Managing Cytospora Canker in Colorado Peach Orchards

Canopy Spray Efficacy and Implementation Strategies

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Agenda

01 **Background**

02 **Study Questions**

03 **Part 1 : Spray Coverage**

04 **Part 2 : Efficacy**

05 **Biocontrols**

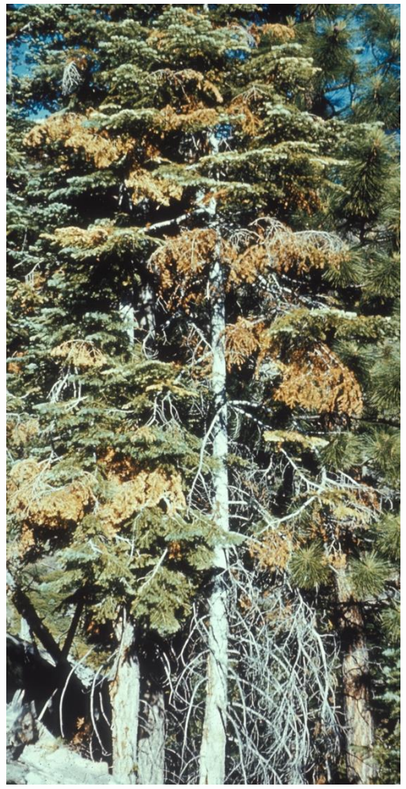
06 **Conclusions**

Cytospora = Leucostoma, Valsa, Valsella

Cytospora canker

Globally distributed on 130+ host species, pathogenicity varies

- **Agricultural**
- **Economic**
- **Ecological**



Flagging on fir

Olive trunk infection

Conidial masses

Aspen trunk infection

USDA Forest Service; Úrbez-Torres et. al., (2020)

Cytospora canker is epidemic in western Colorado

2015 survey

100% of peach orchards

20% of stone fruit loss

3 million dollars in damage

Scaffold branch cankers on peach trees

2015 Survey by the CSU Agricultural Research Station, (Miller et al., 2019)

The peach industry in western Colorado

Palisade Peaches

First planted in 1882

6th generation growers (Talbott)

Highest price per lb in the country

Talbottfarms.com

Irrigated Orchard in Grand Valley, Colorado

Colorado Denver Public Library, Western History Collection

Challenging growing conditions

4800+ ft elevation

temperature fluctuations

limited water

high pH soils

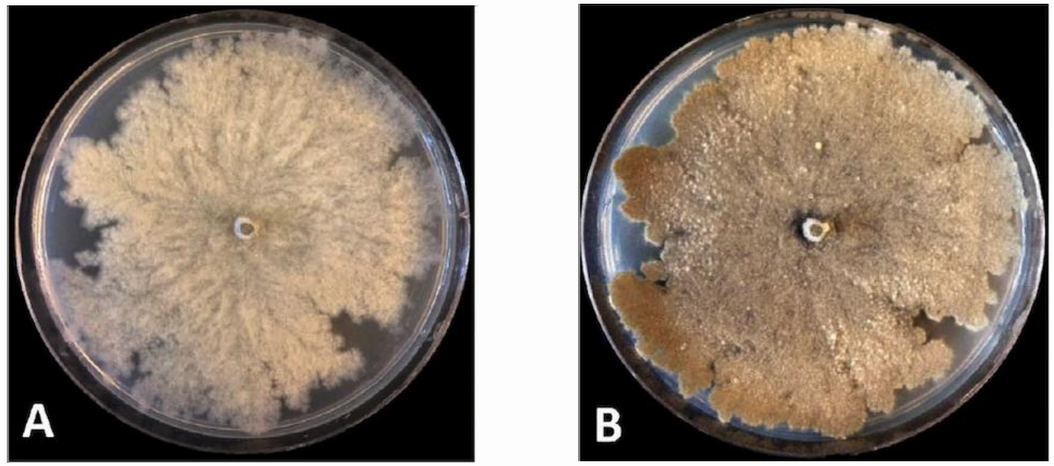
Cytospora plurivora was only recently identified

1907 *C. leucostoma and C. cincta*

2018 *C. plurivora* and 10 other new species described in CA

2022 *C. plurivora* isolated in Colorado

- Not the only *Cytospora* sp. on peach
- Pathogenic on other hosts
- Variable virulence



Cultures of *C. plurivora* at **A.** 7 days **B.** 14 days

Lawrence et al., (2018)

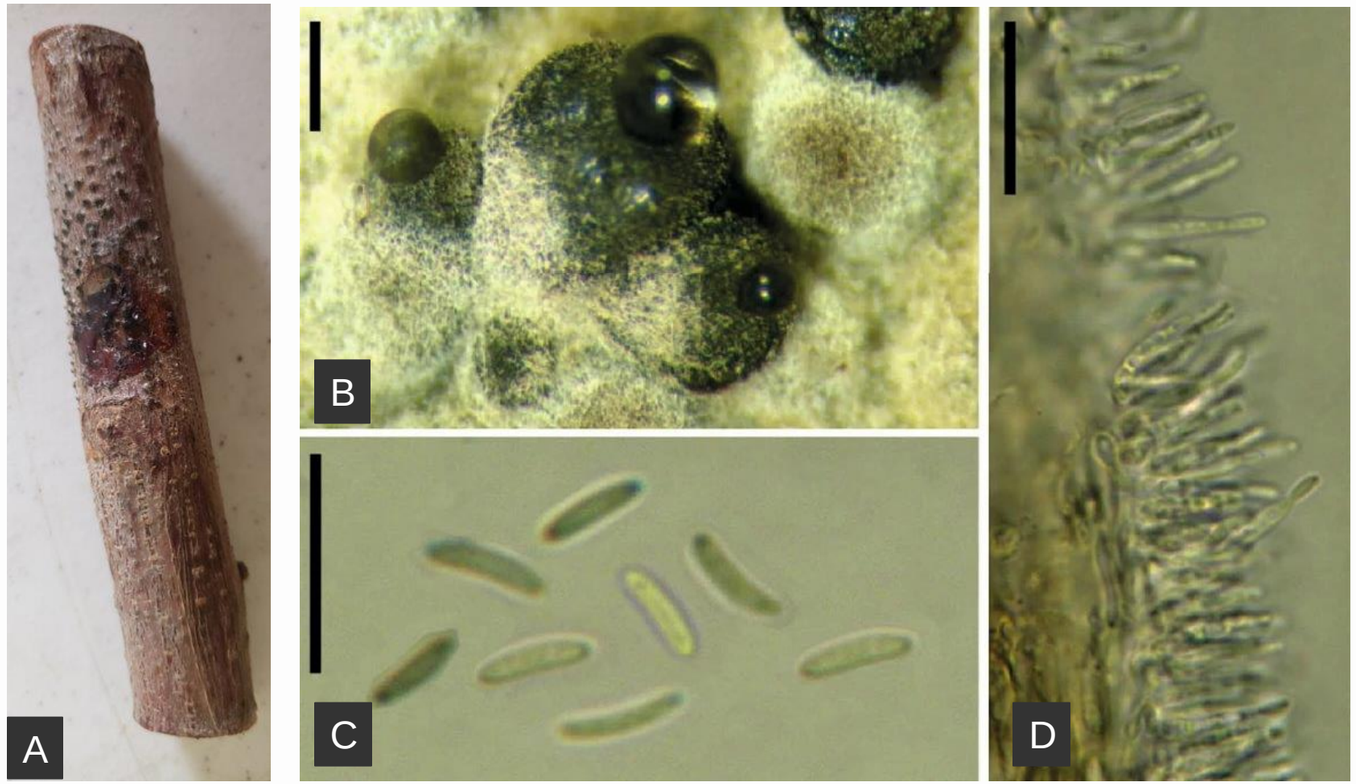
Inoculum is dispersed year-round

Cytospora plurivora

Usually asexual spores
Conidia

Sometimes sexual spores
Ascospores

Rain splash
Irrigation
Aerial dispersal
Insects



A-B. Pycnidia **C.** Conidia **D.** Conidiophores
Bars B = 1 mm; C = 10 µm; D = 20 µm

Grove & Biggs, (2006); Figure: Lawrence et al., (2018)

