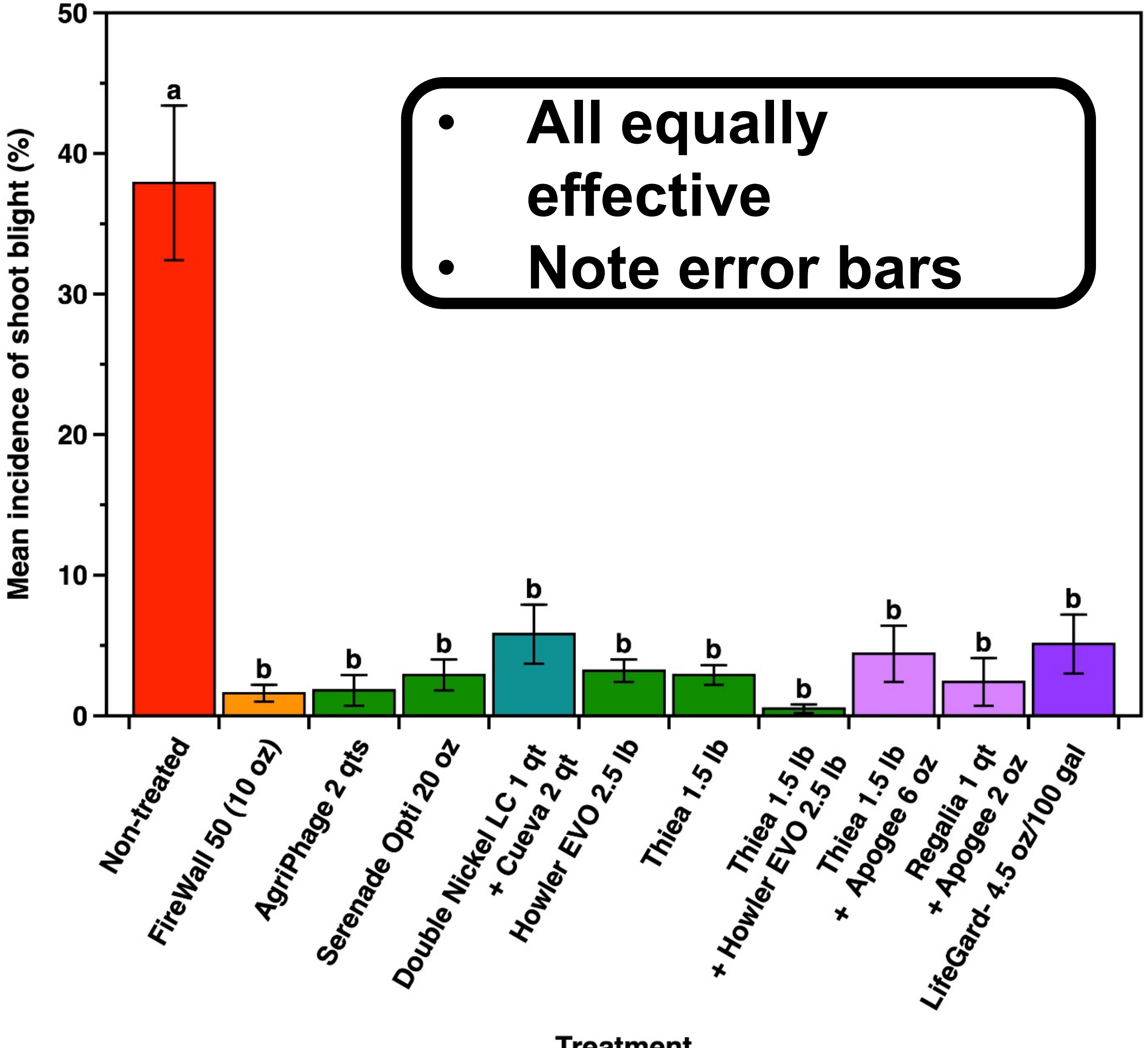


Trials at AgriTech – Assorted 2023

Blossom Blight

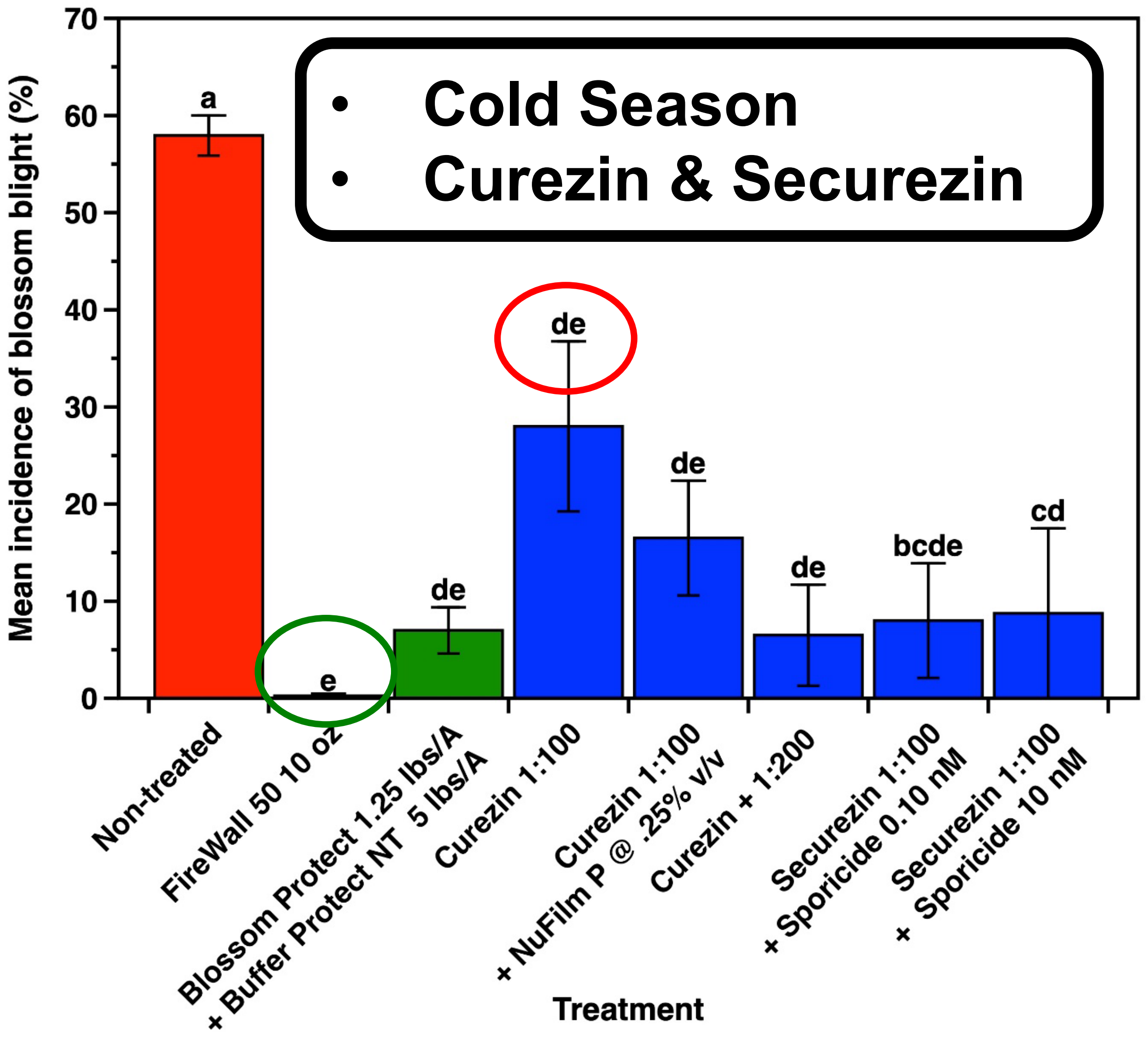


Shoot Blight

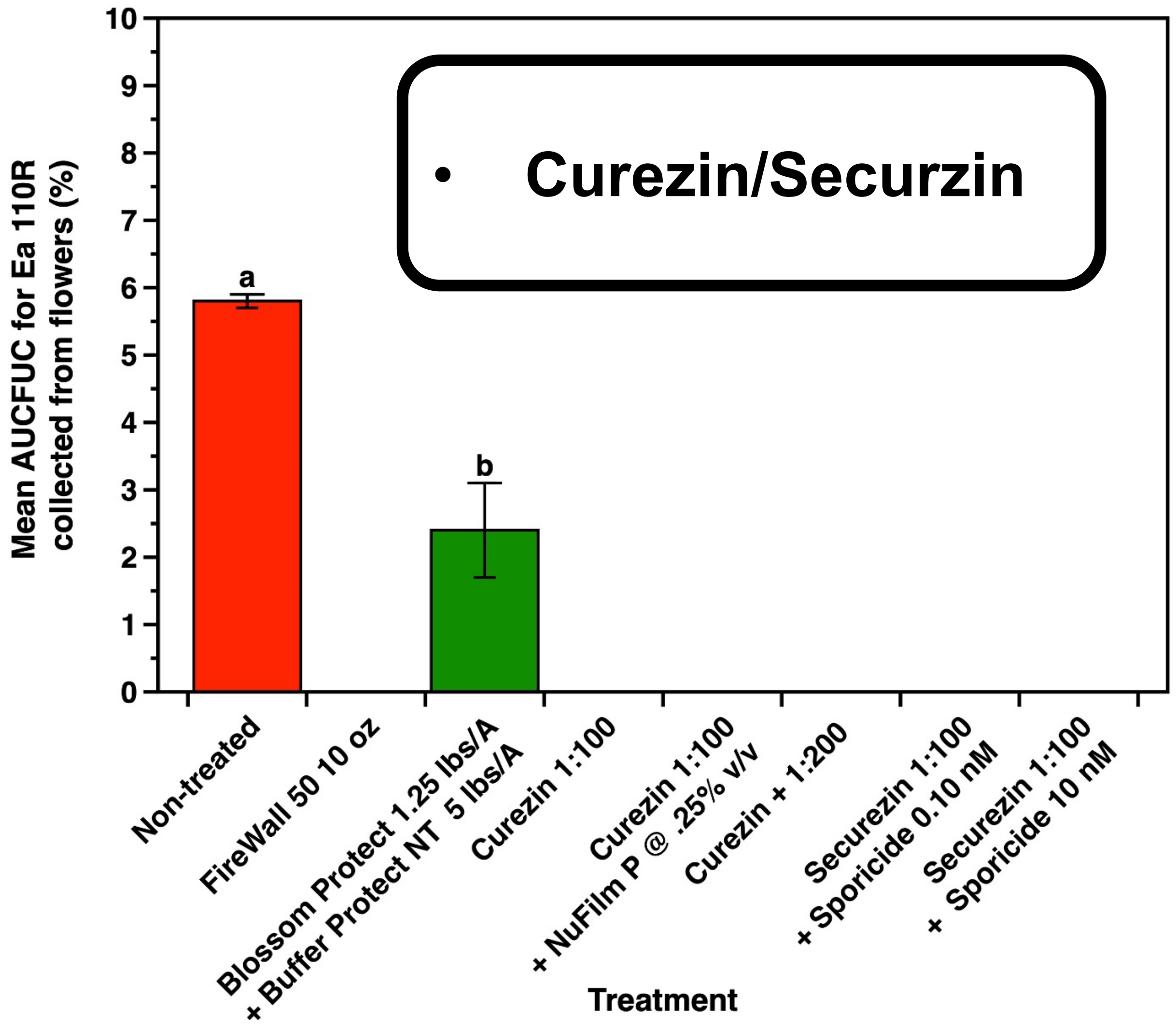


Trials at AgriTech – Copper 2023

Blossom Blight

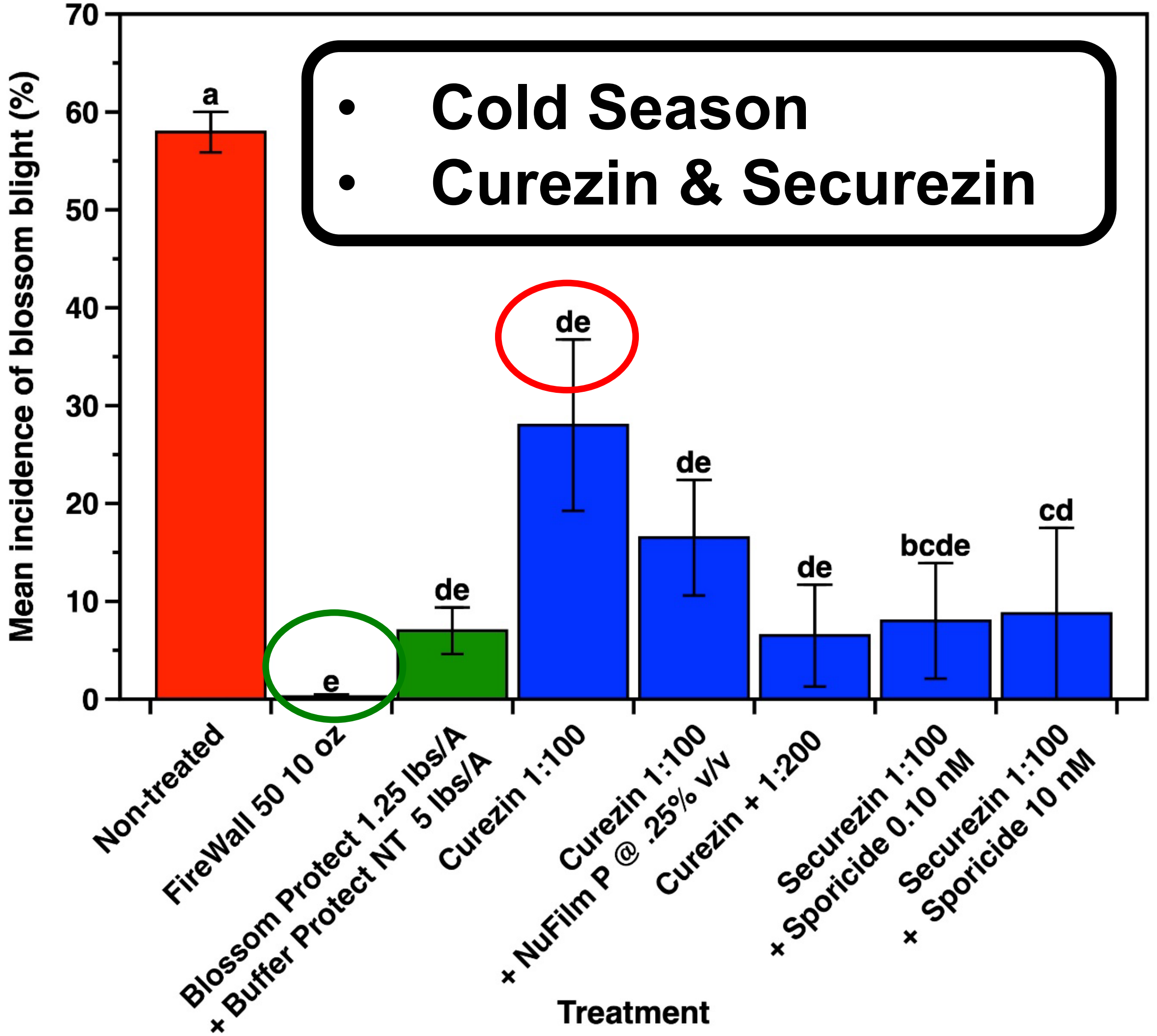


Blossom Populations

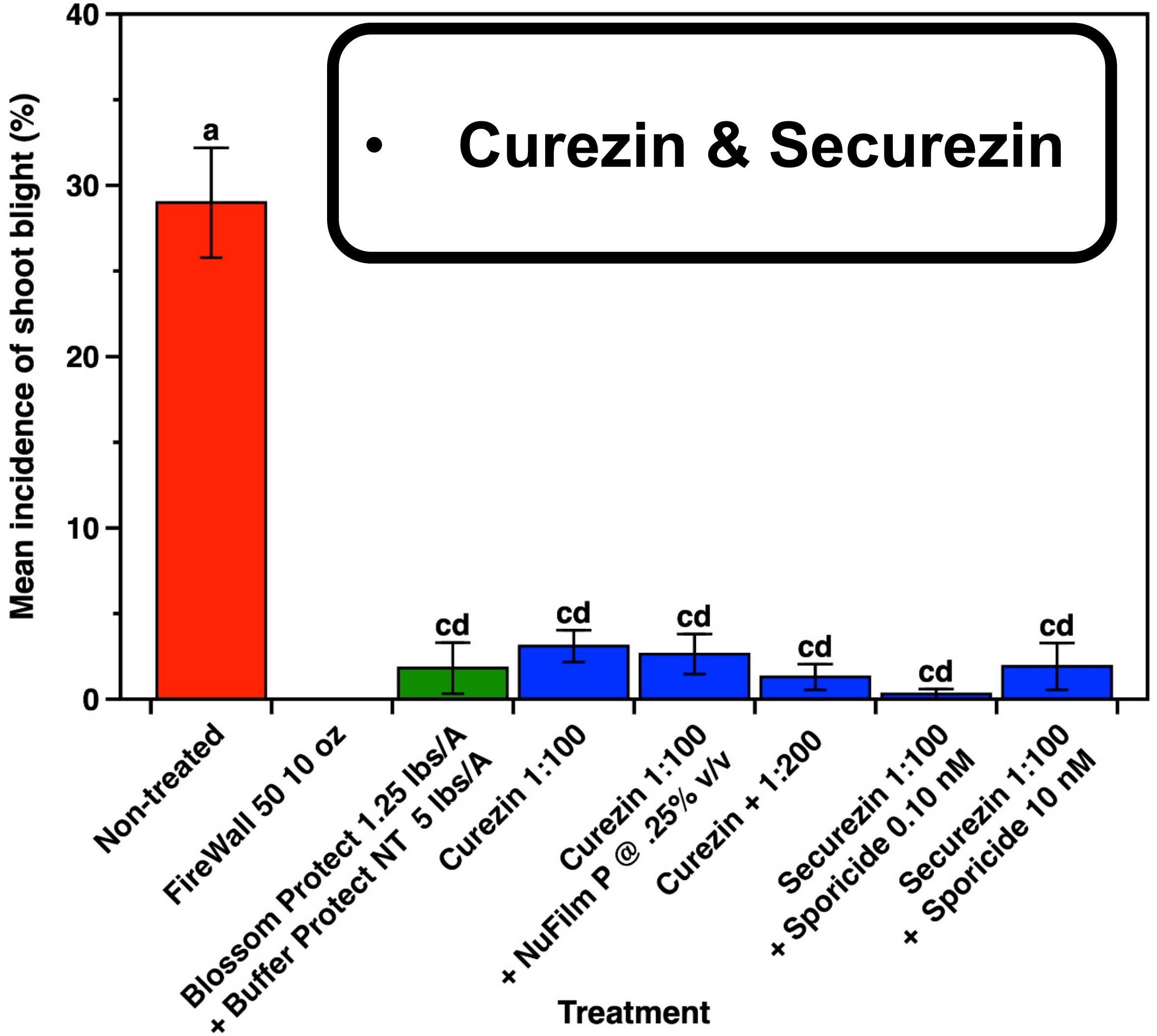


Trials at AgriTech – Copper 2023

Blossom Blight



Shoot Blight



Biologicals and SARS Takeaways

- **Biologicals**
  - Blossom Protect effective
  - Howler & Theia look promising
  - Alum (similar in MI, NC, WA, and OR in 2021 - 2023)
- **SARS**
  - Similar performance from LifeGard & Regalia/ combination w/Apogee
- **Curezin/Securezin**
  - Low MCE copper enhanced w/zinc – remove epiphytic populations

Fire Blight Trials

Pruning practices for fire blight management

Pruning practices to mitigate systemic spread of fire blight

- Pruning shoot blight = frustrating, labor intensive & must occur on cool dry days – rare in summer months

- Pruning can stimulate shoot growth & systemic movement of fire blight bacterium to actively growing shoot tips

- PhCa may prevent shoot stimulation & systemic movement shoot following pruning

Pruning practices to mitigate systemic spread of fire blight

- Conflicting opinions on the use of sterilizing pruning equipment between pruning cuts

- Shoot breaking is also a popular practice for fire blight removal given the ease of implementation

- Breaking exacerbate shoot blight or prevent it by damaging vascular tissue?

