Cytospora Canker Research: WCHC2022

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Dr. Stephan Miller

Plant Pathology

Colorado State University

Cytospora Canker

- Caused by a fungus
- Opportunist pathogen (prefers weak trees), cannot invade healthy intact bark

Pruning cut with infection

canker

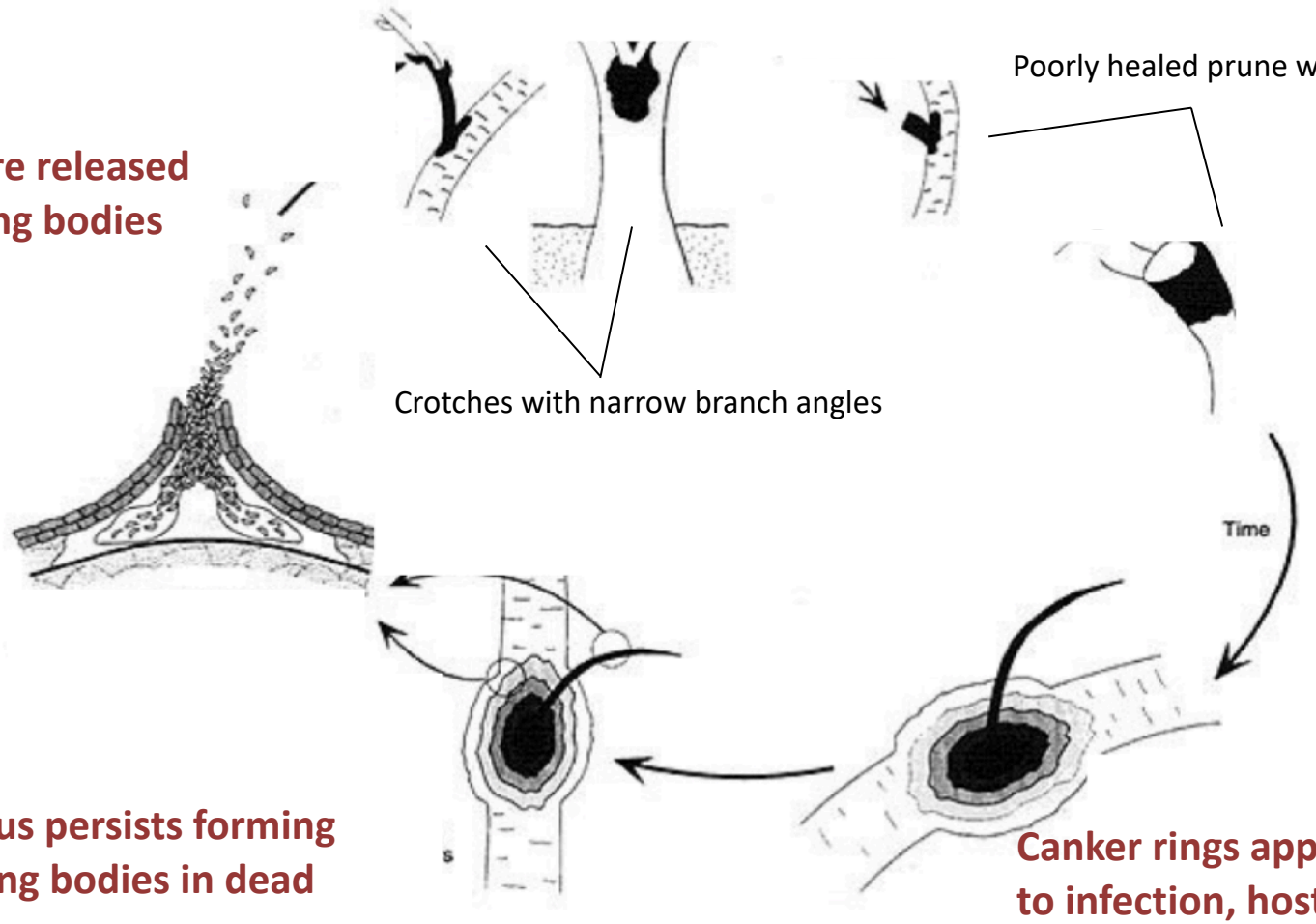
canker

Disease Cycle

Spores infect wounded tissues

Poorly healed prune wounds

Spores are released by fruiting bodies



Fungus persists forming fruiting bodies in dead tissues

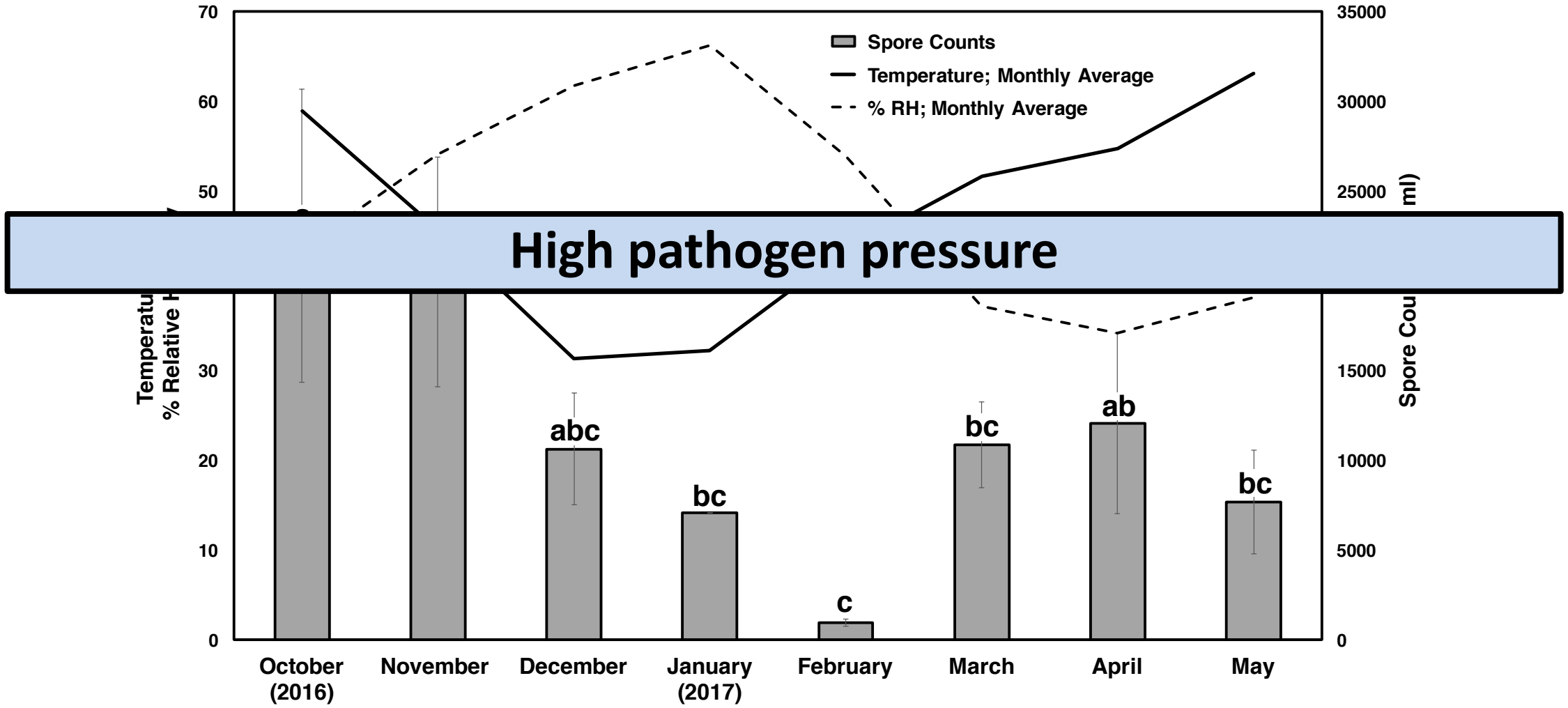
Canker rings appear in response to infection, host callus formation

(Grove & Biggs 2006)