Cytospora spores infect wounded tissues

Pruning Wounds

Frost Cracks

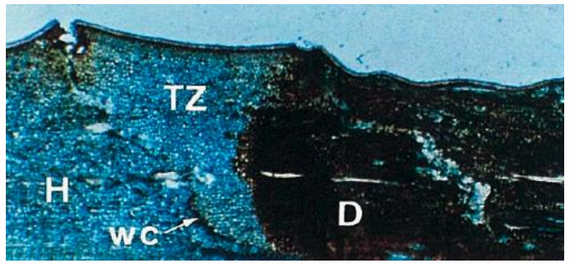
Mechanical Damage

Insect Damage

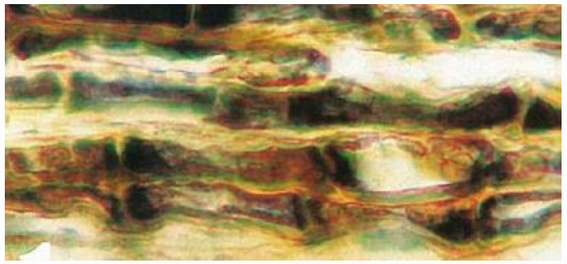
Hyphae invade bark, phloem, and xylem

Then overwinter in dead tissues

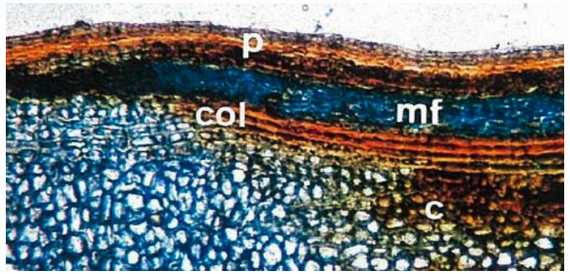
Cytospora canker on cherry



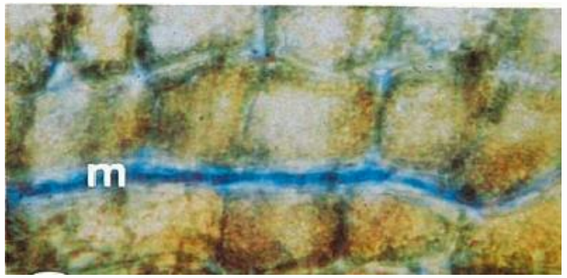
Canker margin



Cells in the transition zone



Periderm and cortex



Phloem cells

Lawrence et al., (2018) ; Tamura & Saito, (1989)

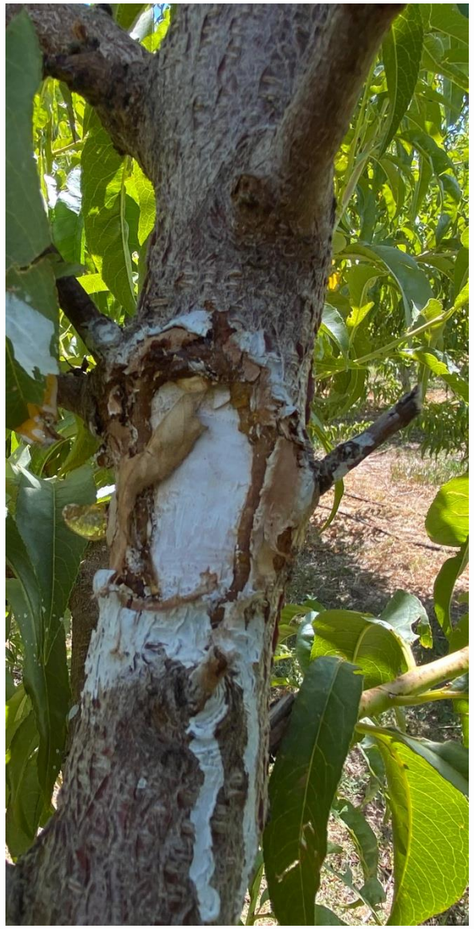
Management options are limited

Cultural

Pruning during low inoculum loads
Sanitation
Surgeries often don’t work
No resistant cultivars or rootstocks

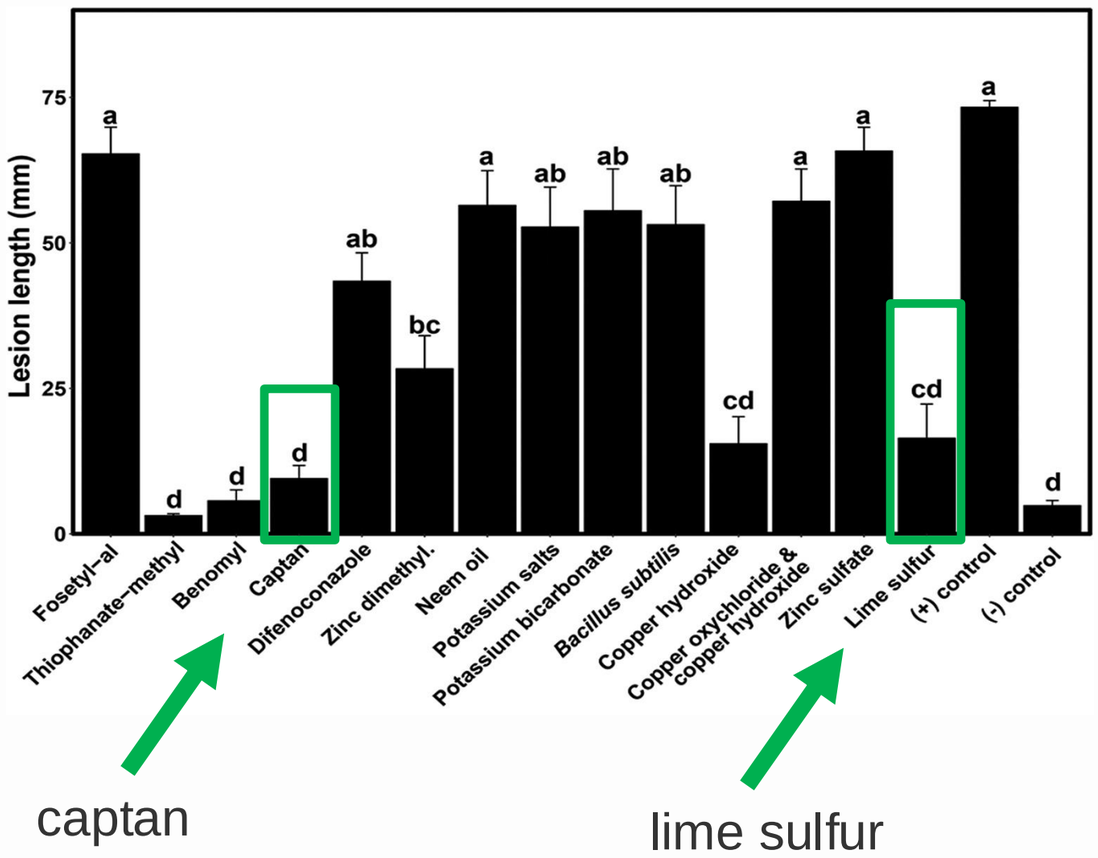
Chemical

No fungicides registered in CO
Mixed results
Direct applications



Grove & Biggs, (2006)

Direct applications are effective, but labor intensive



Conventional
Captan
Benomyl
Thiophanate-methyl (Topsin)

Organic
Lime sulfur
Copper hydroxide

Length of lesions on branches inoculated with *Cytospora* after fungicide applications. Different letters indicate statistical differences ($P < 0.05$).