Pruning Trial Site at Cornell AgriTech

- Orchard sites (Tall Spindle, widely spaced)

  'Gala' trees on B.9 planted in 2000

Pruning Trial Site at Cornell AgriTech

- Orchard sites (High-density)
- ‘RubyFrost’ on G.41 planted in 2019
- Replicated plot panels (RCB): 6 reps w/ five trees each

Pruning practices to mitigate systemic spread of fire blight

Inoculated, but left unpruned

Wilting, oozing, and potentially lead to spread of fire blight throughout the plant & plot

Pruning practices to mitigate systemic spread of fire blight

<u>Best Management Practice (BMP):</u> Prune 4” inches into 2nd year wood (Positive control)

Pruning practices to mitigate systemic spread of fire blight

Breaking: Shoots are manually snapped off into 2nd year wood by hand

Pruning practices to mitigate systemic spread of fire blight

Prune flush to the leader (HD)

Pruning practices to mitigate systemic spread of fire blight

Prune flush to the leader (TS)

Pruning practices to mitigate systemic spread of fire blight

Prune to 4” stub

Pruning practice across all treatments

- Post PF, 6-7” growth of 1st year shoots
- Scissor cut growing tips (10^6 CFU/mL)
- Wait for symptoms & implement pruning practices
- Incidence of shoot blight & progression of cankers

Ancillary practices used with pruning

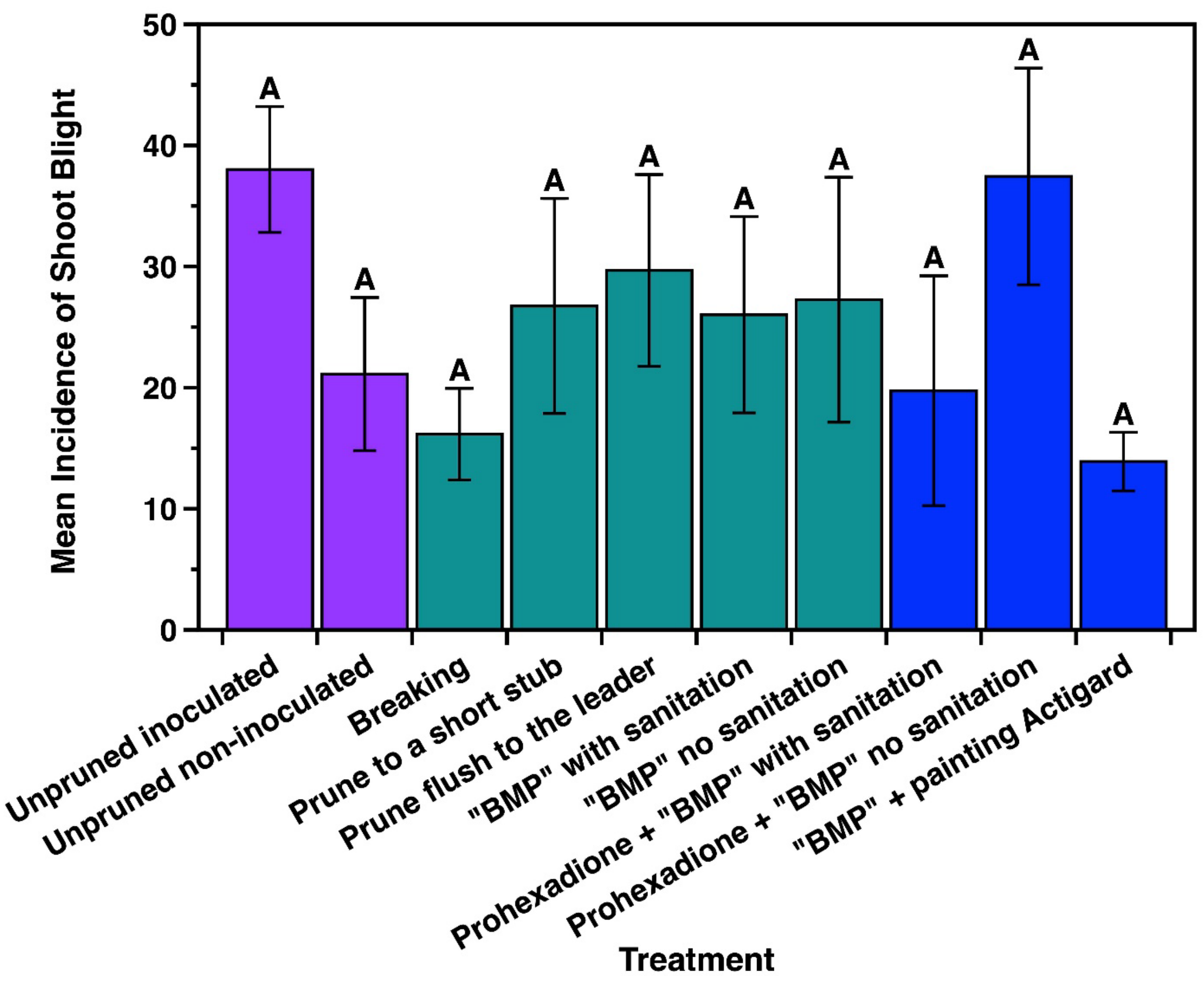
- Post PF, 6-7” growth of 1st year shoots
- Apogee (6 oz/100)
- Scissor cut growing tips (10^6 CFU/mL)
- Wait for symptoms & implement pruning practices (sanitation y/n)
- Actigard paint (1 oz/qt)
- Incidence of shoot blight & progression of cankers or

Pruning practices to mitigate systemic spread of fire blight

Actigard + BMP: Paint Actigard (1 oz/qt with 1% Regulaid) at site of infection at time of removal

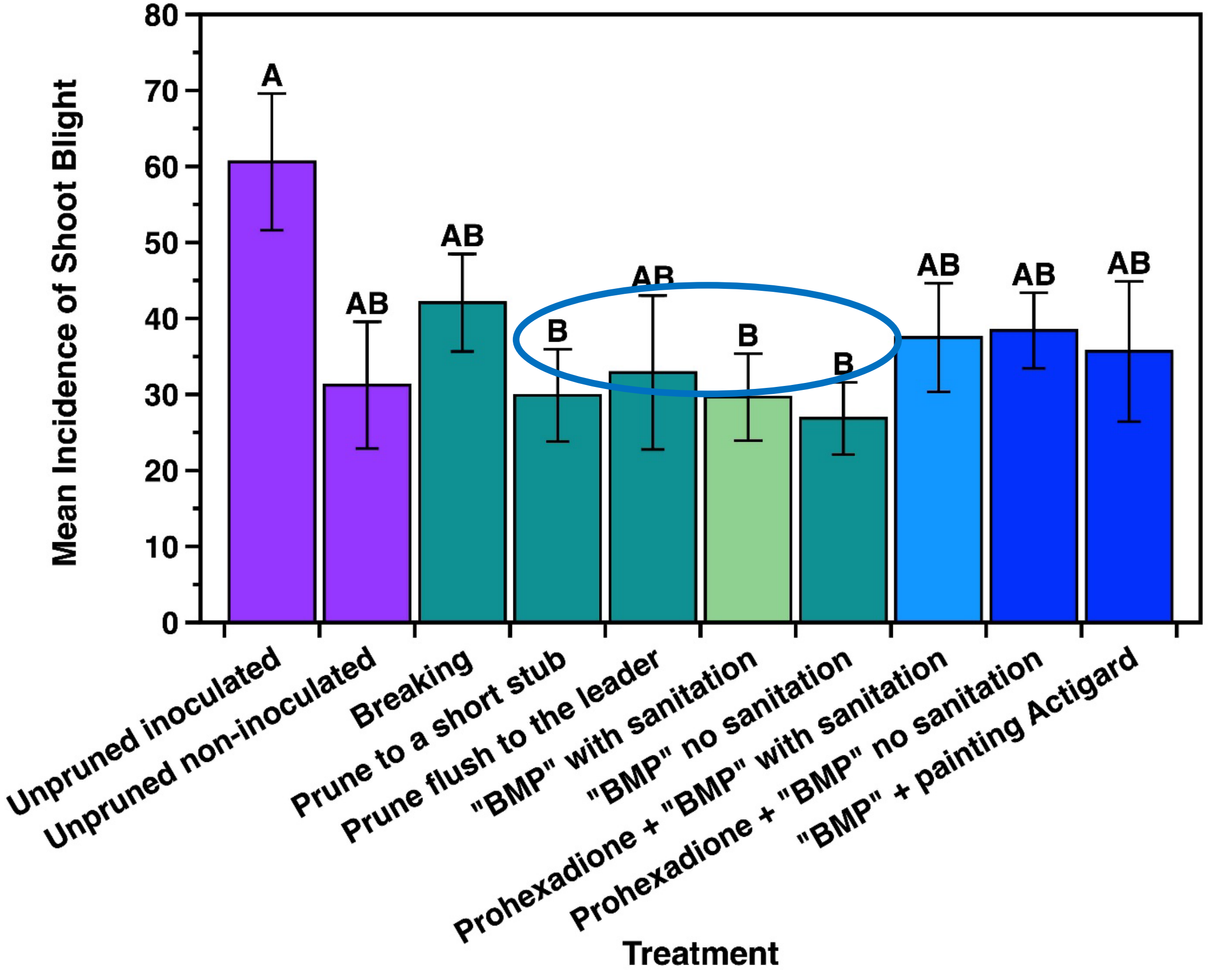
Pruning young high density 2021

- Symptoms developed < 5 days & shoot blight widely prevalent < 7 days
- Internal spread & infection to neighboring trees
- Systemic movement less than 4-5 days