Cytospora Disease Cycle

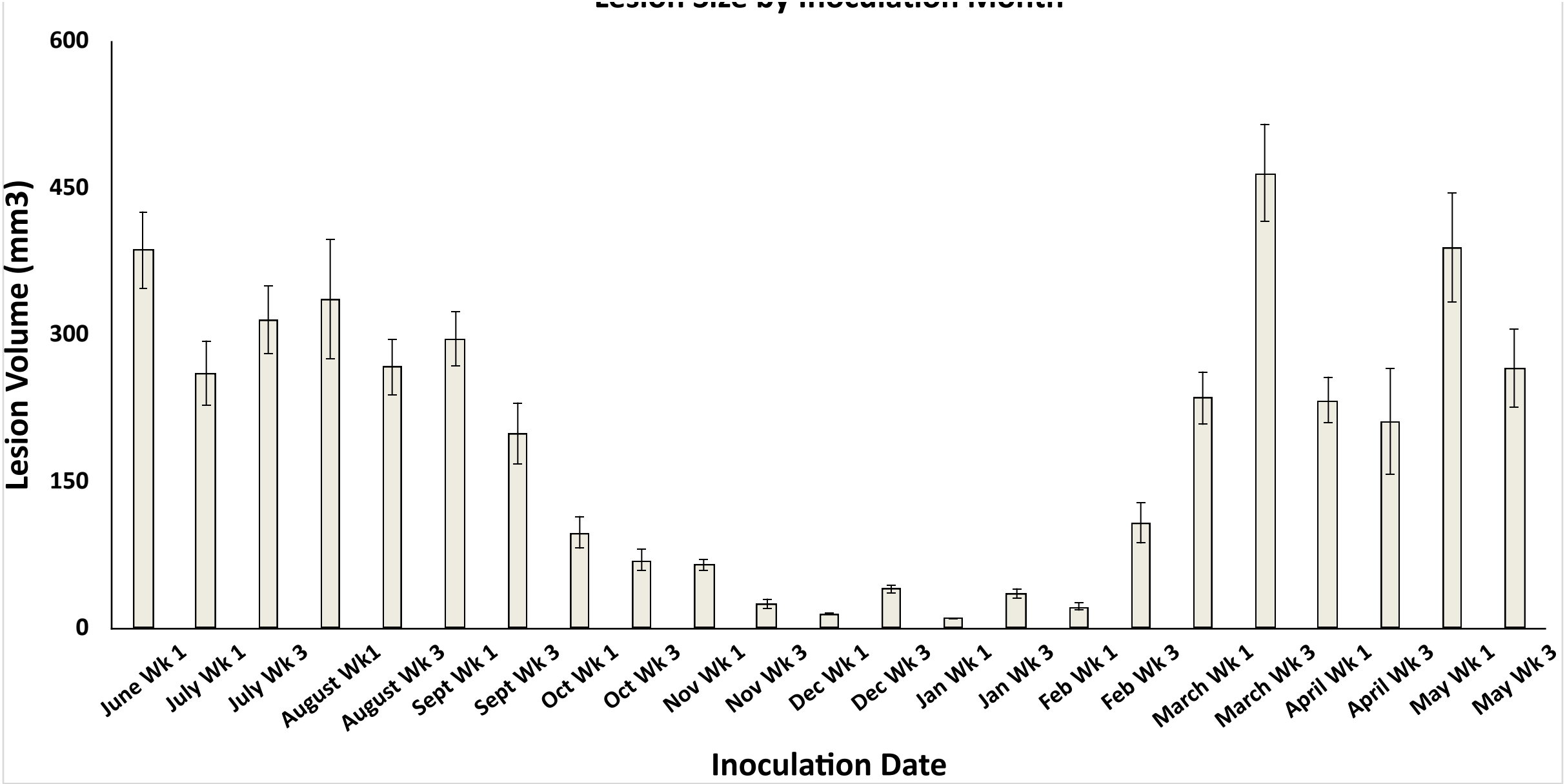
- Fungus grows in bark tissue through open wounds, and can can also enter buds
- Kills by girdling branches or trunk of tree
- Attacks tree when temperatures are above freezing and moisture is available
- Trees affected by drought, late spring frosts, insect and fungi defoliation, sunscald, herbicides, or mechanical injury are susceptible to Cytospora infection

Inoculum produced throughout the year

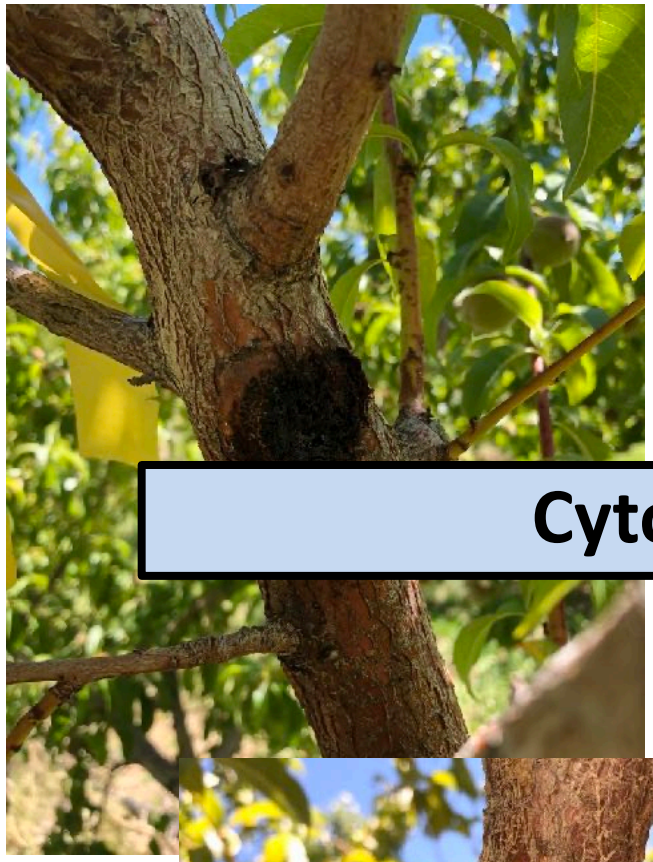


(α = 0.05) (Tukey's HSD adjusted p-values: $P < 0.05$)

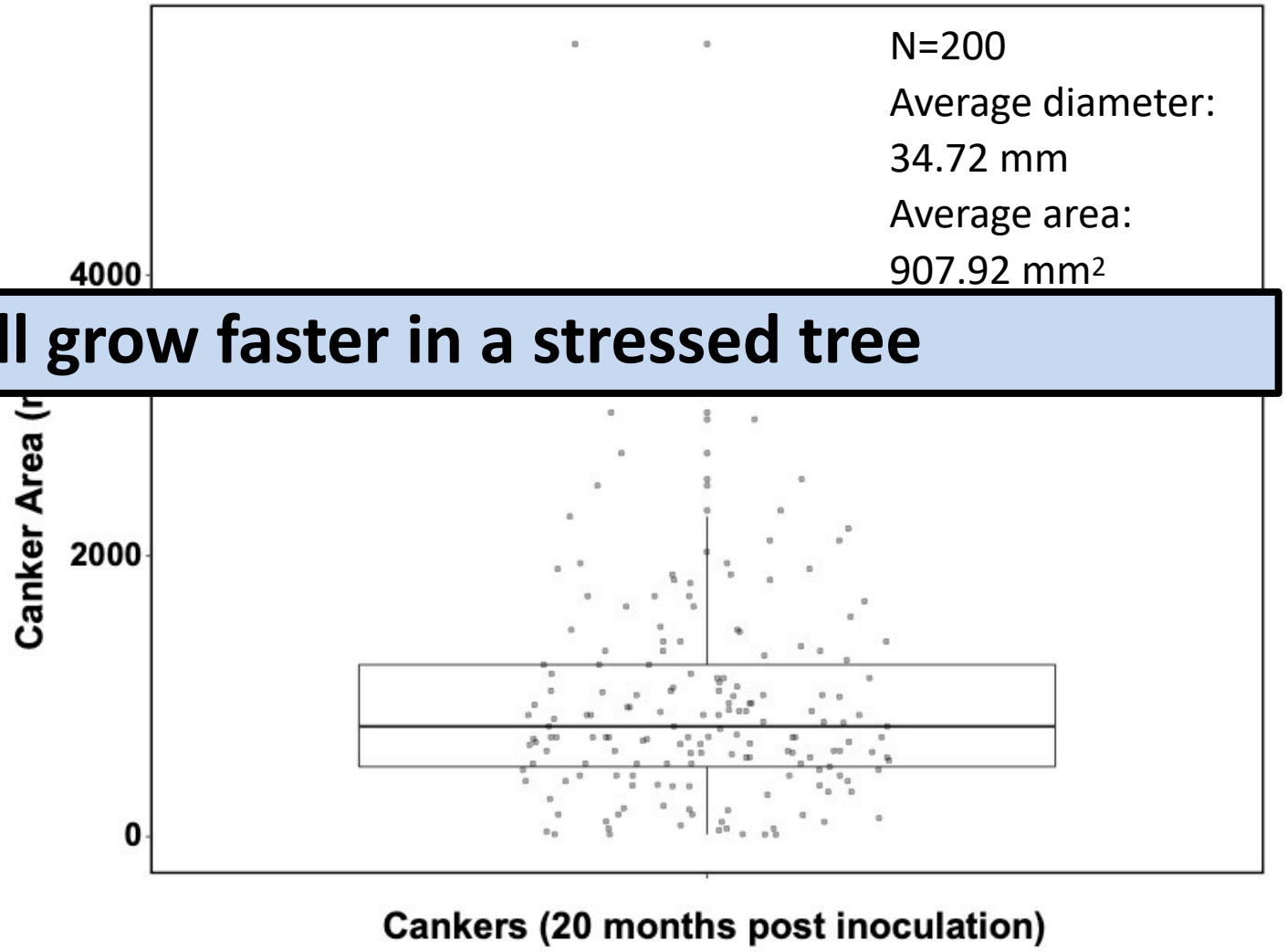
Cytospora can infect peach at any season



Canker growth over 20 months



Cytospora will grow faster in a stressed tree



Comprehensive program for Cytospora Management

- What chemicals are effective against Cytospora?
- Are cultivars equally susceptible?
- How is Cytospora moving around in orchards?
- What is the economic threshold for Cytospora canker?
- What cultural practices are associated with infection?