Miller et al., (2019)

Canopy sprays could be a more efficient option

Air-blast Sprayers

Fast: Lower labor costs

Versatile: Currently used by growers for pest management and nutrient applications

Comprehensive: Target whole tree canopies

Preliminary evidence of efficacy after hard frost

Efficacy for canker pathogens is not well characterized

Quantifying spray coverage to determine best practices

Underapplication results in poor disease management

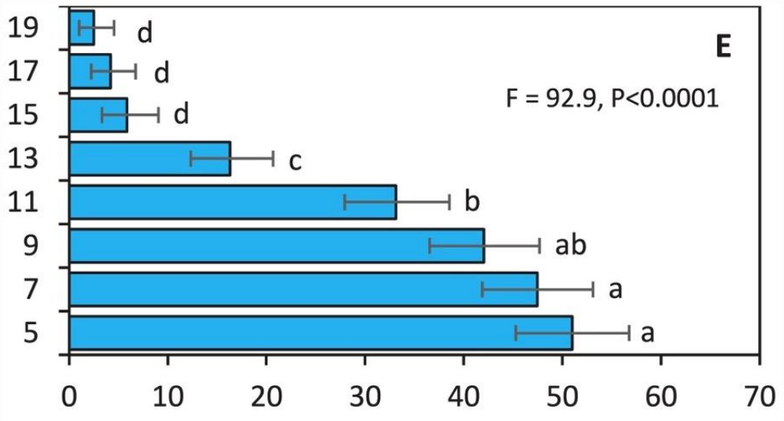
Overapplication increases pesticide drift

Best practices for canker pathogens may be different

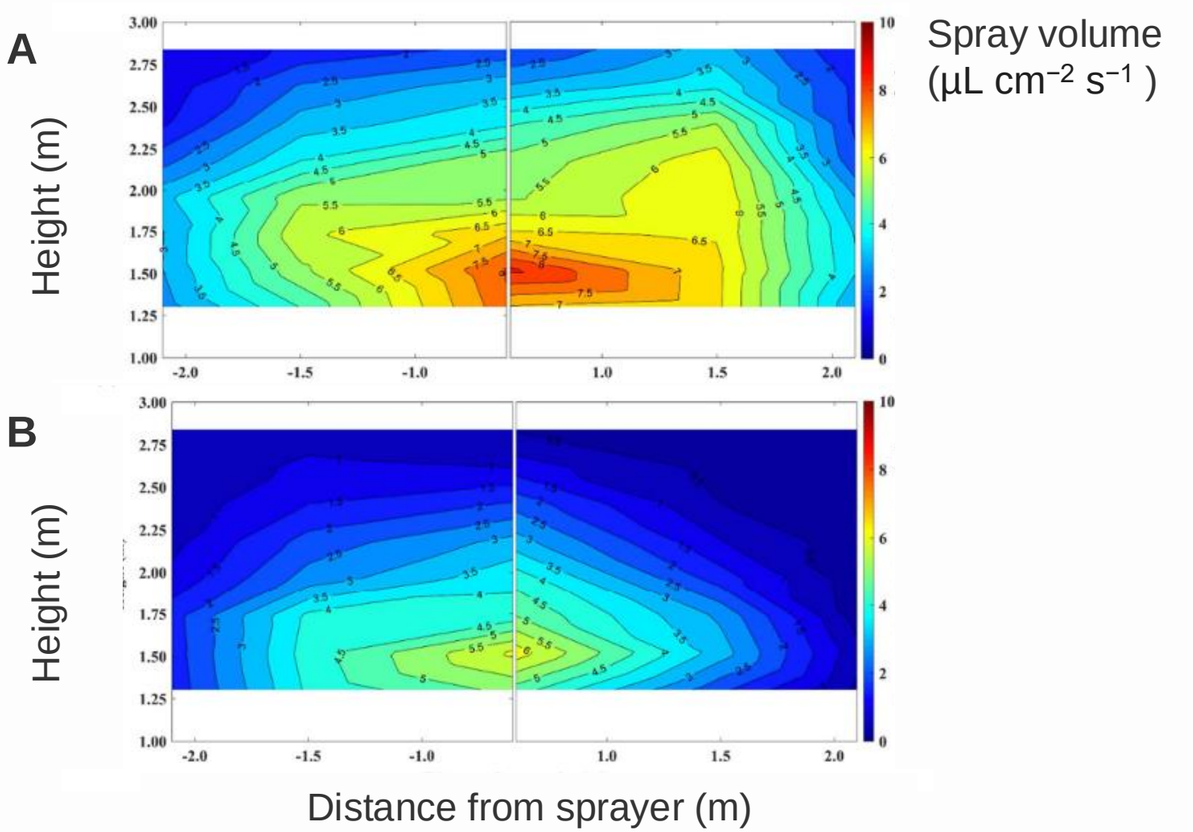
Spray is not uniformly distributed, which impacts efficacy

Top cards receive the least coverage

Sprayer type, region, and specific practices impact coverage



Percent coverage of kromekote cards



Differences in spray volume (µL cm^{-2} s^{-1}) emitted by **A.** Powerblast and Pakblast **(B)** sprayers

Bock et al., (2023); Rathnayake et al., (2021)

Sprayer fans are used to improve coverage

Droplets are projected up and into tree canopies

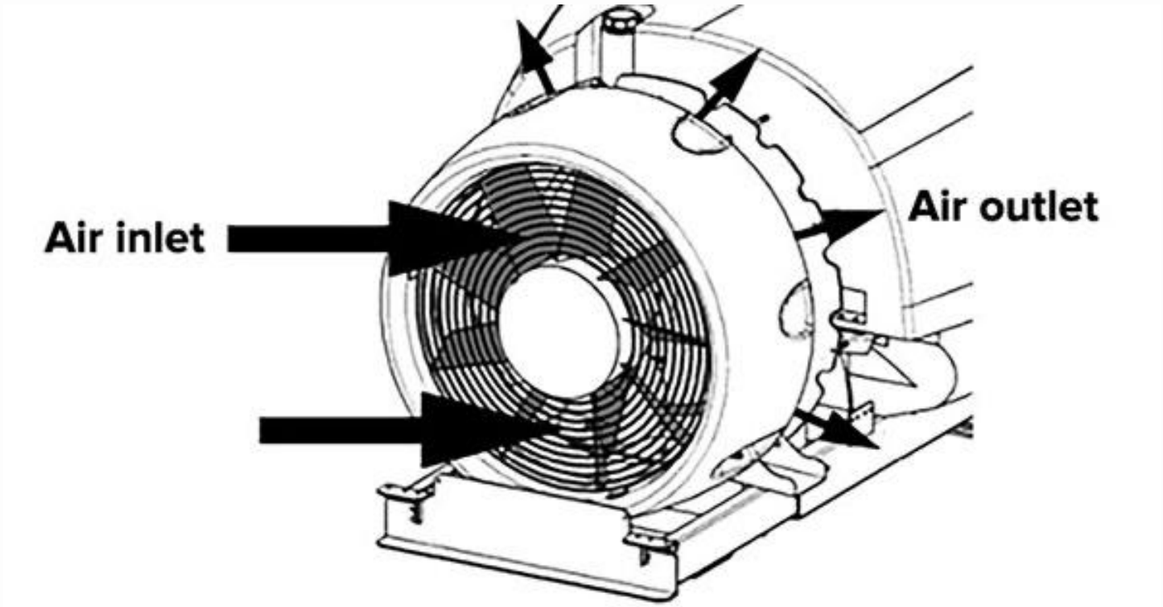


Diagram of air assistance in an air-blast sprayer

Diagram: Ontario Ministry of Agriculture, Food, and Agribusiness and Ministry of Rural Affairs

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04 Part 2 : Efficacy

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06 Conclusions

Research Questions

Can Canopy Sprays be used to manage Cytospora canker?

Part 1

Which factors impact coverage of branches?

Part 2

Can canopy sprays prevent or limit severity of *C. plurivora* infections?