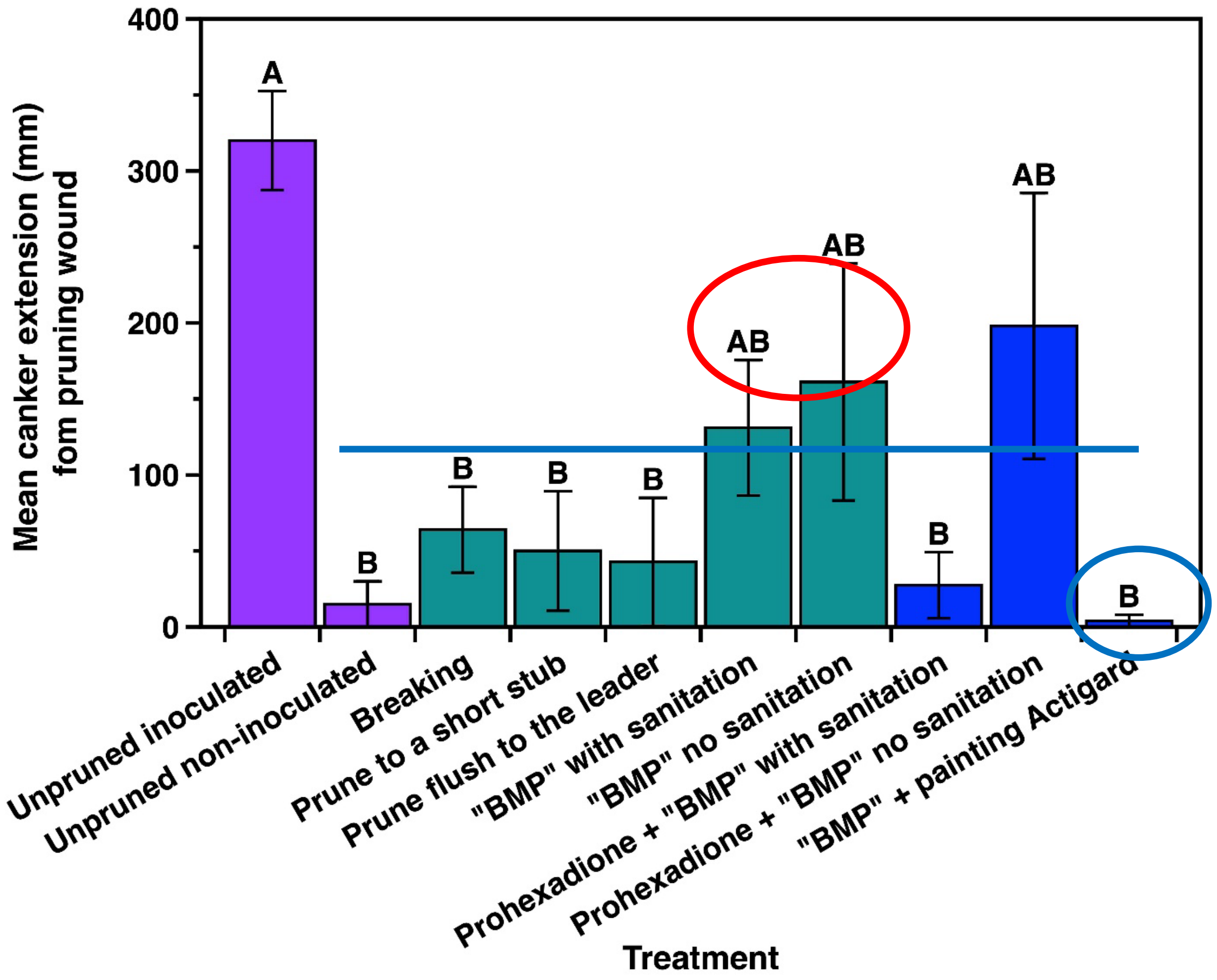
Pruning young high density 2022

- Symptoms developed < 5 days & shoot blight widely prevalent < 7 days
- Internal spread & infection to neighboring trees
- Systemic movement less than 4-5 days
- Temps exceeded 80F with frequent rainstorms



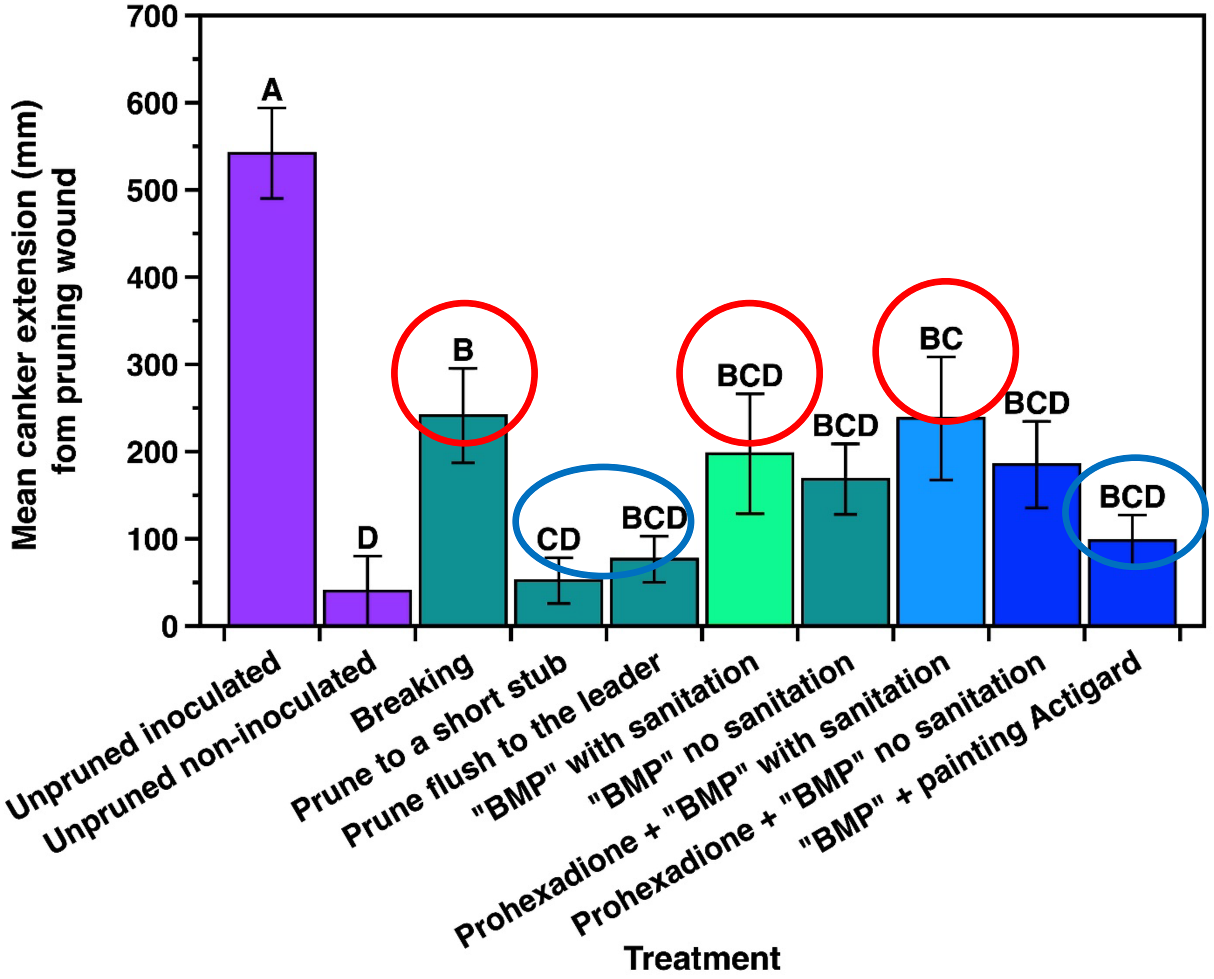
Pruning young high density 2021

- Pruning greatly limited spread of infection down 1st year shoots (mm)
- Over time, increased spread of infection - BMP, but short stub helpful
- Ph Ca, BMP + Sanitation & BMP + Actigard might be helpful in small trees