Testing Chemical Controls

Treatment name	Active ingredient	Mode of Action
CaCl	CaCl	Multi-site
Neem Oil	Neem Oil	Not classified
Mpede	Potassium salts	Multi-site
Kaligreen	Potassium bicarbonate	Not classified
Serenade	Bacillus subtilis	Lipid synthesis/ transport
NuCop WP	Copper Hydroxide	Multi-site
Badge X2	Copper Hydroxide & Copper Oxychloride	Multi-site
ZnSO4	ZnSO4	Multi-site
Lime sulfur	Calcium polysulfide	Multi-site

Treatment name	Active ingredient	Mode of Action
Microthiol Disperss	Sulfur	Multi-site
Fontelis	Penthiopyrad	Respiration
Torino	Cyflufenamid	Unknown
Pristine	Pyraclostrobin & Boscalid	Respiration
Aliette WDG	Fosetyl	Unknown
Topsin M WSB	Thiopthanate-methyl	Site- specific
Benlate WP	Benomyl	Cytoskeleton/ motor proteins
Captan	N-Trichloromethylthio-4-cyclohexene-1,2-dicarboximide	Multi-site
Inspire Super	Difencoconazole & Cyprodinil	Protein synthesis
Ziram	Zinc dimethyldithiocarbamate	Multi-site

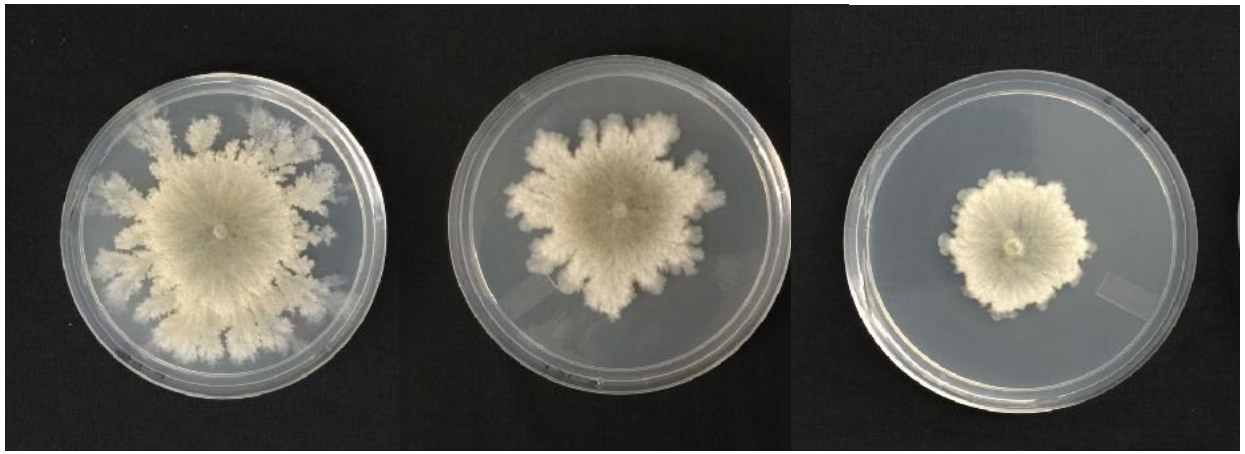
Testing chemicals as laboratory tests

Laboratory Trials:

- Testing chemicals in the lab on petri dishes

  Effective:

  - Aliette, Topsin, Benlate, Captan Inspire, Mpede, Kaligreen, Serenade, NuCop, Badge, ZnSO4, Lime Sulfur



- Testing chemicals in the lab on detached branches

  Effective:

  - Topsin, Captan, NuCop, Lime Sulfur

Fungicide/ Sealant Trials (2018/2019)

Novel Treatment Combinations	% Active Ingredient in Aqueous Solution
VitiSeal	10%
VitiSeal + Thiophanate-methyl	10%, 0.053%
Latex Paint	70%
Latex Paint + Thiophanate-methyl	70%, 0.053%
JMS Oil + Lime Sulfur BSP	90%, 3%
VitiSeal + Lime Sulfur BSP	10%, 3%
Nu-Film + Lime Sulfur BSP	10%, 3%
Latex + Lime Sulfur BSP	70%, 3%

Fungicide/ Sealant Trials (2018/2019)

VitiSeal

- Sealant barrier for plant wounds
- Co-polymer emulsion (contains cinnamon oil)
- Was not OMRI approved

JMS Stylet-Oil

- OMRI approved
- Mineral oil

Nu- Film

- OMRI approved
- Spreader/ sticker derived from pine

Methods: Fungicide Trials (2018/2019)


David Sterle

1. Wounds were made on 1-year old tree shoots and sprayed with label mid-rate applications of fungicides
   - Random complete block design with 20 tree blocks

2. 10^5 spore suspension inoculations made on branches and wrapped in Parafilm

3. Branches were harvested 3 months post inoculations and assessed


Branch being pruned


Fungicide application


Cytospora 10^5 Inoculation

Are Spores Present if Lesions are Not?

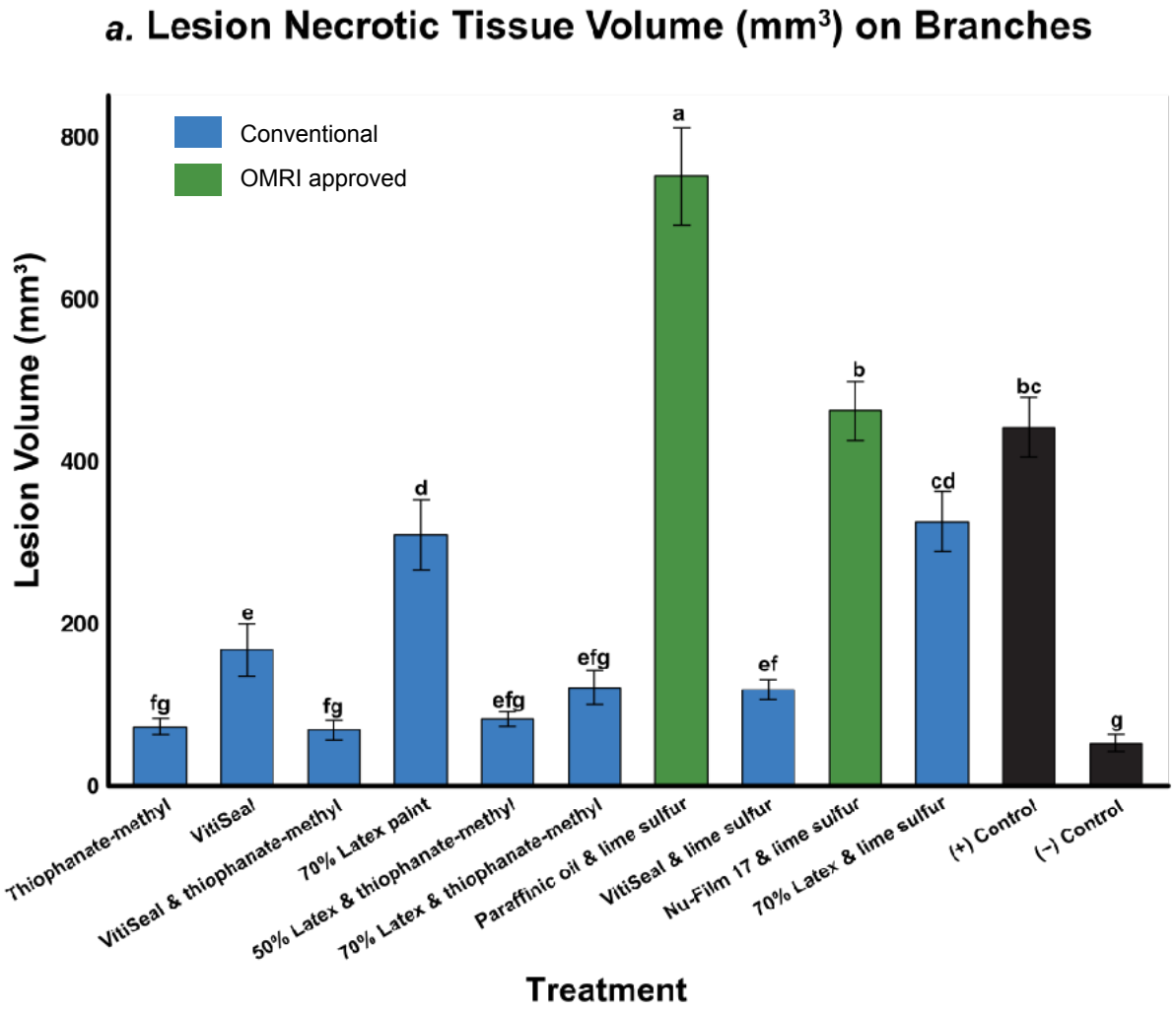
- Isolated tissue from inoculation area
- Placed plant tissue on petri dish to see if fungus was there
- n= 20 per treatment