Four field trials were conducted

Part 1 **Two Coverage Trials**

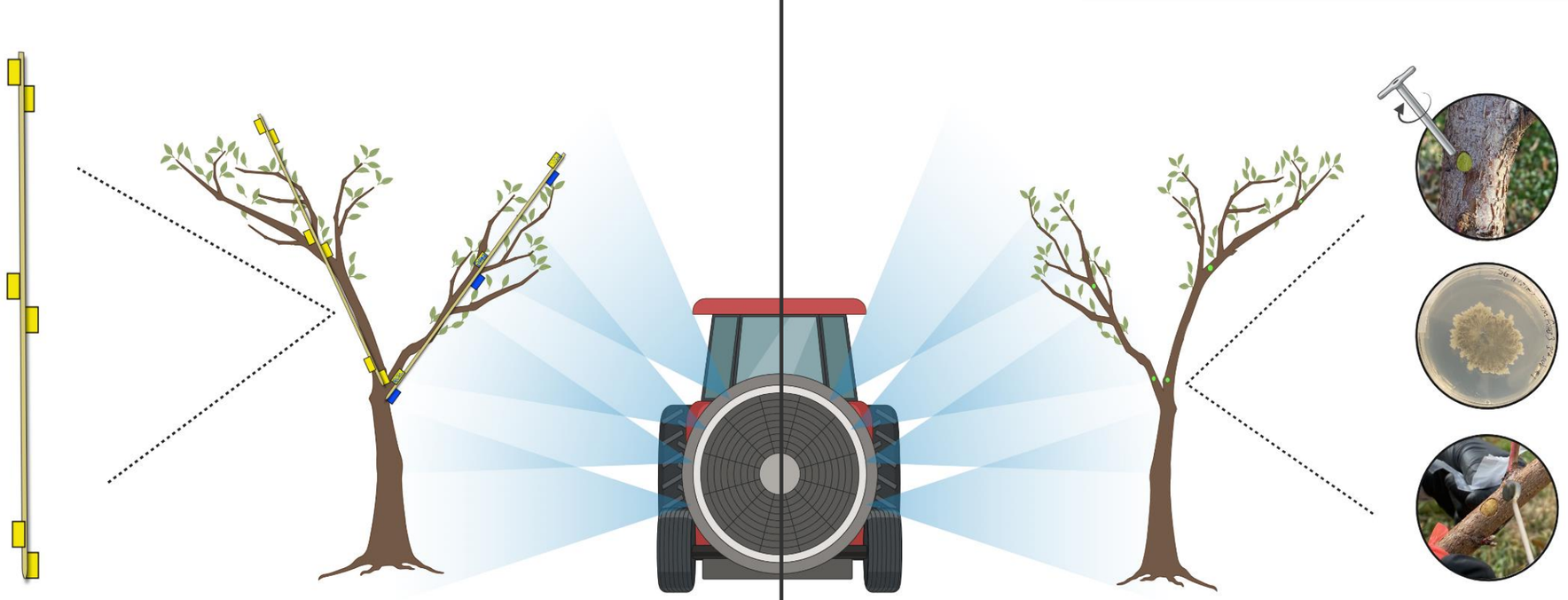
March 2023

July 2023

Part 2 **Two Fungicide Trials**

November 2023 - March 2024

April - June 2024



Western Colorado Agricultural Experiment Stations

WCRC - Rogers Mesa
Organic Orchard

RM

Planted in 2018
Avrg Height: 2.45, 2.96m
Mixed Cultivars

WCRC - Orchard Mesa
Conventional Orchards

OM-1

2019 - 2020
3.15, 3.68m
Mixed Cultivars

OM-2

2014
3.52m
Cresthaven on Viking

Methods : Equipment

RM:
Rears Pak-Blast
50 gal

OM:
Rears Pul-Blast
400 gal

Calibration: 200 gal/acre

Driving Speed: 4.1 km/h (2.55 mph)

Tee Jet Disc-Core, Full-Cone Nozzles

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Part 1 : Coverage Trials

Part 1

Which factors impact uniform coverage of branches?