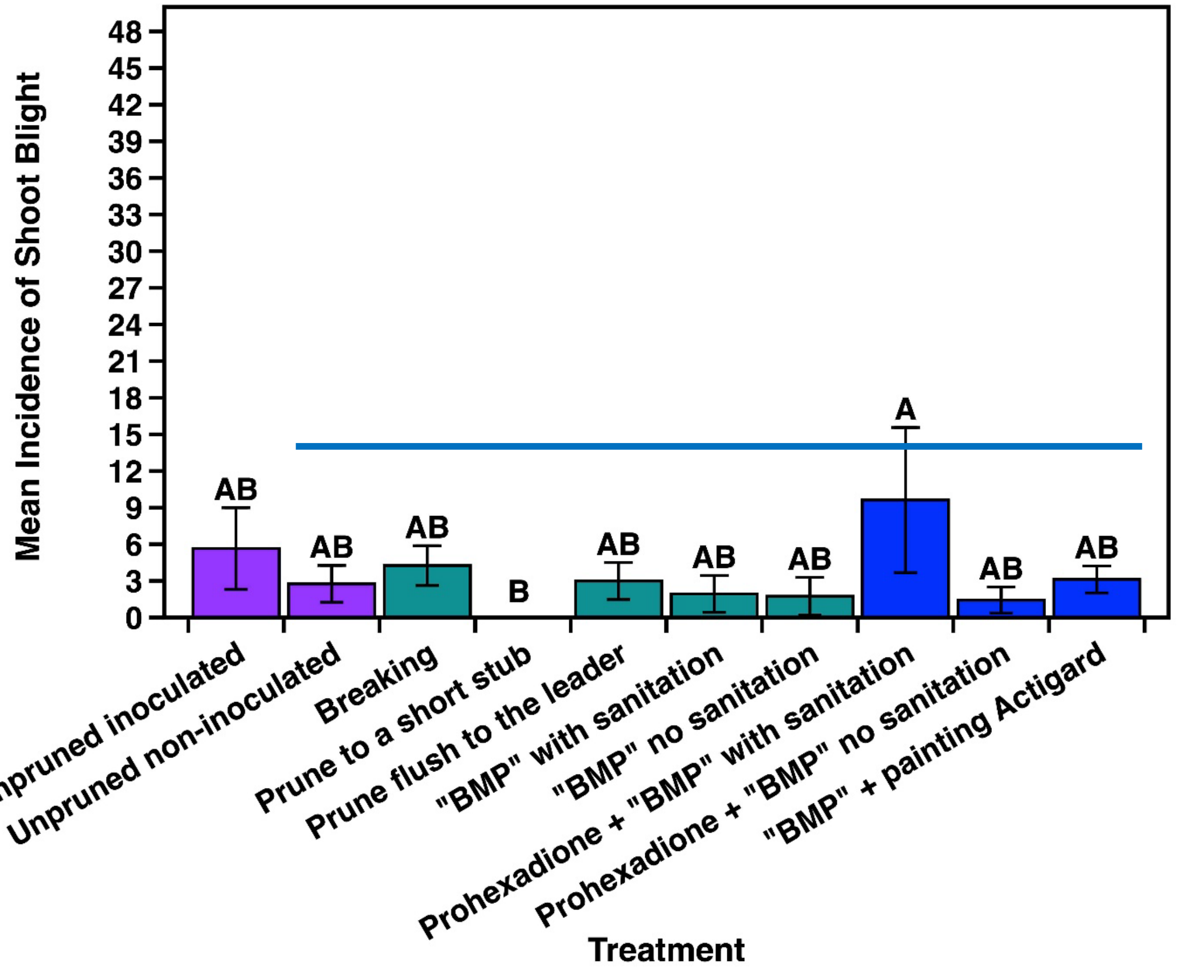
Pruning young high density 2022

- Pruning greatly limited spread of infection down 1st year shoots (mm)
- Over time, increased internal spread - Breaking & BMP
- Flush, Short & painting Actigard with BMP helpful in young trees



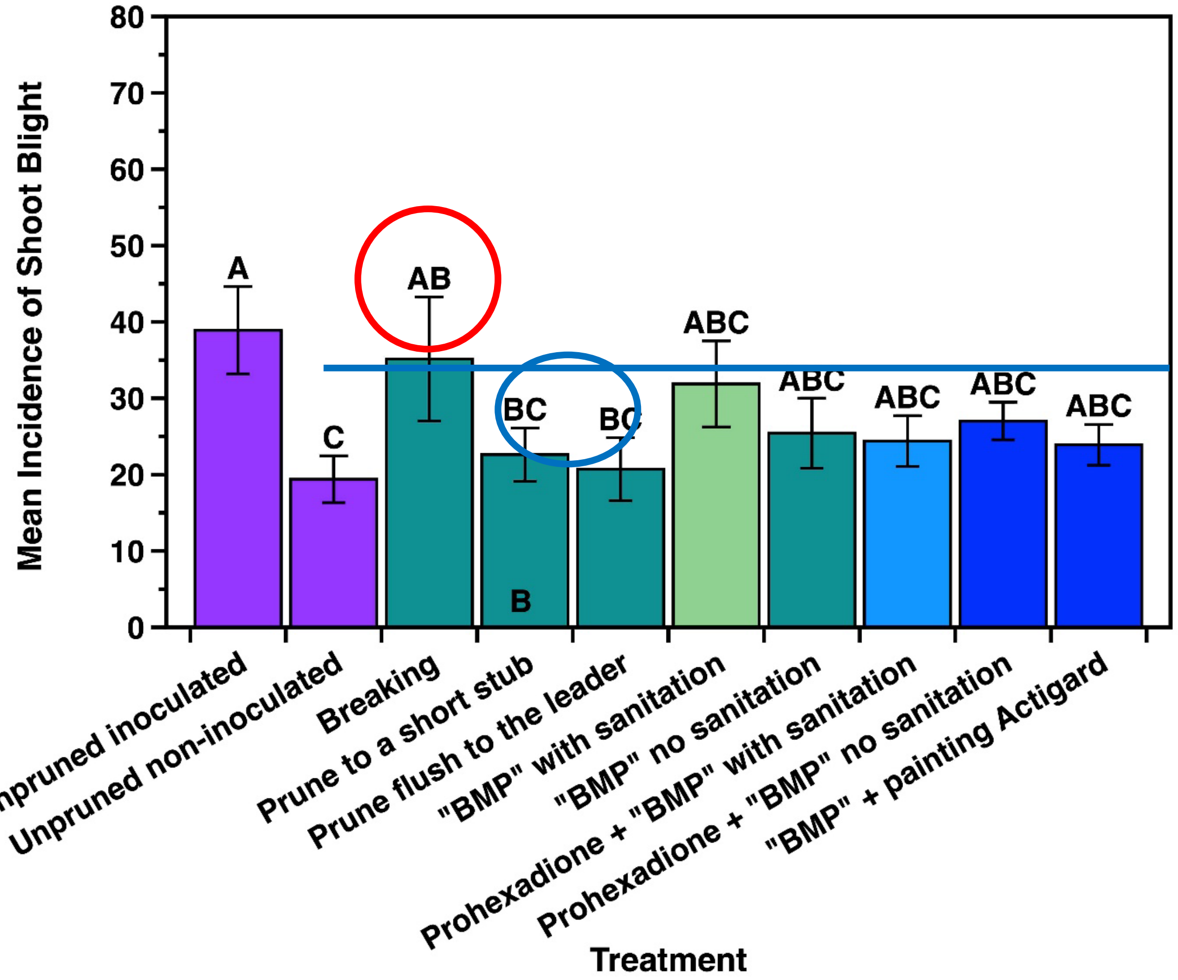
Pruning old Vertical Axis 2021

- Symptoms developed < 5 days
- Little systemic movement over the experiment
- No internal spread & infection of neighboring trees (spacing & age)
- Moderate season; still frequent rains storms