Branches from field trials

Agar plate with branch tissue

Cytospora colony

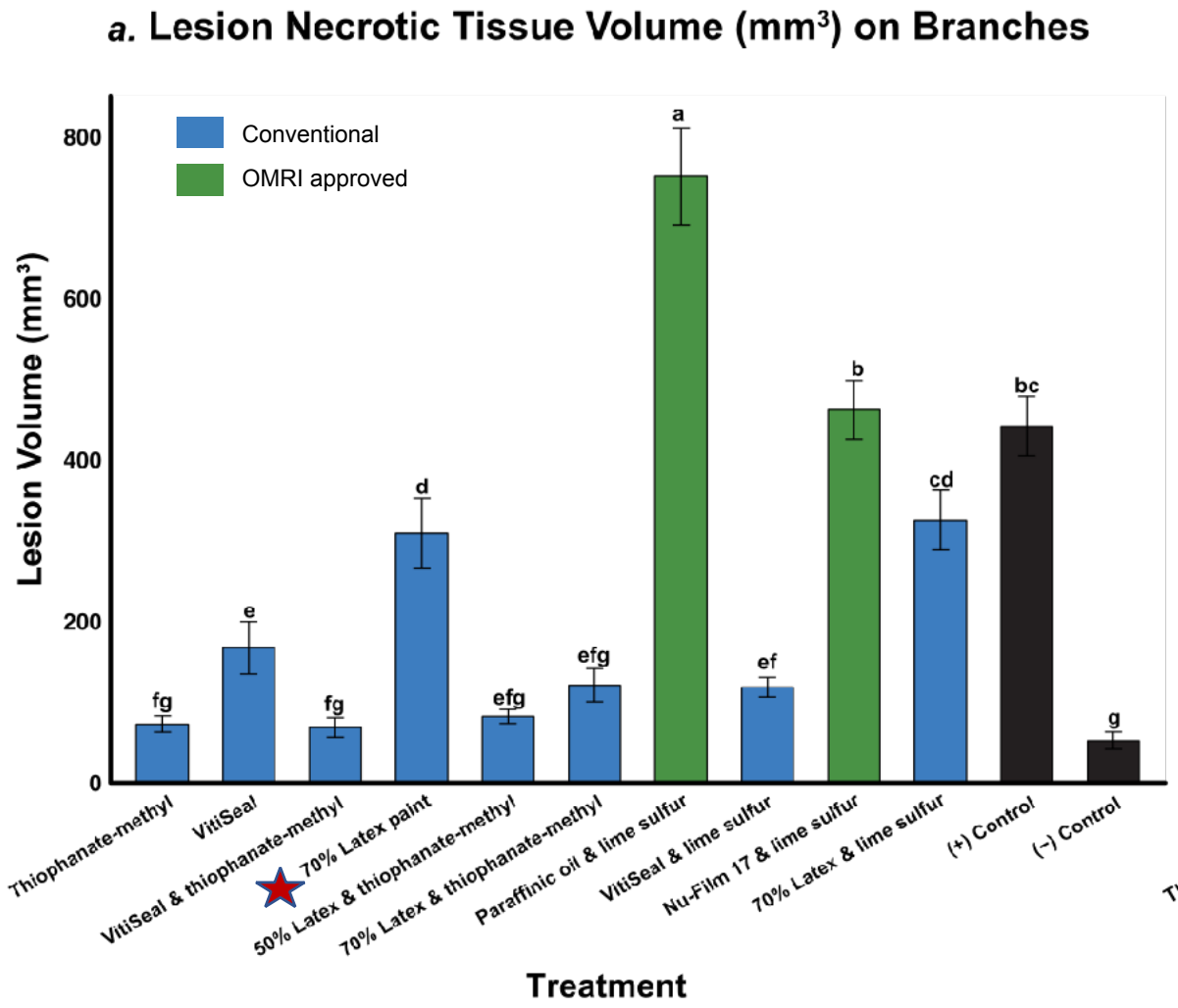
Results: Fungicide Efficacy (2018/2019)

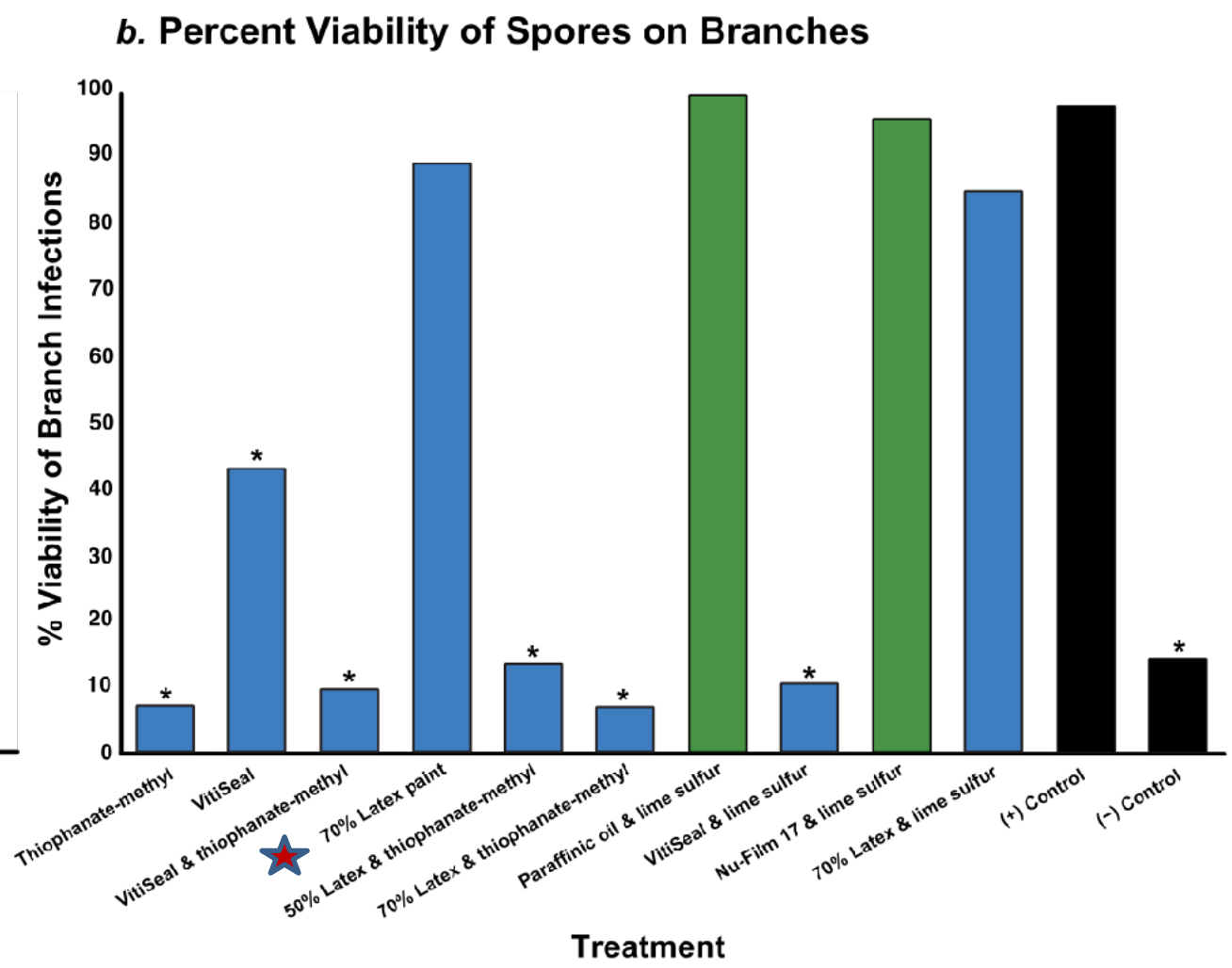


(α = 0.05)
Tukey's HSD adjusted p-values: $P < 0.05$
n= 20 replicates per treatment/ bar

(α = 0.01)
Fisher's Exact Test for Contingency Tables
n= 20 replicates per treatment/ bar

Results: Fungicide Efficacy (2018/2019)





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Tukey's HSD adjusted p-values: $P < 0.05$
n= 20 replicates per treatment/ bar

(α = 0.01)
Fisher's Exact Test for Contingency Tables
n= 20 replicates per treatment/ bar

Miller, Sterle, Minas, Stewart. 2020

Most Effective Preventive Treatments

Effective Chemicals:

- Topsin, Captan, Vitiseal, Lime Sulfur and maybe Cueva

Effective Chemical Mixtures:

- Latex+Topsin, Latex+Captan, Vitiseal+Topsin, Vitiseal+Lime Sulfur

Topsin is high risk for resistance development

COLORADO STATE UNIVERSITY
EXTENSION

Preventive Control for Cytospora Canker on Peach

Fact Sheet No. 2.954 Crop Series | **Diseases**

by Jane E. Stewart[1], Stephan T. Miller[1], Ioannis S. Minas[2,3]

Miller et al. 2019

Are some cultivars more tolerant to Cytospora?

Are some cultivars more tolerant to Cytospora canker?

1. Investigate Host Susceptibility

- Are there peach cultivars that are less susceptible to *C. plurivora*?

2. Investigate Environmental Conditions Favoring Disease

- Does environmental stress increase disease severity?
    1. Water deficit?
    2. Increased soil pH?