1. How does coverage vary by height in trees?

2. Do air-blast sprayer fans improve the uniformity of coverage?

3. Is coverage better in spring or summer applications?

Methods: Coverage was measured with WSP cards

WSP = Water Sensitive Paper, contact with water induces a color change

Heights

Top

Middle

Bottom

Fan use

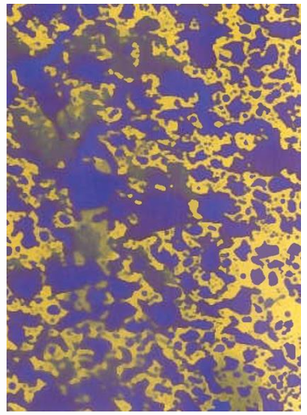
Fan on

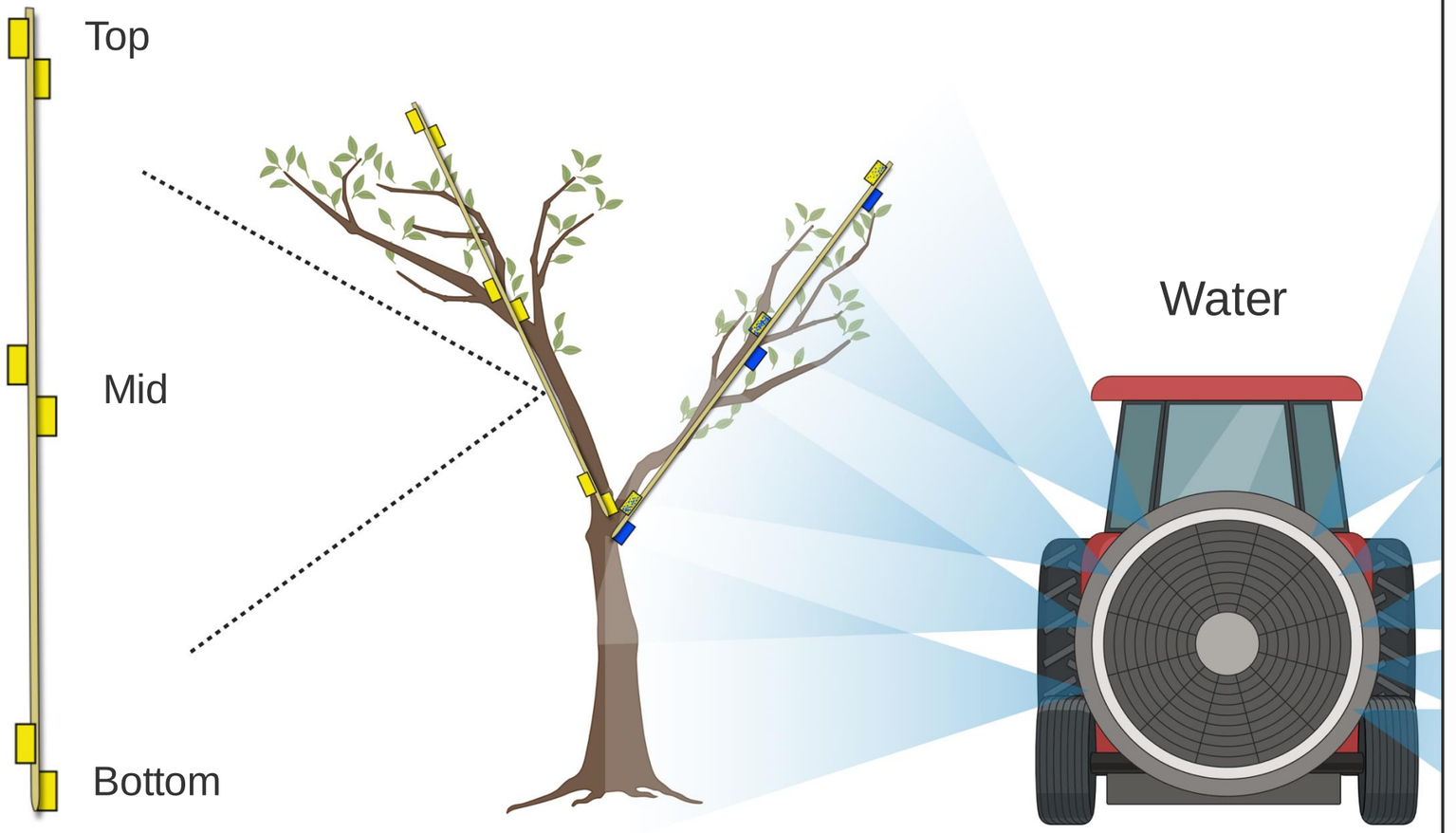
Fan off

Season

Spring

Summer

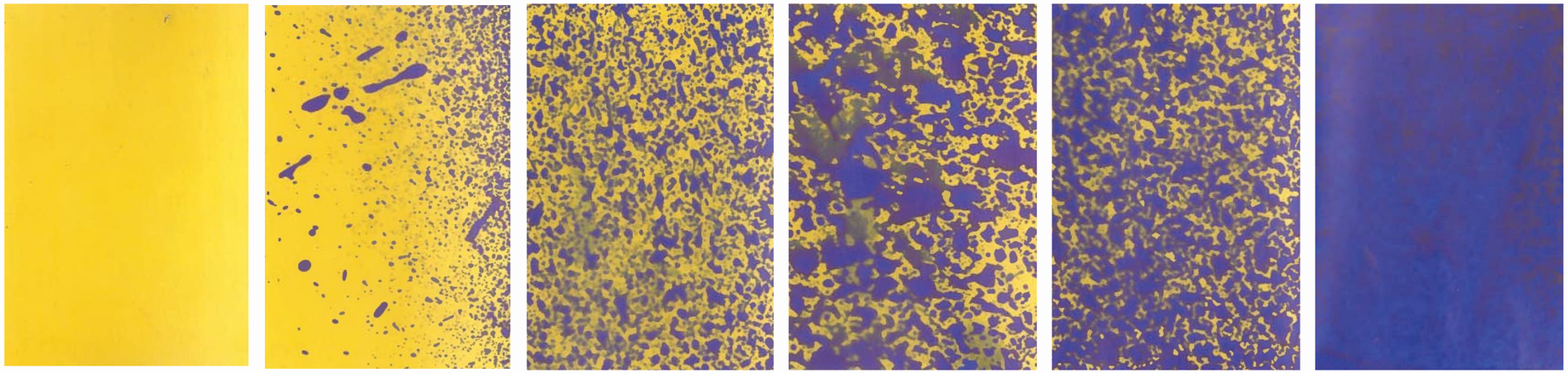




Bamboo stakes were placed in v-perpendicular trees

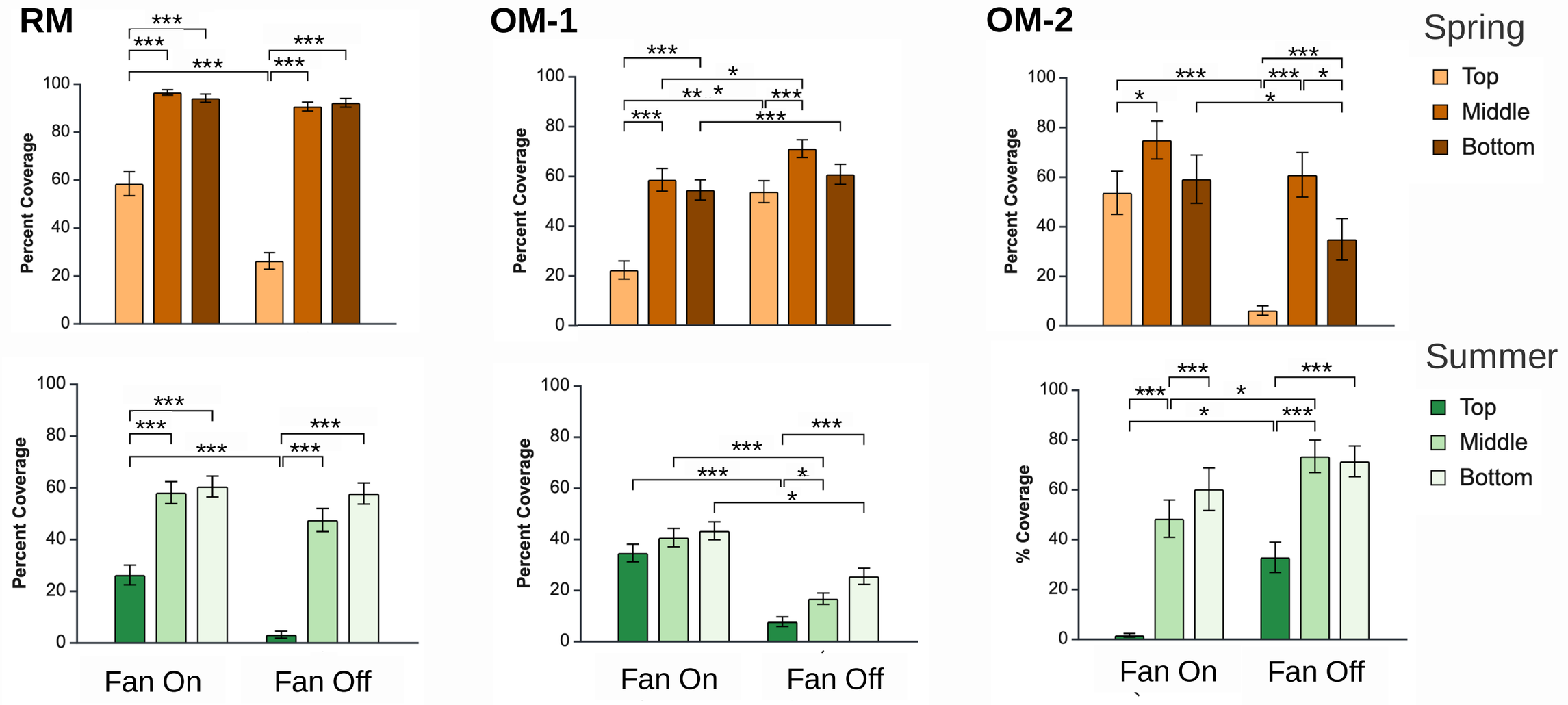
Results: Coverage ranged from 0%-100%

Scans of cards, analyzed in ImageJ



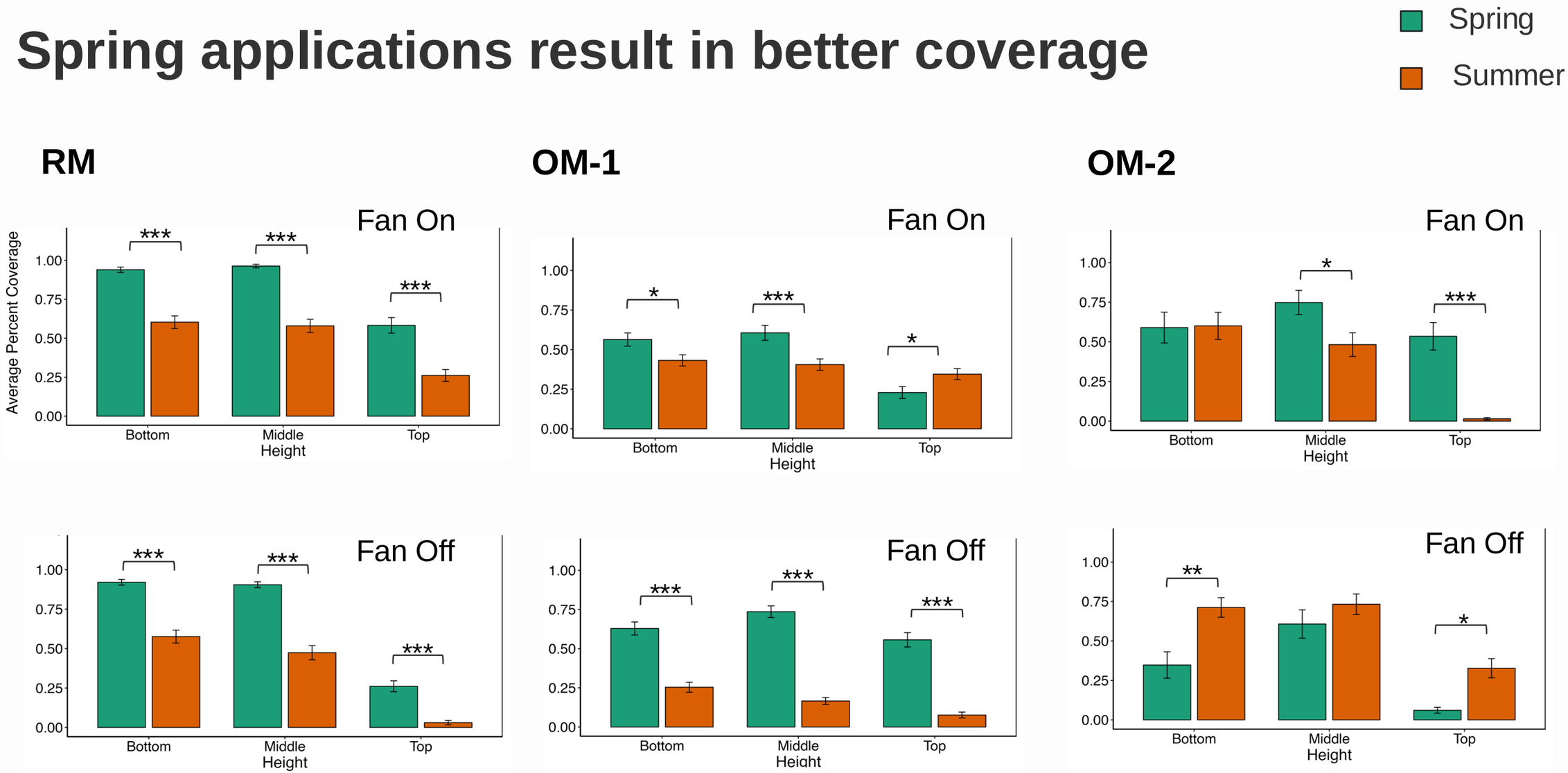
Control 23% 55% 74% 89% 100%

Lowest coverage on top cards, in both seasons



Asterisks and brackets indicate significance in pairwise comparisons (Kenward-Roger degrees of freedom).
Significance levels: $p < 0.001$ ***, $**p < 0.01$ **, $p < 0.05$ *.

Spring applications result in better coverage



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Coverage Trial Conclusions

Part 1

Which factors impact uniform coverage of branches?

1. How does coverage vary by height in trees?

Coverage is not evenly distributed, top cards consistently received the lowest coverage

2. Do air-blast sprayer fans improve the uniformity of coverage?