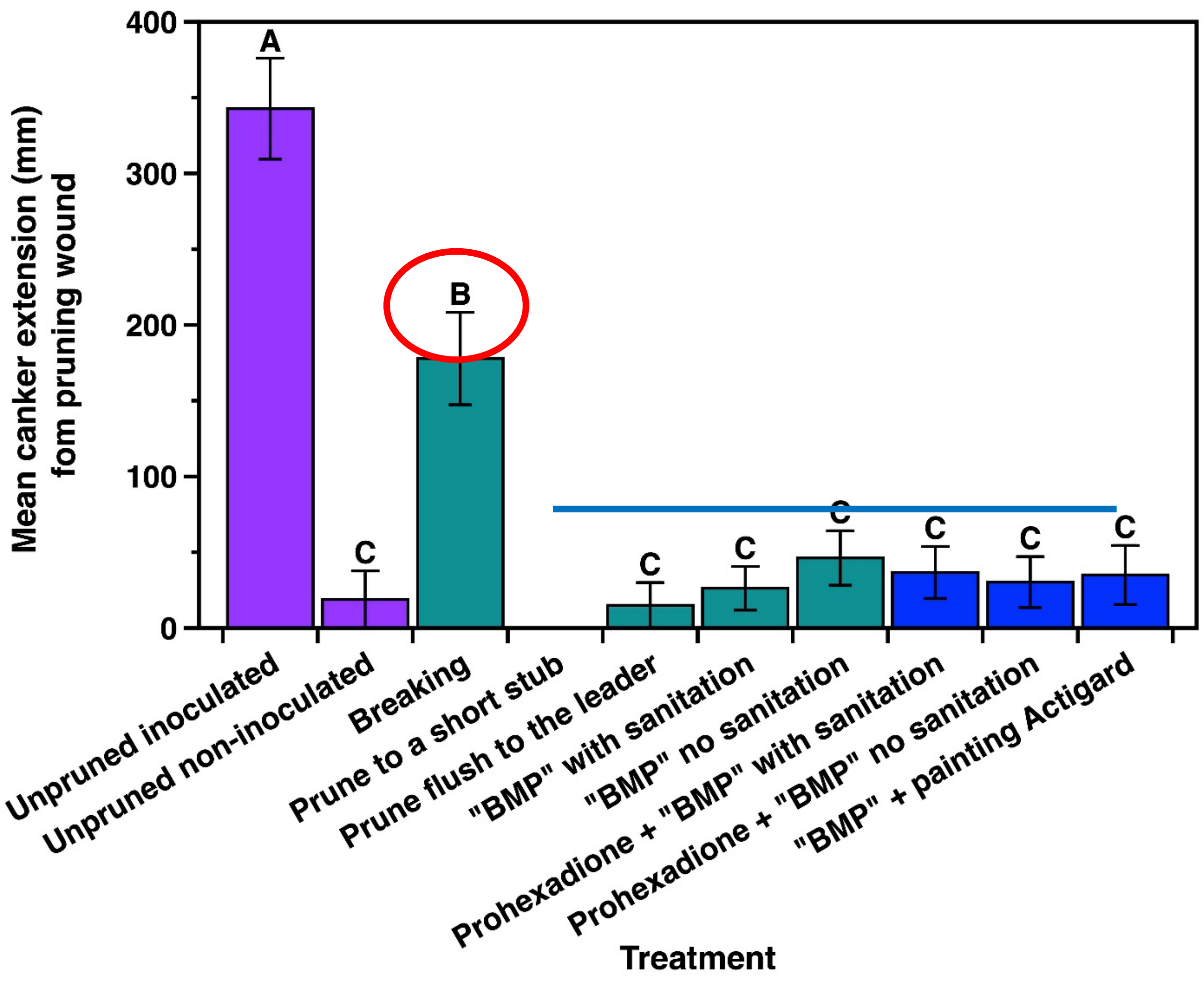
Pruning old Vertical Axis 2022

- Symptoms developed < 5 days
- More systemic movement than 2021 infections over the entire tree: breaking & short stub
- Temps exceeded 80F with frequently rainstorms



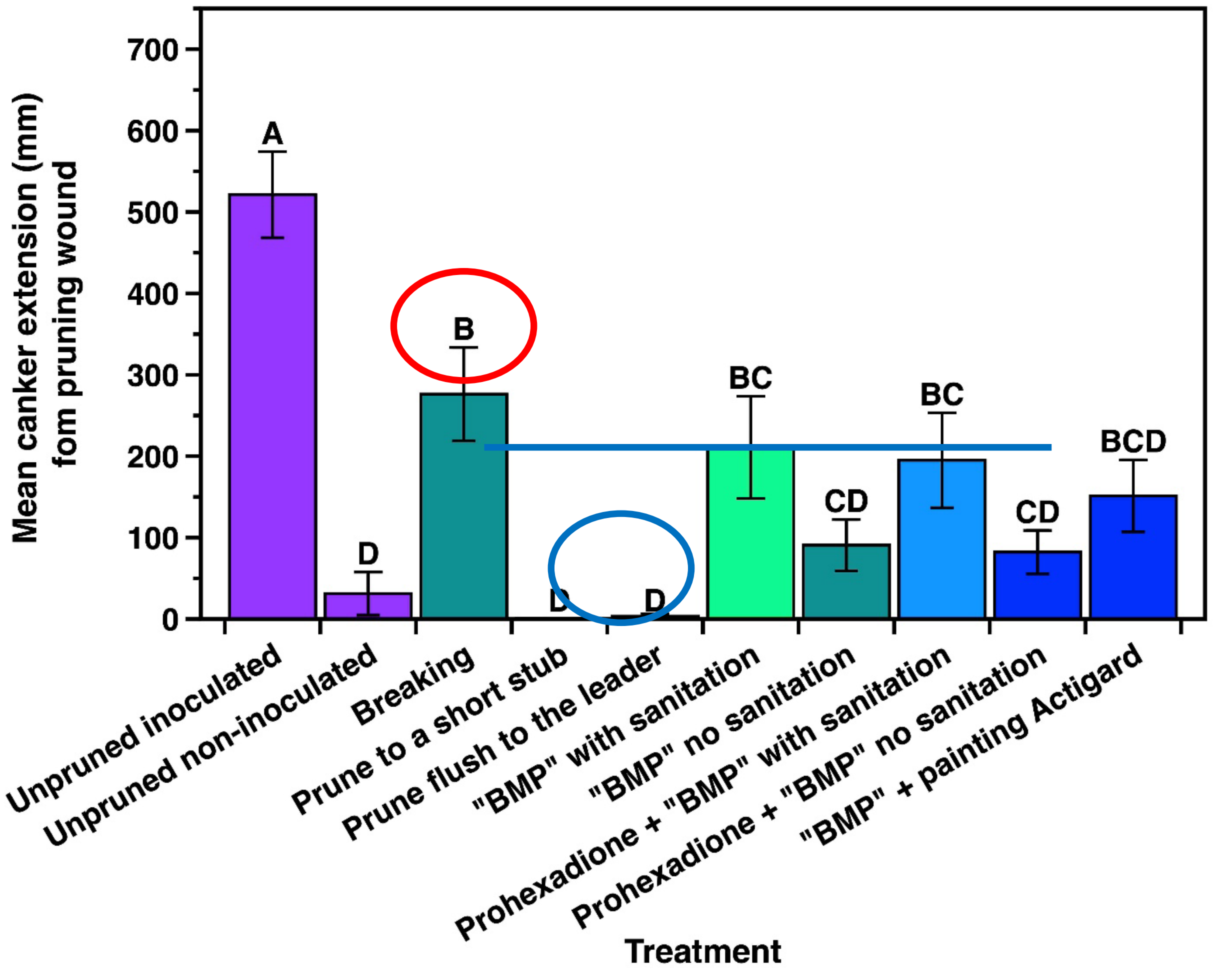
Pruning old Vertical Axis 2021

- Pruning greatly limited spread of infection in 1st year shoots (mm)
- Over time, “Breaking” increases in internal spread of infection (2018-19 & WA too)
- BMP, Short stub, Flush to leader



Pruning old Vertical Axis 2022

- Pruning greatly limited spread of infection in 1st year shoots (mm)
- Breaking still increases in internal spread of infection
- Short Stub & Flush to leader best!
- Sanitation, PhCa & Actigard not helpful in older trees



Pruning summary and takeaways

- Young trees: symptoms developed < 5 days and shoot blight was widely prevalent on in 7 days throughout planting
- Internal spread & infection of neighboring trees furthest in young trees & reduced in older trees: Tree age & planting distance?
- Overall: pruning greatly reduces spread of infection from the pruning wound in both

Pruning summary and takeaways

- Breaking is risky; lead to increased progression in some year and trees
  - Studies in 2018-2019 in NY and WA on mature trees suggest that breaking increased spread of necrosis
- Young trees: BMP not effective w/out sanitation >> Short stub or Flush pruning more effective

Pruning summary and takeaways

- Actigard & PhCa w/ pruning helpful on limiting spread of necrosis on the young trees:
  - Actigard @ high rate & labor intensive
  - PhCa less consistent in benefit if any

- Older trees: many practices effective, few benefits from sanitation of tools, defense inducers, and PhCa

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Cornell University Founded A.D. 1865

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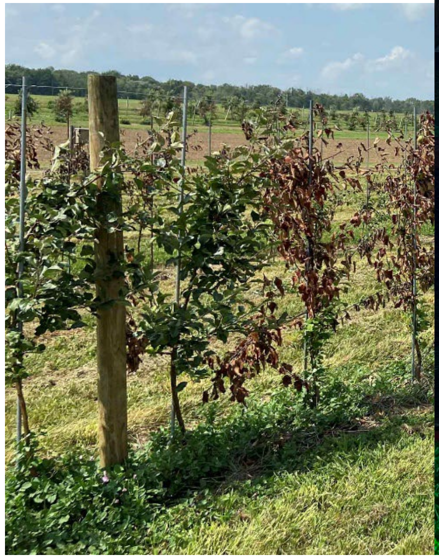
Fire Blight Trials