Cytospora canker

Exp. 1 **Greenhouse Trials:**

Evaluating cultivars under controlled conditions

Greenhouse Trials

Exp. 2 **Field Trials:**

Evaluating cultivars in production setting

Field Trials

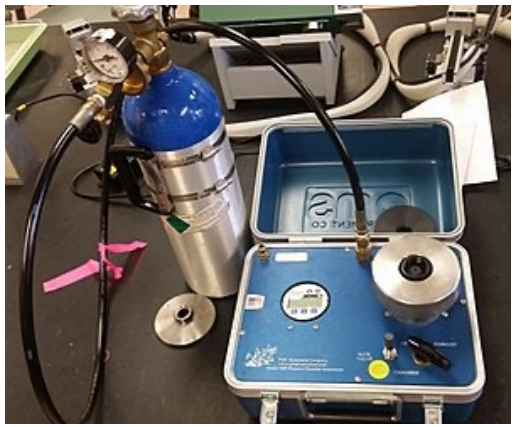
Methods: Greenhouse Trials

Cultivars

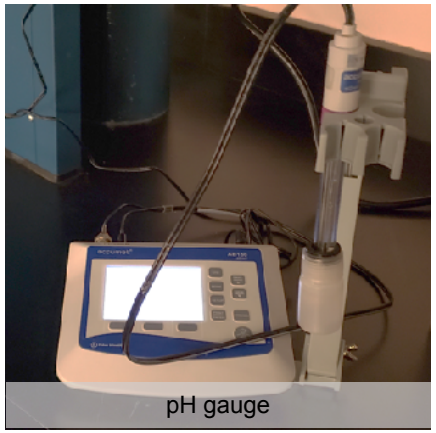
1. **Glohaven**/Lovell Michigan
2. **Glowingstar**/Lovell
3. **Blushingstar**/Lovell
4. **Starfire**/Lovell
5. **Newhaven**/Lovell
6. **Flamin Fury PF 19-007**/Lovell
7. **Flamin Fury PF 23**/Lovell
8. **Flamin Fury PF 24**/Lovell
9. **Red Haven**/Lovell
10. **O'Henry**/Lovell California
11. **Angelus**/Lovell
12. **Suncrest**/Lovell
13. **Cresthaven**/ Lovell

Design

- 5 tree rep. per cult. per treatment
- Trees established for 2 months
- Trees stressed for 2 months
- Inoculated after 2 months of treatments



Pressure bomb for measuring LWP



pH gauge

Treatments

1. Control
- 100% pot capacity
- pH 7

→
- 100% pot capacity determined by weight

2. Deficit- Irrigation
- 60% pot capacity
- pH 7

→
- Trees watered at 60% pot capacity for two months

3. High-pH
- 100% pot capacity
- pH 9

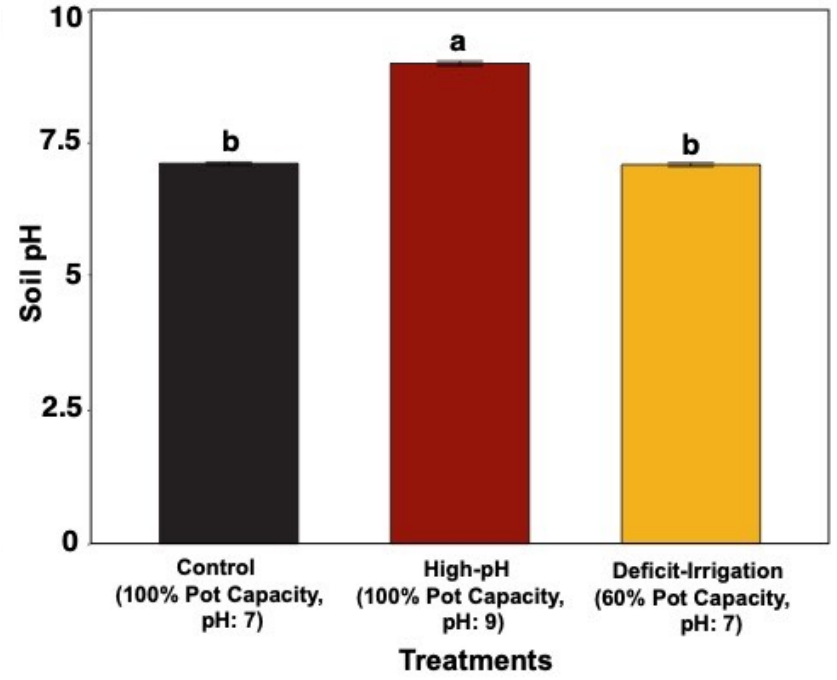
→
- pH adjustments made through irrigation water, through addition of sodium carbonate and bicarbonate

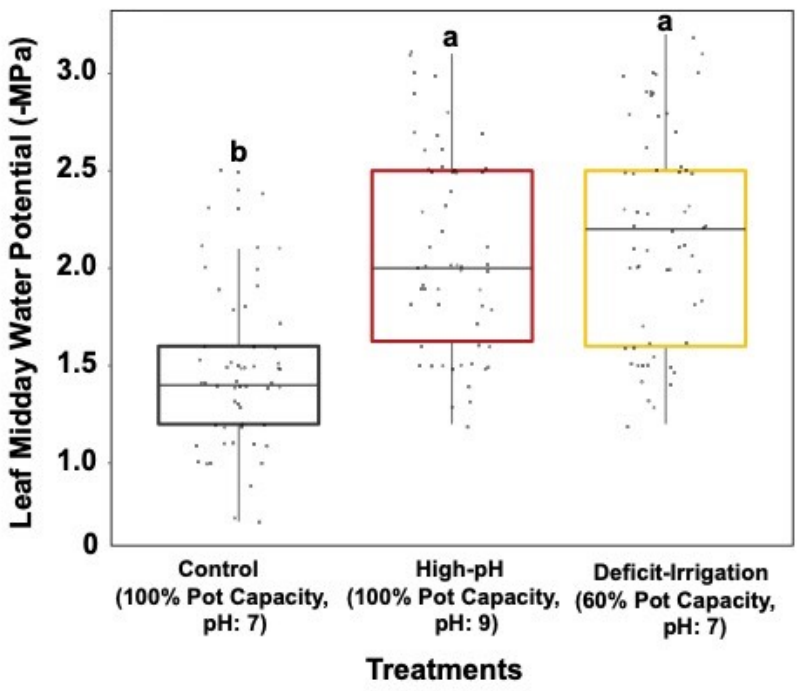
Lesion

- Leaf water potential (LWP) measurements taken at solar mid-day
- Soil slurries evaluated for pH
- Lesion volume mm^3 measured 8 days post inoculation