Fan use impacted coverage, but trends were not consistent. The impact of fan use may depend on orchard characteristics such as height and canopy density.

3. Is coverage better in spring or summer applications?

Coverage is higher in spring, bare trees had much higher coverage. Foliage likely blocks spray, even with fan use.

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Part 2 : Efficacy

Part 1

Which factors impact uniform coverage of branches?

Part 2

Do canopy sprays prevent or limit severity of *C. plurivora* infections?

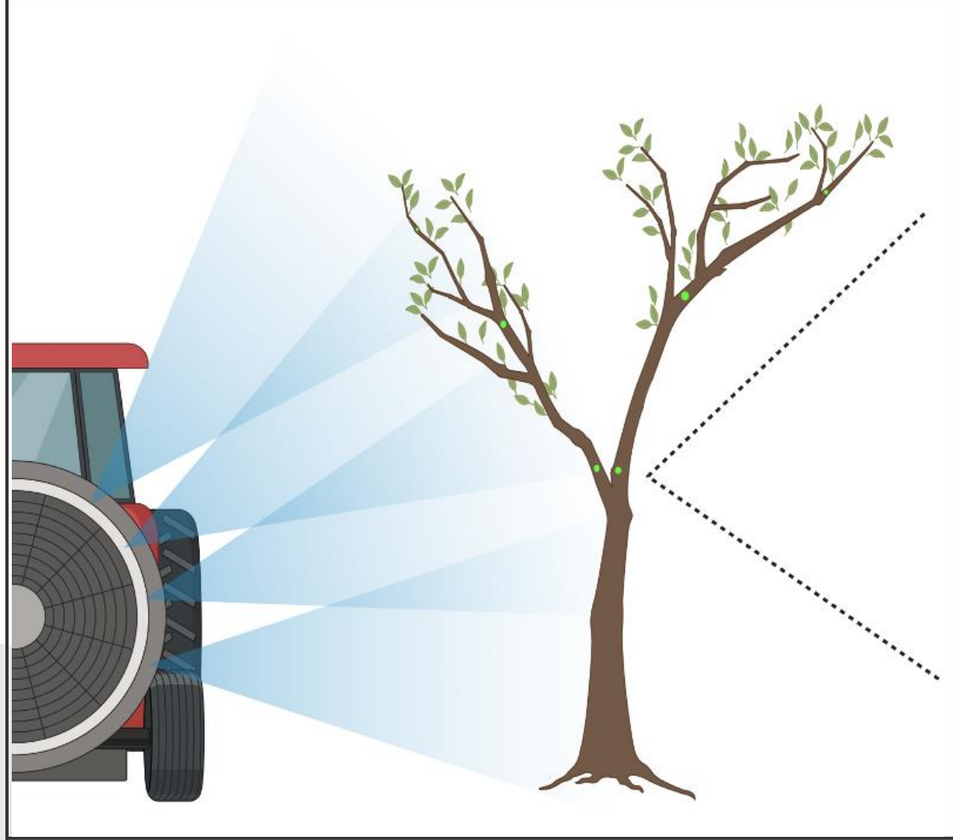
1. Are canopy spray applications of lime sulfur or captan effective?

2. Are fall or spring sprays effective?

3. Does efficacy vary by branch height?

Fungicide sprays were tested in fall and spring

Lime sulfur at RM and captan at OM



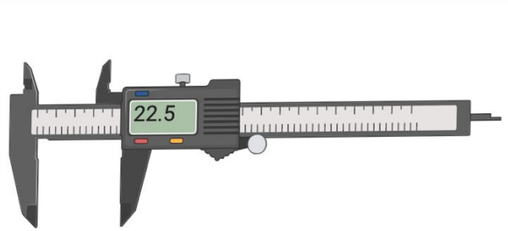
wounded

sprayed

inoculated

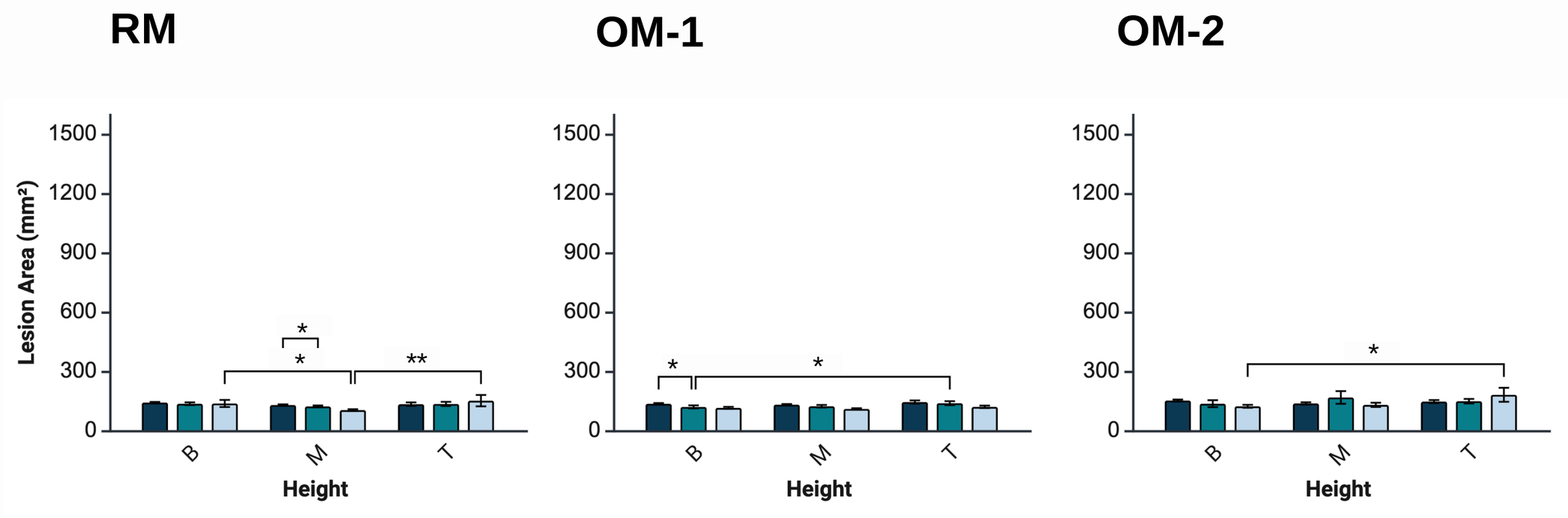
	wounded	sprayed	inoculated
Negative control	✓		
Positive control	✓		✓
Treated	✓	✓	✓

Efficacy was assessed by comparing lesion area (mm²)



No efficacy in fall trials

Lesion growth was minimal overall



Asterisks and brackets indicate significance in pairwise comparisons (Kenward-Roger degrees of freedom).
Significance levels: *p < 0.001* ***, **p < 0.01* **, *p* < 0.05 *.