Pruning practices for fire blight management

Suppression of fire blight using UV light

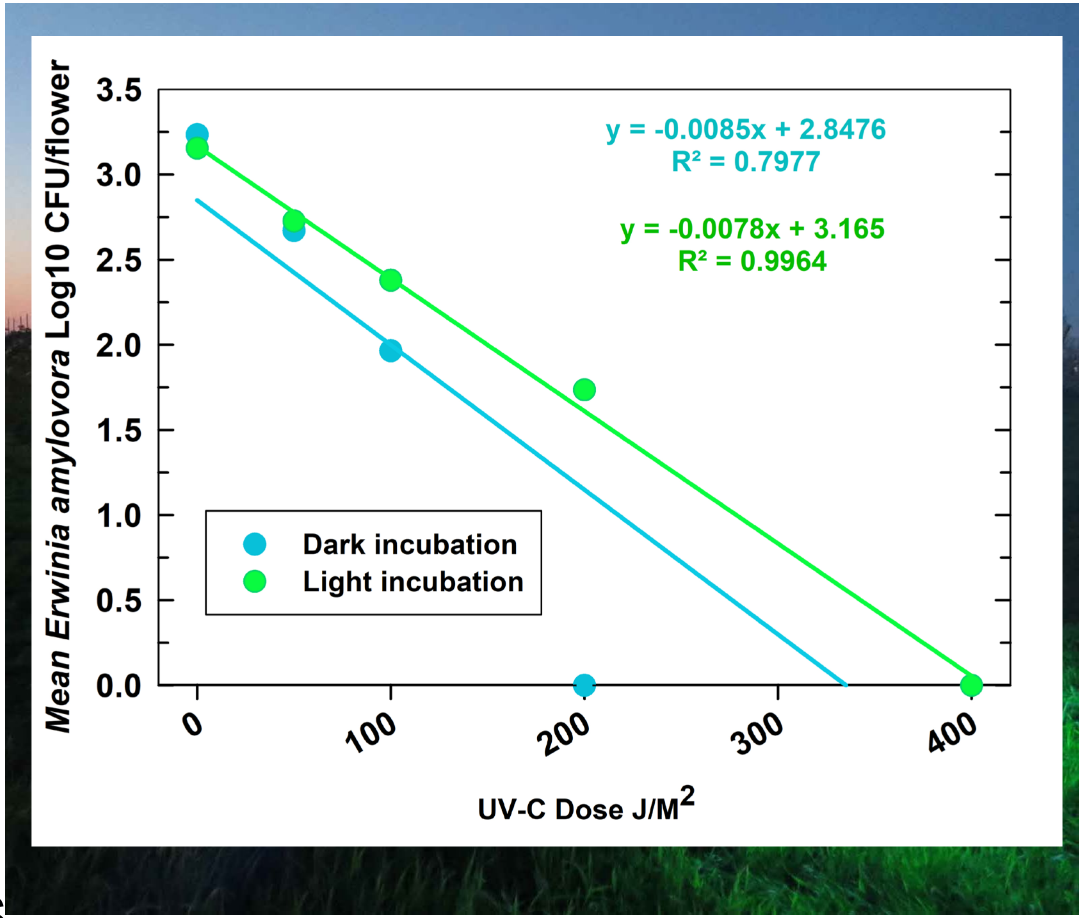
Suppression of fire blight using UV light

- Infections at bloom initiate fire blight epidemics > devastating shoot blight
- Preventing blossom blight requires precise applications of antibiotics > resistance & lack consumer appeal
- Germicidal (UV-C) light is effective against bacteria, algae, & some fungi
  - Medicine, aquaculture, & agriculture
  - Organic approved
  - No residue



Suppression of fire blight using UV light

- Some pathogens & microbes can repair UV damage in sunlight (even *Erwinia amylovora*) – Use at night
- Some crops like Hemp can be injured by UV light & if dose "too low", not effective
- Works **REALLY** well on natural inoculum levels or organisms multiplying on surfaces (like *Erwinia amylovora)*
- Difficult to conduct natural inoculum tests with fire blight



UVC Trial Site at Cornell AgriTech

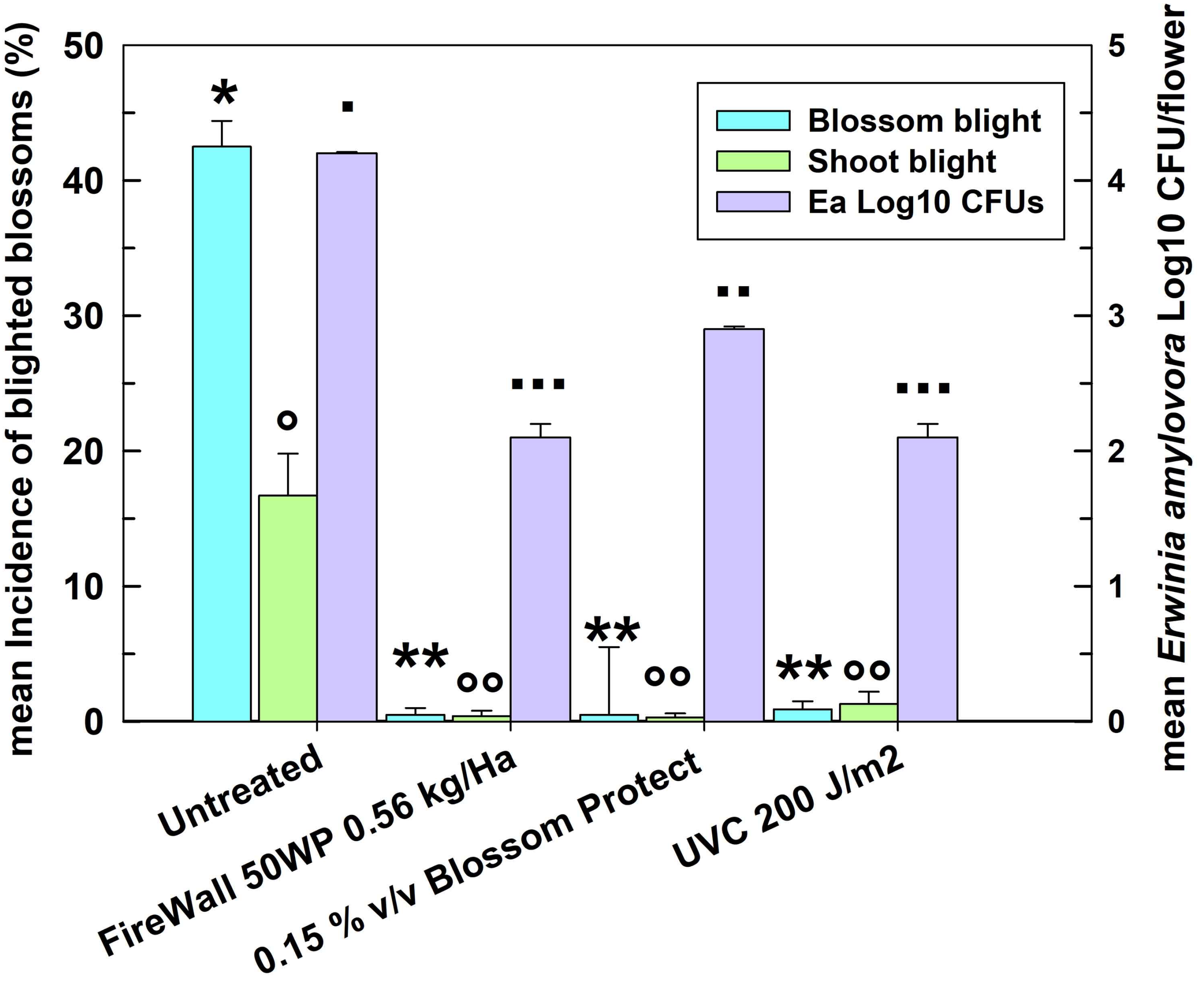
- Orchard sites (High Density Super Spindle)
- ‘Evercrisp’ on G.41 planted in 2019
- Reduced trellis (96”) to accommodate UV-C unit for grapes
- Replicated plot panels (RCB): 4 reps w/ ten trees each: V1 and V2

UVC -Blossom Blight Trials

- At 80% bloom
  - Streptomycin (Firewall 50 WP 0.56kg/Ha)
  - Aureobasidium pullulans (1.05% buffer protect + 0.15% blossom protect)
- Ea 273 at $1x10^6$ $CFUml^{-1}$
- That evening > UVC $200J/m^2$
- 100% Bloom: Strep, Aureo, UVC $200J/m^2$
- Blossom blight & shoot blight incidence
- Ea populations & leaf shape and shoot growth (possible UVC injury)

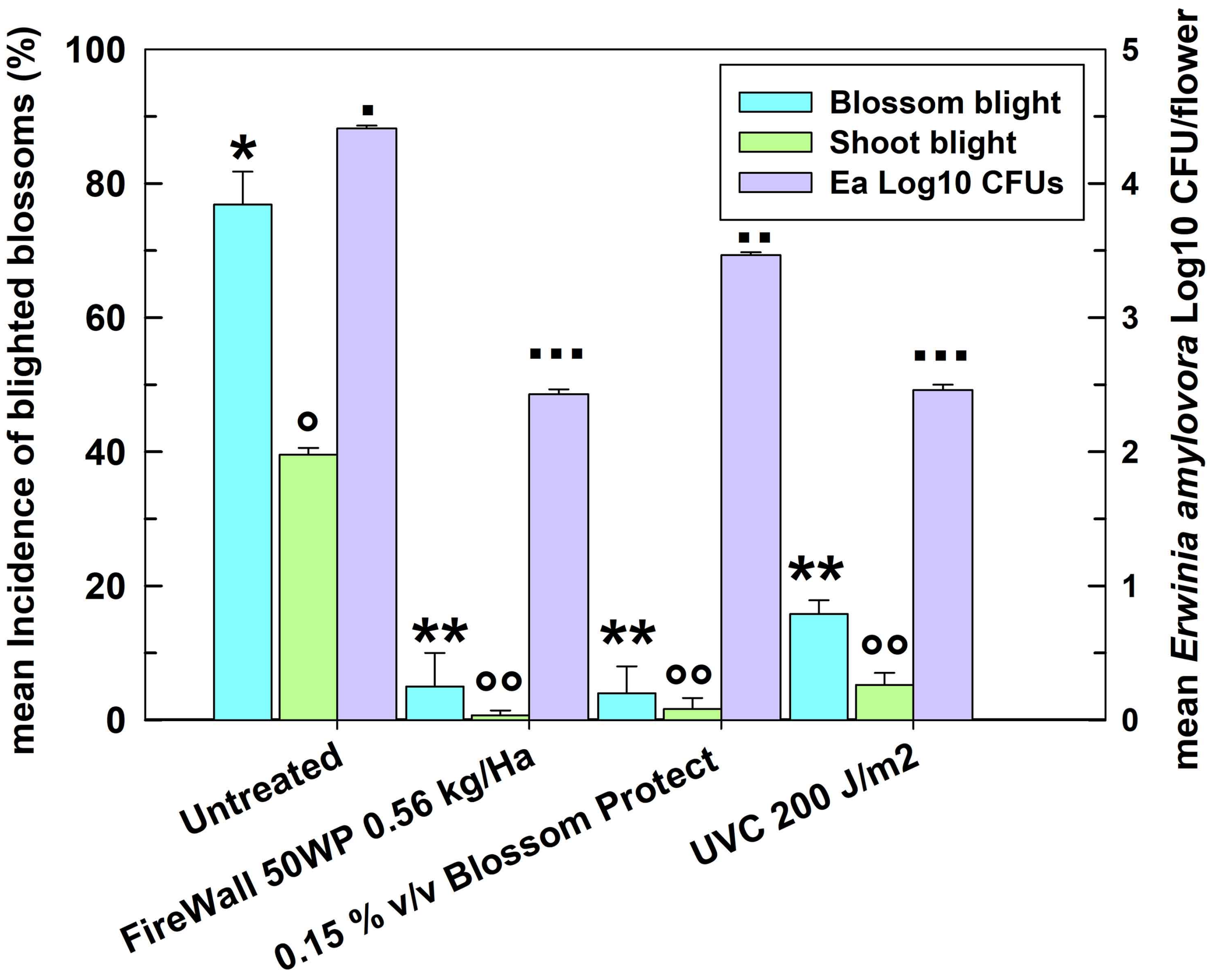
UVC Fire Blight trials (2021) – ‘Evercrisp’