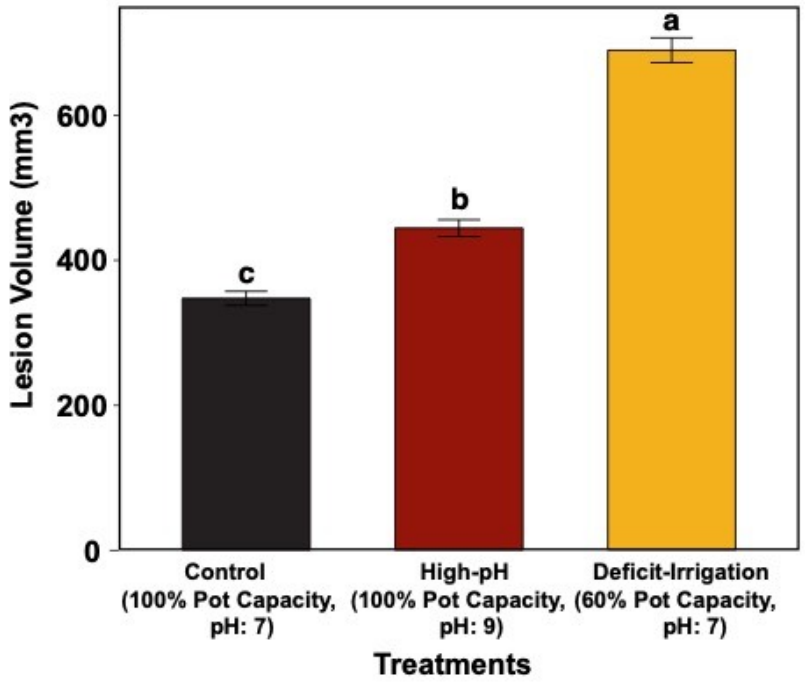
Results: Greenhouse Trials

pH and deficit-irrigation differences between treatments





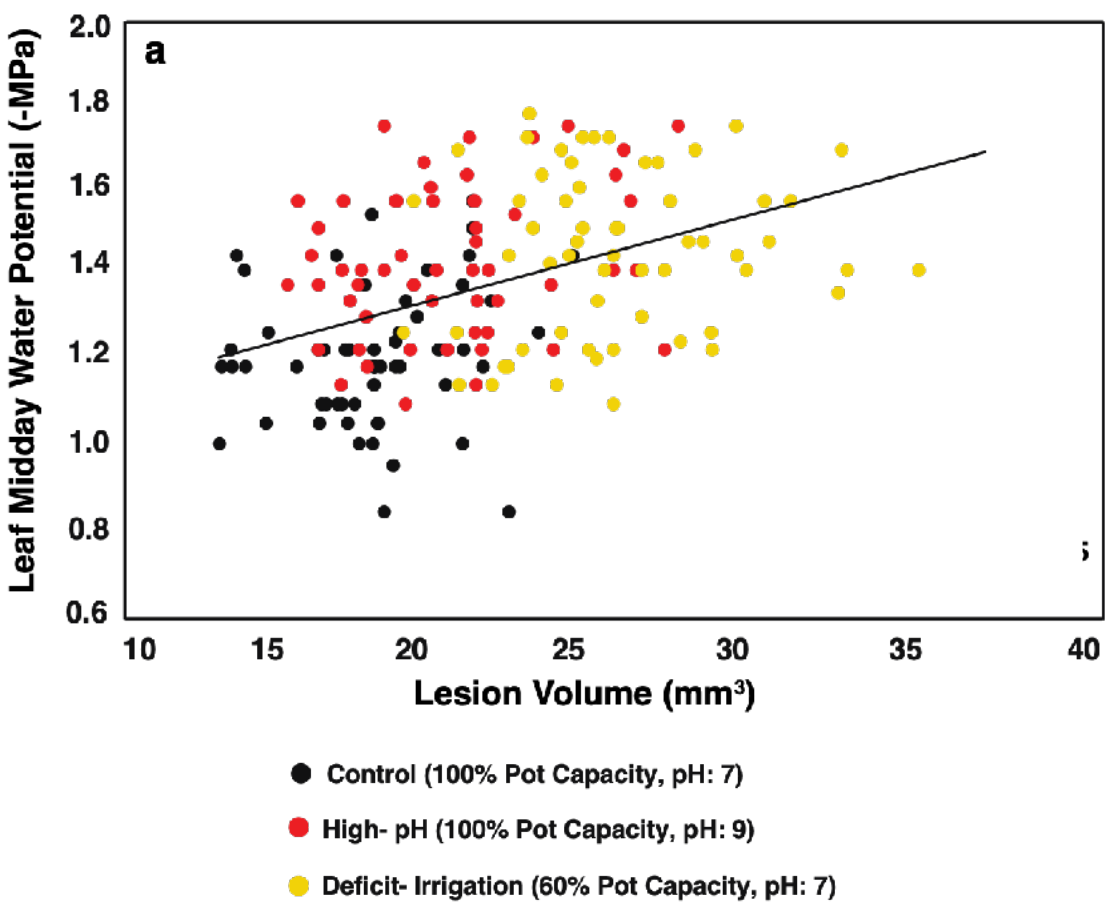
Differences in lesion sizes by treatment

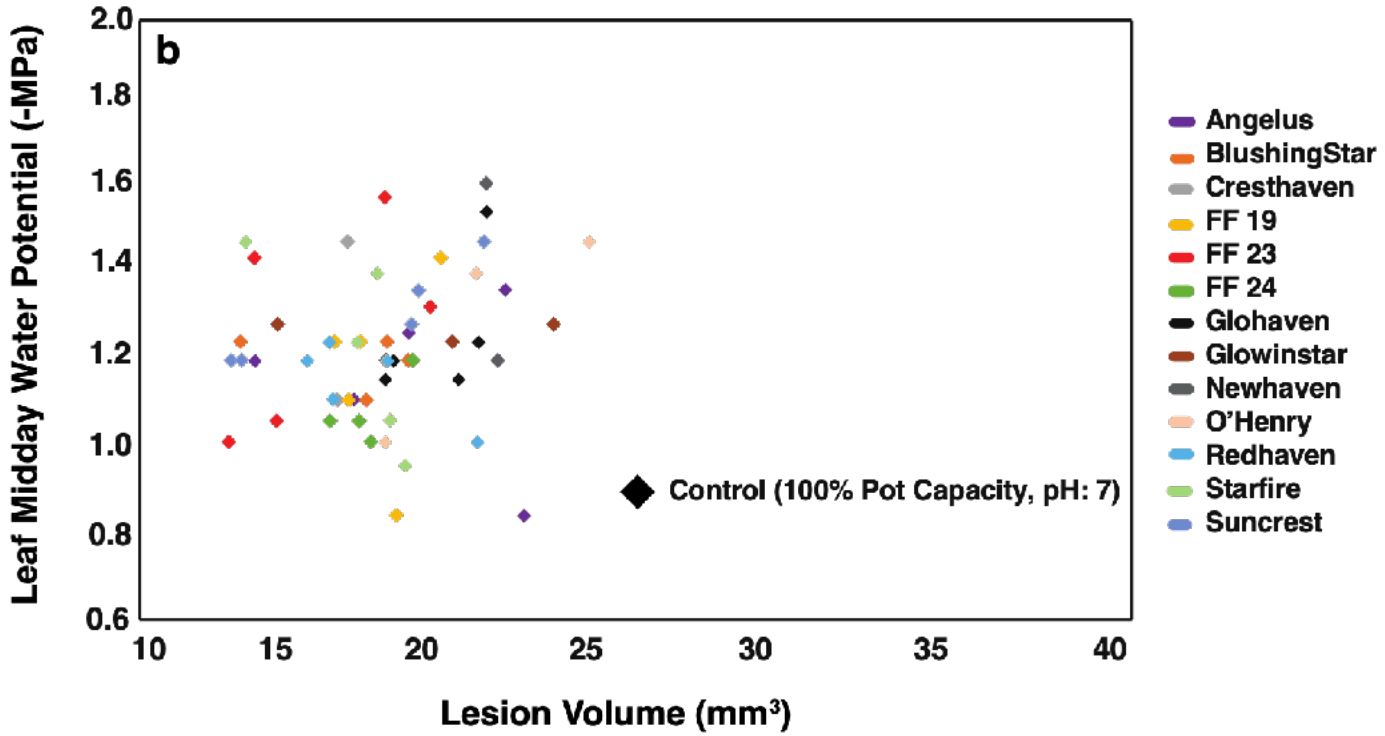


(α = 0.05)
Tukey's HSD adjusted p-values: $P < 0.05$
n = 65 observations per treatment

Results: Greenhouse Trials

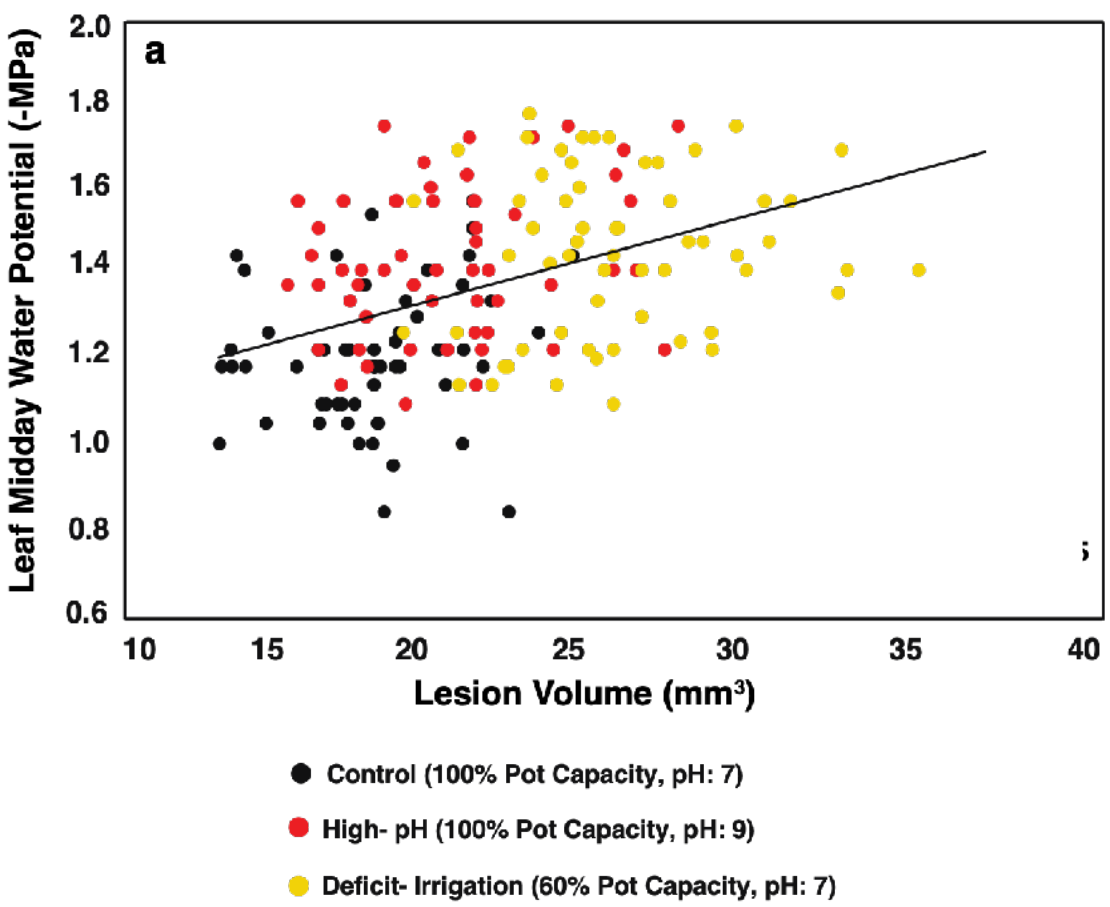
Relationship between lesion volume and leaf water potential