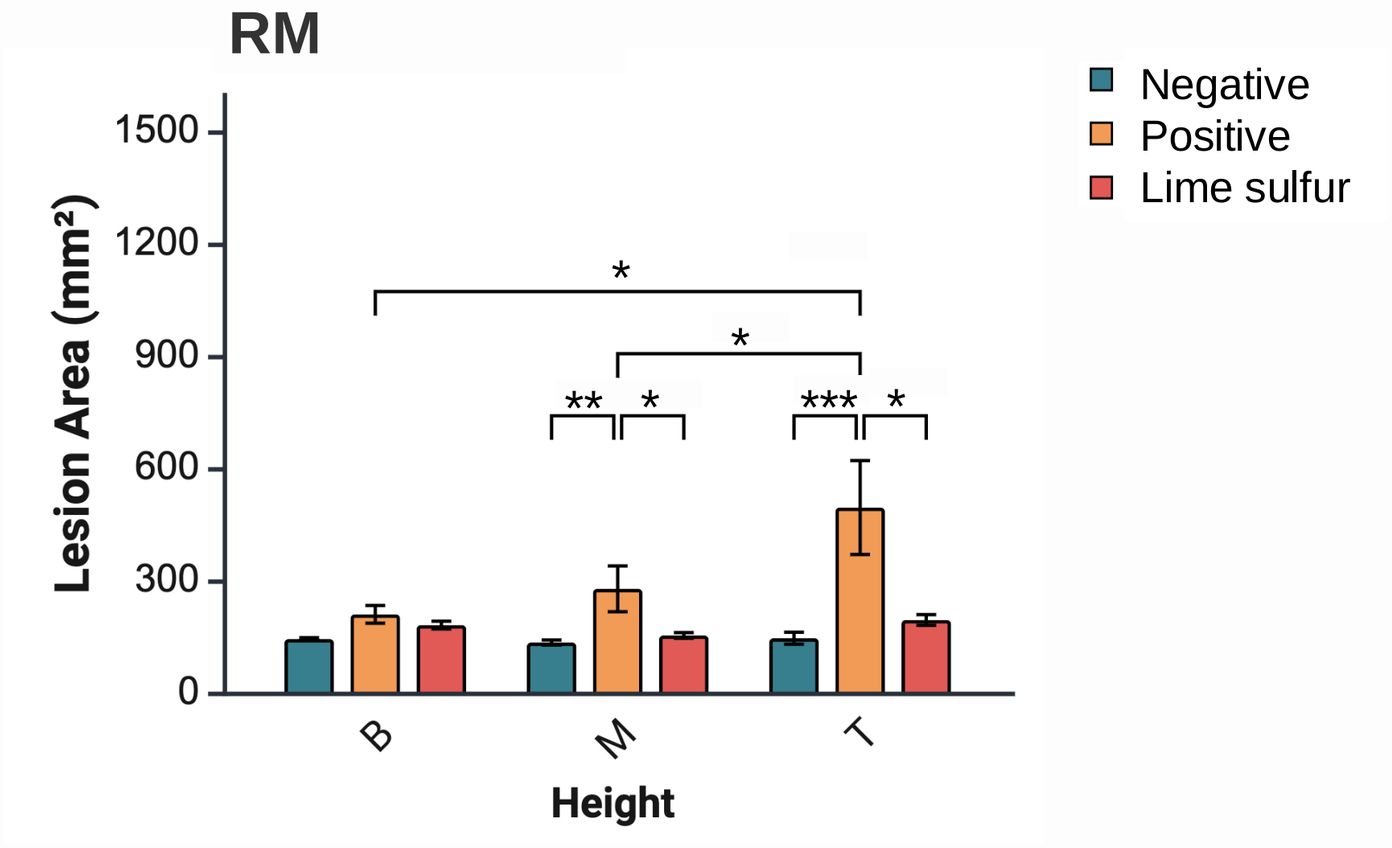
Cold temperatures resulted in minimal lesion growth in fall

Fall: November - March

Spring: April - June

Lime sulfur was effective in spring applications

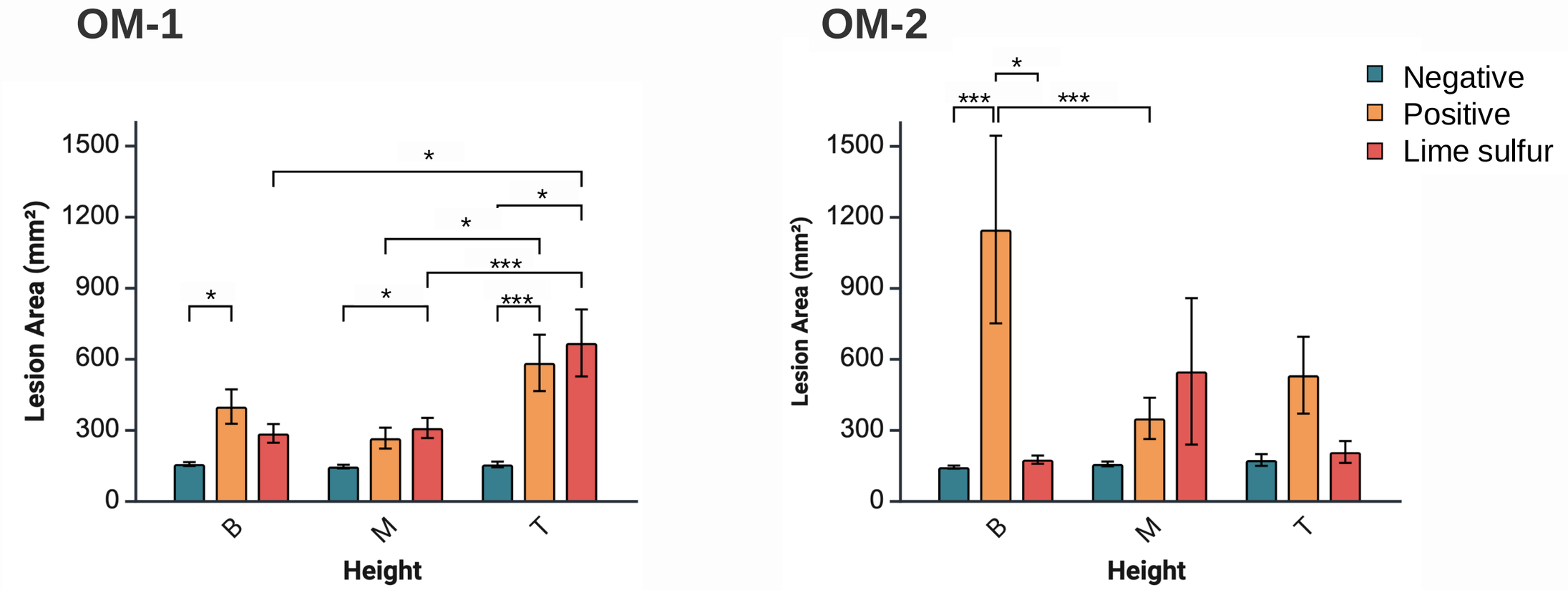
On mid-scaffold and top branches



Asterisks and brackets indicate significance in pairwise comparisons (Kenward-Roger degrees of freedom). Significance levels: *p* < *0.001* ***, **p* < *0.01* **, *p* < 0.05 *.