- **Exceptionally cold bloom – low levels of infection on ‘Evercrisp’**
- Greatly reduced Ea populations on flowers
- Excellent control of blossom and shoot blight in this cool season



UVC Fire Blight trials (2022) – 'Evercrisp'

- **Exceptionally warm wet year – high levels of infection on 'Evercrisp'**
- Reduced Ea populations on flowers, but higher than 2021
- Excellent control of blossom and shoot blight, but still high



UVC Fire Blight trials (2021) – ‘Evercrisp’

No differences in leaf shape & internode length

Treatment programs (amt./100 gal)	Leaf length (mm)*	Leaf width (mm)*	Internode length on 1st year shoots (%)
Over both inoculum doses			
Untreated	82.5 ± 0.1 a	56.3 ± 0.1 a	39.4 ± 0.1 a
Streptomycin (Firewall 50 WP 0.56kg/Ha)	83.2 ± 0.8 a	56.2 ± 0.5 a	41.1 ± 2.3 a
Aureobasidium pullulans (1.05% buffer protect + 0.15% blossom protect)	82.6 ± 0.7 a	56.4 ± 0.7 a	39.6 ± 0.6 a
UVC 200 J/m^2	82.6 ± 0.1 a	56.3 ± 0.1 a	39.6 ± 0.1 a

UVC Fire Blight trials (2022) – ‘Evercrisp’

No differences in leaf shape & internode length

Treatment programs (amt./100 gal)	Leaf length (mm)*	Leaf width (mm)*	Internode length on 1st year shoots (%)
Over both inoculum doses			
Untreated	82.8 ± 0.1 a	59.8 ± 0.2 a	45.5 ± 0.6 a
Streptomycin (Firewall 50 WP 0.56kg/Ha)	82.5 ± 2.3 a	59.1 ± 1.3 a	44.4 ± 2.9 a
Aureobasidium pullulans (1.05% buffer protect + 0.15% blossom protect)	81.7 ± 0.6 a	60.1 ± 0.3 a	44.4 ± 1.0 a
UVC 200 J/m^2	82.1 ± 1.0 a	59.9 ± 0.1 a	46.9 ± 0.9 a

UVC Horticultural impacts Trial at Cornell AgriTech

- ‘Buckeye Gala’, ‘Lady in Red’, ‘Royal Red’ Honeycrisp’ on M.9-337 planted in 2021
- Orchard sites (High Density Super Spindle)
- Reduced trellis (96”) to accommodate UV-C unit for grapes
- Replicated plot panels (RCB): 4 reps w/ five trees

Līga Astra Kalniņa

UVC Horticultural impacts Trial at Cornell AgriTech

- At 80% and 100% bloom
  - Streptomycin (Firewall 50 WP 0.56kg/Ha)
  - Aureobasidium pullulans (1.05% buffer protect + 0.15% blossom protect)
- No inoculation with Ea 273
- Weekly and Bi-weekly UVC 200J/m^2
- Blossom blight & shoot blight incidence **(none)**
- Ea populations & leaf shape and shoot and tree growth (possible UVC injury)

Līga Astra Kalniņa

UVC Horticultural impacts (2022) – 'Gala'

No impact of UV applications on growth and development

Treatment programs (amt./100 gal)	Log10 CFU/mL	Leaf length (mm)*	Leaf width (mm)*	Internode length on 1st year shoots (%)	1st year shoot length (cm)	Canopy Height (cm)
Untreated	1.5 ± 0.0 a	91.3 ± 0.3 a	78.7 ± 0.1 a	49.9 ± 0.6 a	22.0 ± 0.3 a	189.6 ± 0.5 a
Streptomycin (Firewall 50 WP 0.56kg/Ha)	0.0 ± 0.0 b	92.2 ± 1.4 a	79.0 ± 1.0 a	47.0 ± 0.9 a	20.3 ± 0.4 a	189.7 ± 1.6 a
Aureobasidium pullulans (1.05% buffer protect + 0.15% blossom protect)	0.0 ± 0.0 b	92.7 ± 0.8 a	77.3 ± 0.2 a	49.1 ± 1.4 a	21.4 ± 0.3 a	189.8 ± 1.4 a
UVC 200 J/m^2 1/week	0.0 ± 0.0 b	93.5 ± 0.4 a	78.4 ± 0.3 a	49.3 ± 0.7 a	21.2 ± 0.5 a	192.4 ± 0.7 a
UVC 200 J/m^2 2/week	0.0 ± 0.0 b	91.2 ± 0.2 a	79.4 ± 0.3 a	49.4 ± 0.7 a	21.9 ± 0.3 a	190.1 ± 0.3 a

UVC Horticultural impacts (2022) – ‘Lady in Red’

No impact of UV applications on growth and development

Treatment programs (amt./100 gal)	Log10 CFU/mL	Leaf length (mm)*	Leaf width (mm)*	Internode length on 1st year shoots (%)	1st year shoot length (cm)	Canopy Height (cm)
Untreated	1.5 ± 0.0 a	92.5 ± 0.6 a	70.3 ± 0.1 a	55.9 ± 0.5 a	20.1 ± 0.2 a	180.4 ± 0.4 a
Streptomycin (Firewall 50 WP 0.56kg/Ha)	0.0 ± 0.0 b	92.6 ± 3.6 a	69.1 ± 0.2 a	51.3 ± 2.3 a	20.1 ± 0.2 a	177.5 ± 1.9 a
Aureobasidium pullulans (1.05% buffer protect + 0.15% blossom protect)	0.0 ± 0.0 b	91.7 ± 1.1 a	70.7 ± 0.6 a	50.9 ± 0.7 a	20.0 ± 0.3 a	180.5 ± 0.5 a
UVC 200 J/m^2 1/week	0.0 ± 0.0 b	93.3 ± 0.4 a	69.8 ± 0.4 a	55.4 ± 0.6 a	20.4 ± 0.3 a	179.3 ± 0.4 a
UVC 200 J/m^2 2/week	0.0 ± 0.0 b	93.1 ± 0.1 a	70.2 ± 0.2 a	55.0 ± 0.9 a	19.9 ± 0.1 a	180.4 ± 0.4 a

UVC Horticultural impacts (2022) – ‘Royal Red Honeycrisp’

No impact of UV applications on growth and development

Treatment programs (amt./100 gal)	Log10 CFU/mL	Leaf length (mm)*	Leaf width (mm)*	Internode length on 1st year shoots (%)	1st year shoot length (cm)	Canopy Height (cm)
Untreated	1.5 ± 0.0 a	67.7 ± 0.6 a	50.1 ± 0.2 a	34.9 ± 0.3 a	17.5 ± 0.2 a	160.0 ± 0.8 a
Streptomycin (Firewall 50 WP 0.56kg/Ha)	0.0 ± 0.0 b	67.6 ± 1.1 a	48.6 ± 0.7 a	33.7 ± 2.2 a	18.0 ± 0.2 a	157.8 ± 2.2 a
Aureobasidium pullulans (1.05% buffer protect + 0.15% blossom protect)	0.0 ± 0.0 b	68.0 ± 0.7 a	48.1 ± 0.4 a	35.0 ± 2.3 a	17.1 ± 0.3 a	160.2 ± 1.3 a
UVC 200 J/m^2 1/week	0.0 ± 0.0 b	67.2 ± 0.7 a	50.7 ± 0.4 a	34.7 ± 2.9 a	17.3 ± 0.4 a	159.3 ± 0.8 a
UVC 200 J/m^2 2/week	0.0 ± 0.0 b	67.4 ± 0.2 a	50.2 ± 0.3 a	34.6 ± 0.7 a	17.8 ± 0.2 a	159.8 ± 0.6 a

UVC summary and takeaways

- UVC was effective at 200 J/m^2 against high and low inoculum
- Cold & warm bloom seasons, comparable to conventional (strep) & organic (*Aureobasidium*) standards
- Reduced populations on surface of flowers greatly, no apparent damage, or impacts on the development of young trees
- No residue, potential for frequent use & robotic automation

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Cox Lab Members

Alexandra Davidson
Isabella Yannuzzi
Andrew Painton
Mary Cowser
McKenzie Schessl

Cornell AgriTech
New York State Agricultural Experiment Station