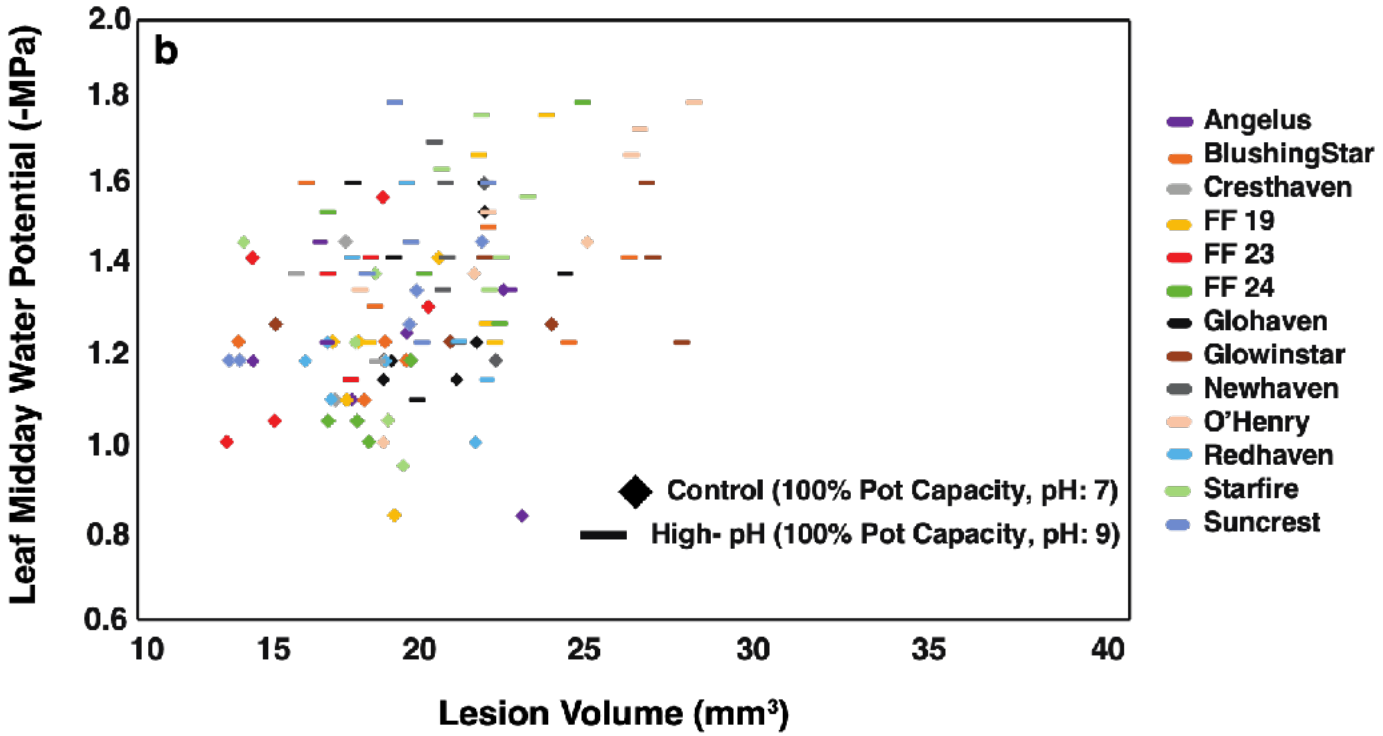




Results: Greenhouse Trials

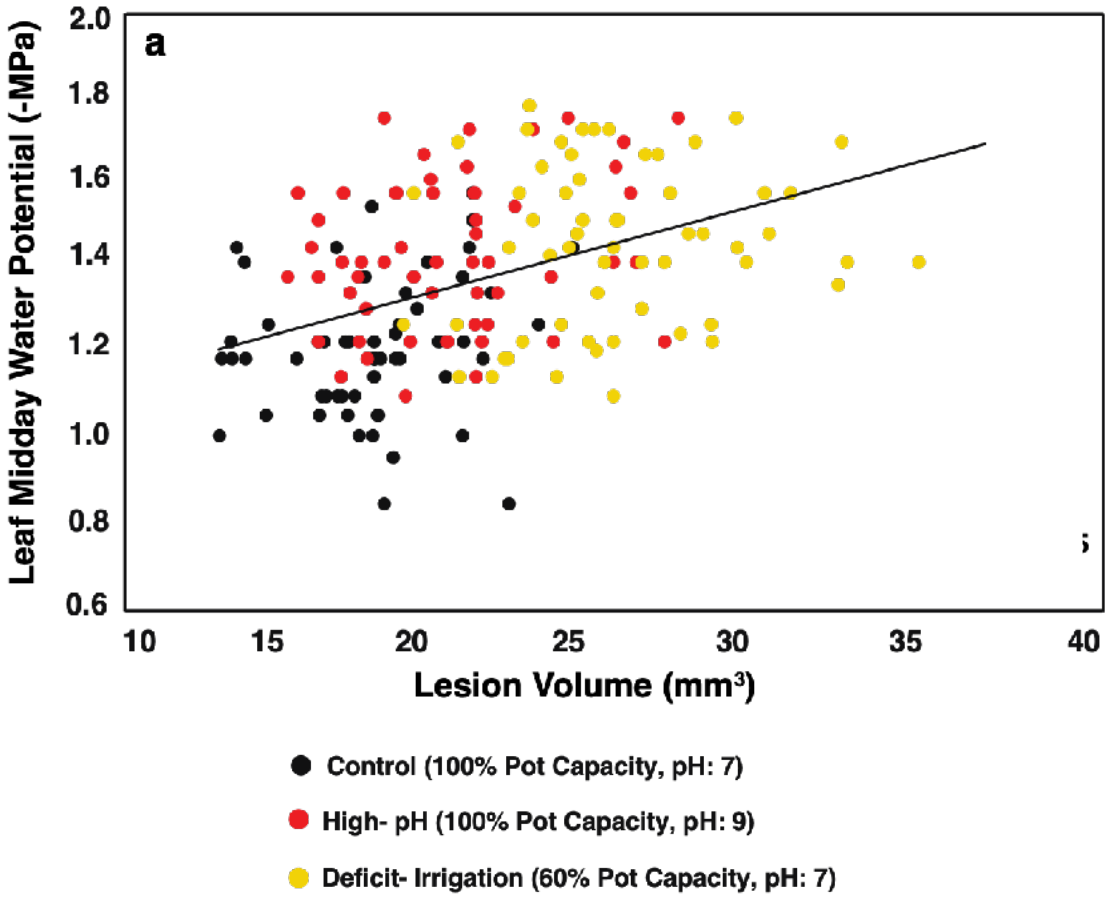
Positive Relationship between lesion volume and leaf water potential



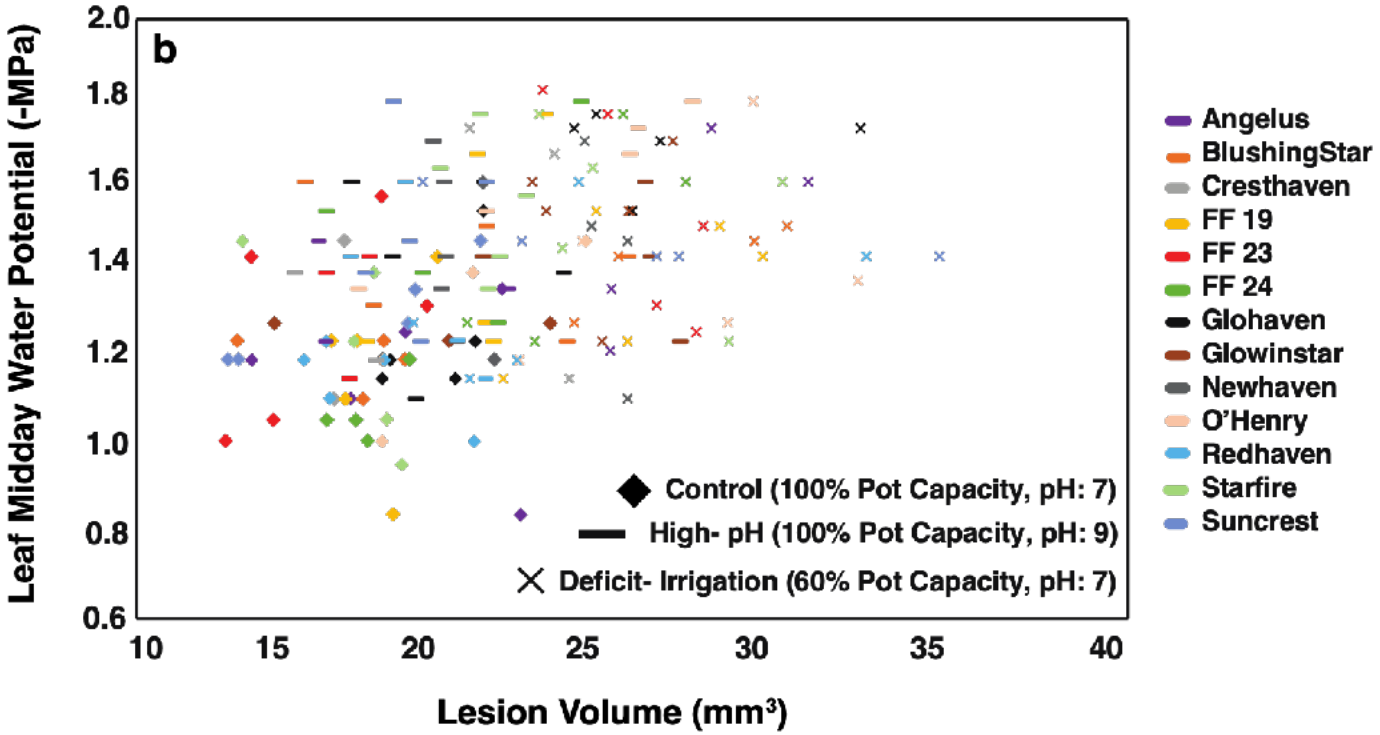


Results: Greenhouse Trials

Positive Relationship between lesion volume and leaf water potential



No cultivar trends



Field Trials: Evaluating cultivars in production setting

Cultivars

1. **Glohaven**/Lovell Michigan
2. **Glowingstar**/Lovell
3. **Blushingstar**/Lovell
4. **Starfire**/Lovell
5. **Newhaven**/Lovell
6. **Flamin Fury PF 19-007**/Lovell
7. **Flamin Fury PF 23**/Lovell
8. **Flamin Fury PF 24 Cold Hardy**/ Lovell
9. **Red Haven**/Lovell
10. **O'Henry**/Lovell California
11. **Angelus**/Lovell
12. **Suncrest**/Lovell