Efficacy of captan was inconclusive

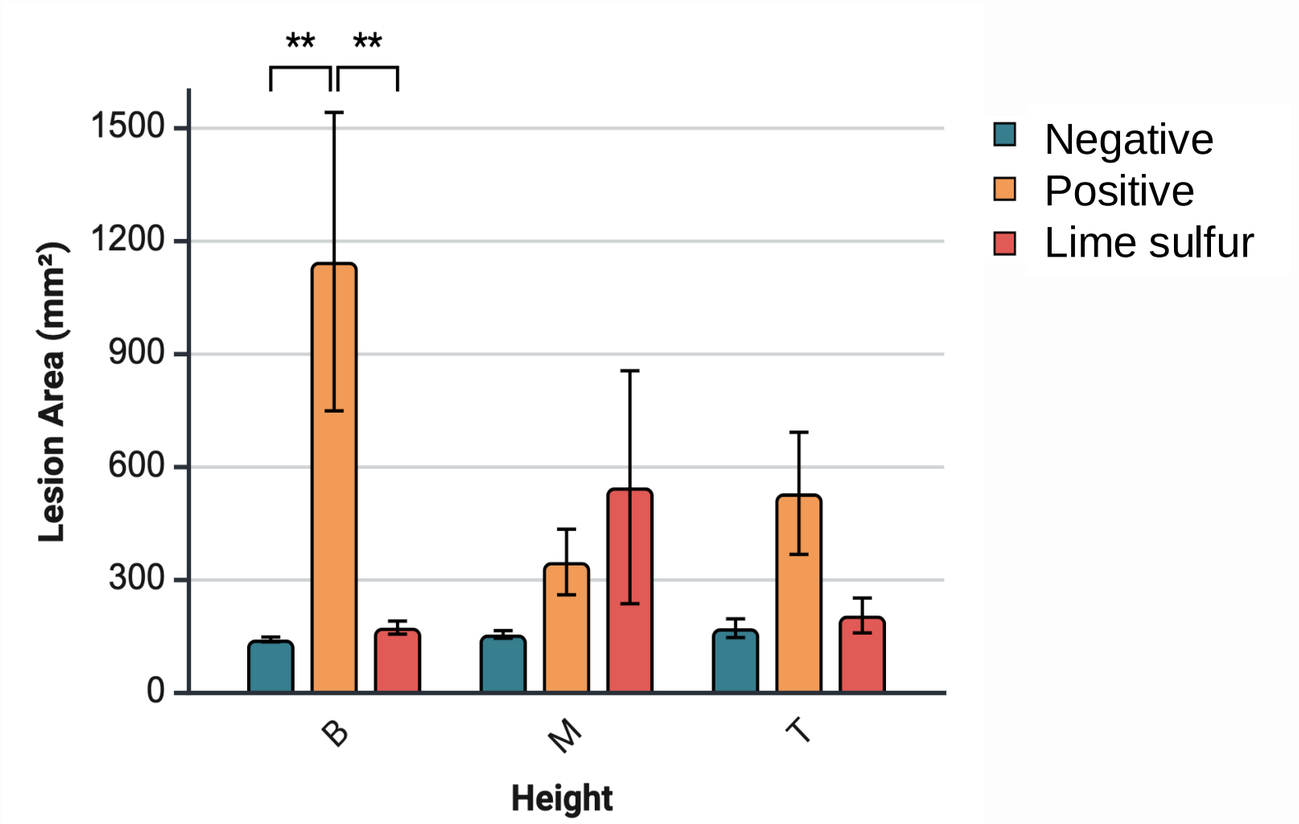
1.5 quarts/acre may be an insufficient rate



Asterisks and brackets indicate significance in pairwise comparisons (Kenward-Roger degrees of freedom). Significance levels: *p < 0.001* ***, **p < 0.01* **, *p* < 0.05 *.

Captan was effective on main scaffold branches in OM-2

84.85% decrease in lesion area, orchard characteristics may have played a role



Asterisks and brackets indicate significance in pairwise comparisons (Kenward-Roger degrees of freedom). Significance levels: *p < 0.001* ***, **p < 0.01* **, *p* < 0.05 *.

Fungicide Trial Conclusions

Part 2

Do canopy sprays prevent or limit severity of *C. plurivora* infections?

1. Are canopy spray applications of lime sulfur or captan effective?

Lime sulfur and captan were only effective under certain circumstances.

2. Are fall or spring sprays effective?

Spring applications of lime sulfur (3%) may be effective.

Captan is not consistently effective at 1.5 quarts/ acre, but the efficacy observed warrants further study.

3. Does efficacy vary by branch height?

Yes, but no consistent trends.

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Biocontrols may be an alternative to traditional fungicides

Vintec now registered in CA for Cytospora canker

- *Trichoderma* based product
- More effective against *C. plurivora* than Topsin

Control

Topsin

Vintec active ingredient

	C. plurivora ($n = 24$)		
Wound treatment	MPR (%)[x]	*PP*[y]	95% CL of *PP*[z]
Water	58.3	0.41 b	(0.19; 0.67)
Trichoderma gamsii ICC080 and *T. asperellum* ICC012	41.7	0.59 ab	(0.33; 0.81)
T. harzianum KRL-AG2	29.2	0.72 ab	(0.45; 0.89)
T. paratroviride RTFT014	4.2	0.96 a	(0.74; 0.99)
Thiophanate-methyl	20.8	0.8 ab	(0.54; 0.93)
T. atroviride SC1	4.2	0.96 a	(0.75; 0.99)

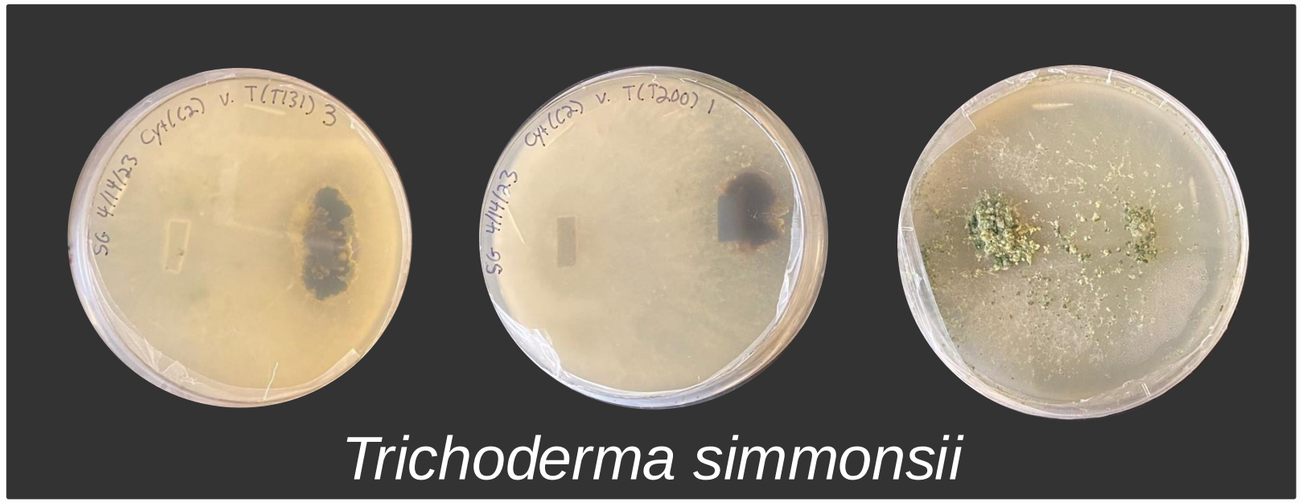
Mean Percent Recovery (MPR) of *C. plurivora* 24 hrs after inoculation

Tavadon et al., (2023)

Trichoderma was effective in preliminary trials

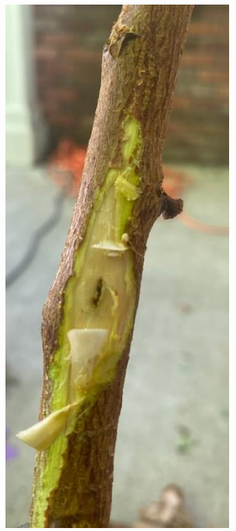
In Vitro

Competition assays
C. plurivora vs. *Trichoderma simmonsii*



Field Trials

Control



T. simmonssii

Inoculations of branches treated with Trichoderma isolates resulted in significantly smaller lesions

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Conclusions

Coverage of branches is best when trees are bare

Uniform coverage is a major issue, particularly for top branches

Continued studies should explore variations in equipment and orchards

Fall Canopy sprays are likely not effective or needed in average years

Latency of fall infections and extent of pathogen spread should be explored

Spring Canopy sprays of Lime Sulfur (3%) may be effective

Repeated studies during multiple seasons

Captan (1.5 quarts/acre) did not show consistent efficacy

Midrate applications may prove more successful

***Trichoderma* spp. and products are effective against C. plurivora**

This warrants future exploration of canopy spray trials

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