Design

5 tree repetitions per cultivar per treatment

- Trees established from 2018-2020

Treatments

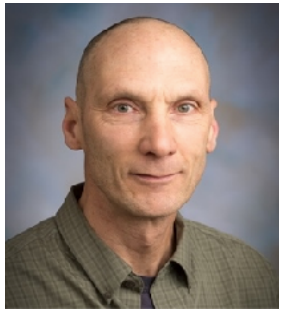
1.Full-irrigation row

- RAW of clay-loam soil
  - 2.1 acre/inch water

2. Deficit- irrigation row

- 60% of RAW = 1.26 acre/inches

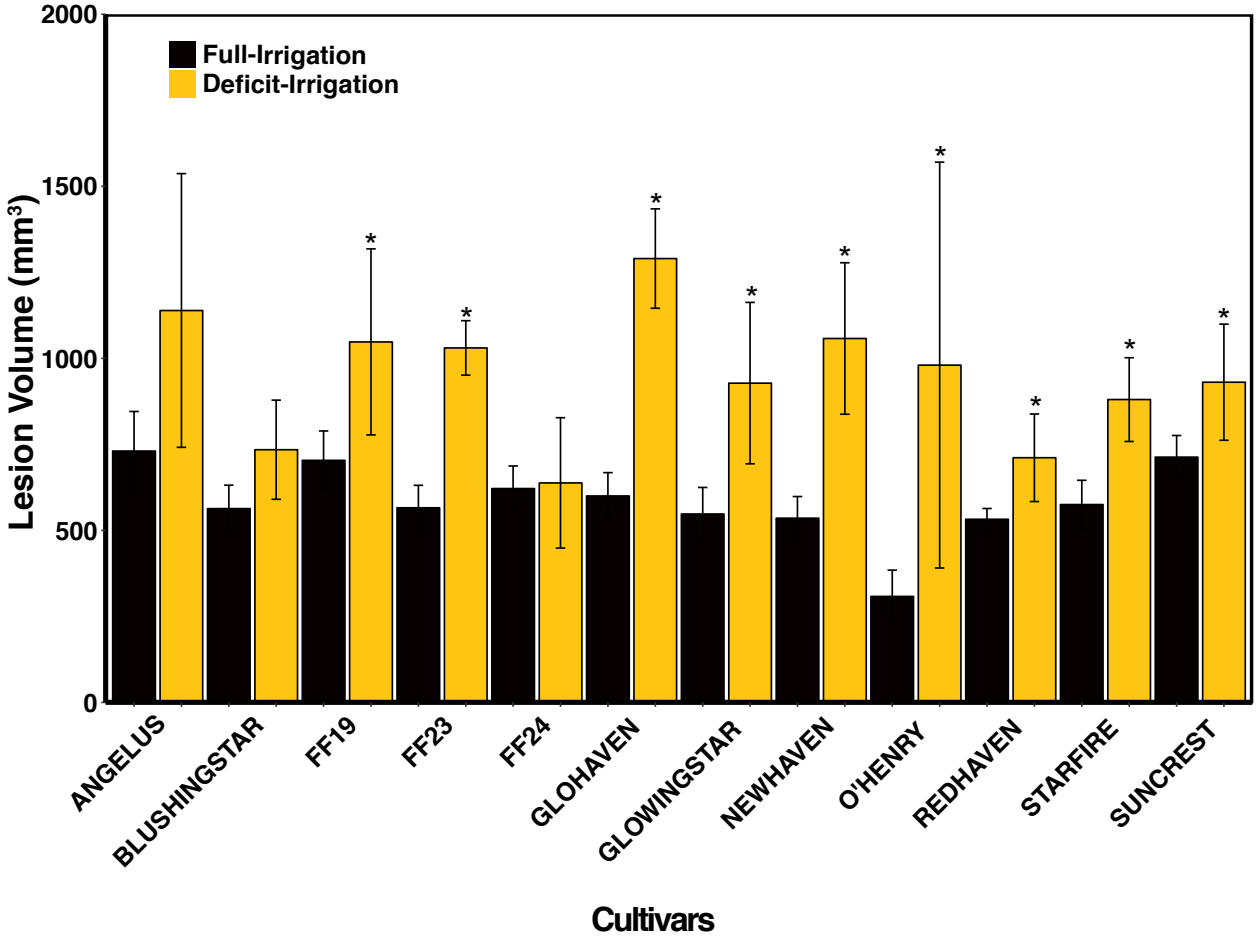
- Pre-dawn WP taken b/t 0300HR and 0600HR
  - Taken once a day for an entire irrigation period
- Trees Inoculated after 3 months of treatments
- Lesion volume mm^3 measured 8 days post inoculation



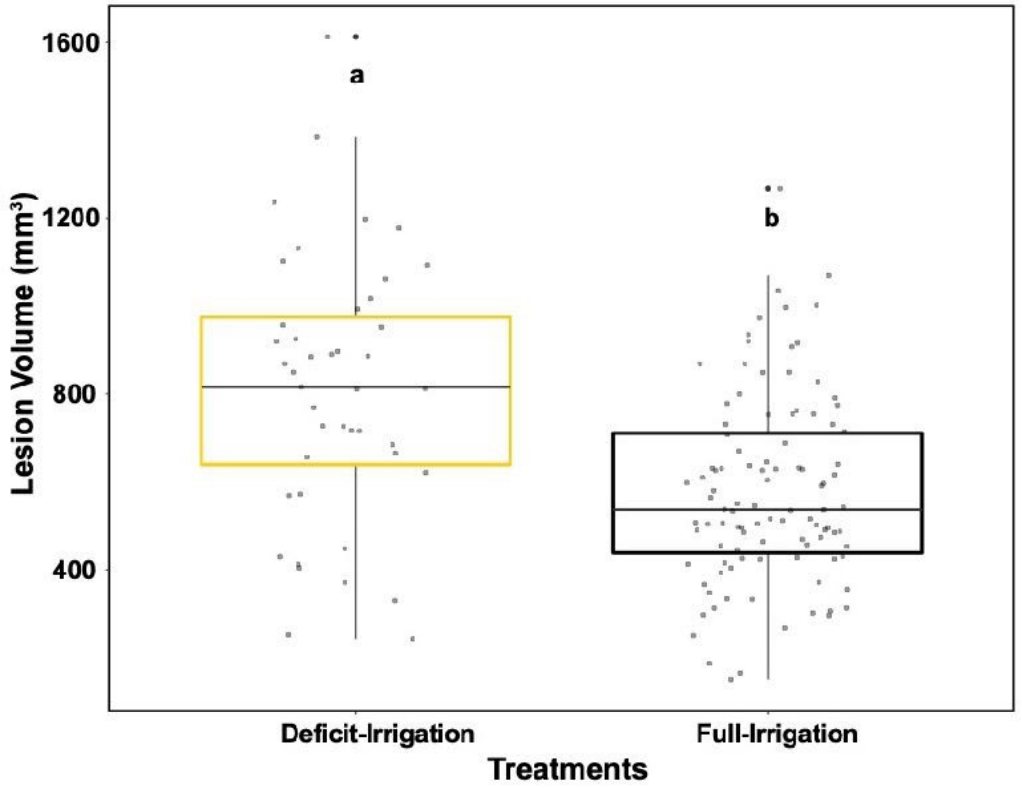
Dr. Greg Litus

Sean Wright

Increased lesion size under deficit-irrigation



(α = 0.05)
Tukey's HSD adjusted p-values: $P < 0.05$
n= 25 replicates per bar, 5 averaged observations per bar



(α = 0.05)
Tukey's HSD adjusted p-values: $P < 0.05$
n= 300 replicates per treatment, 60 observations per treatment

Are some cultivars more tolerant to Cytospora canker?

Are there peach cultivars that are less susceptible to Cytospora canker?

- PF24 showed evidence of tolerance in all trials
- Little differences across scion tissues

Does environmental stress increase disease severity?

- Water deficit + increased pH/ salinity increases disease severity on host and decreases tree water potential.

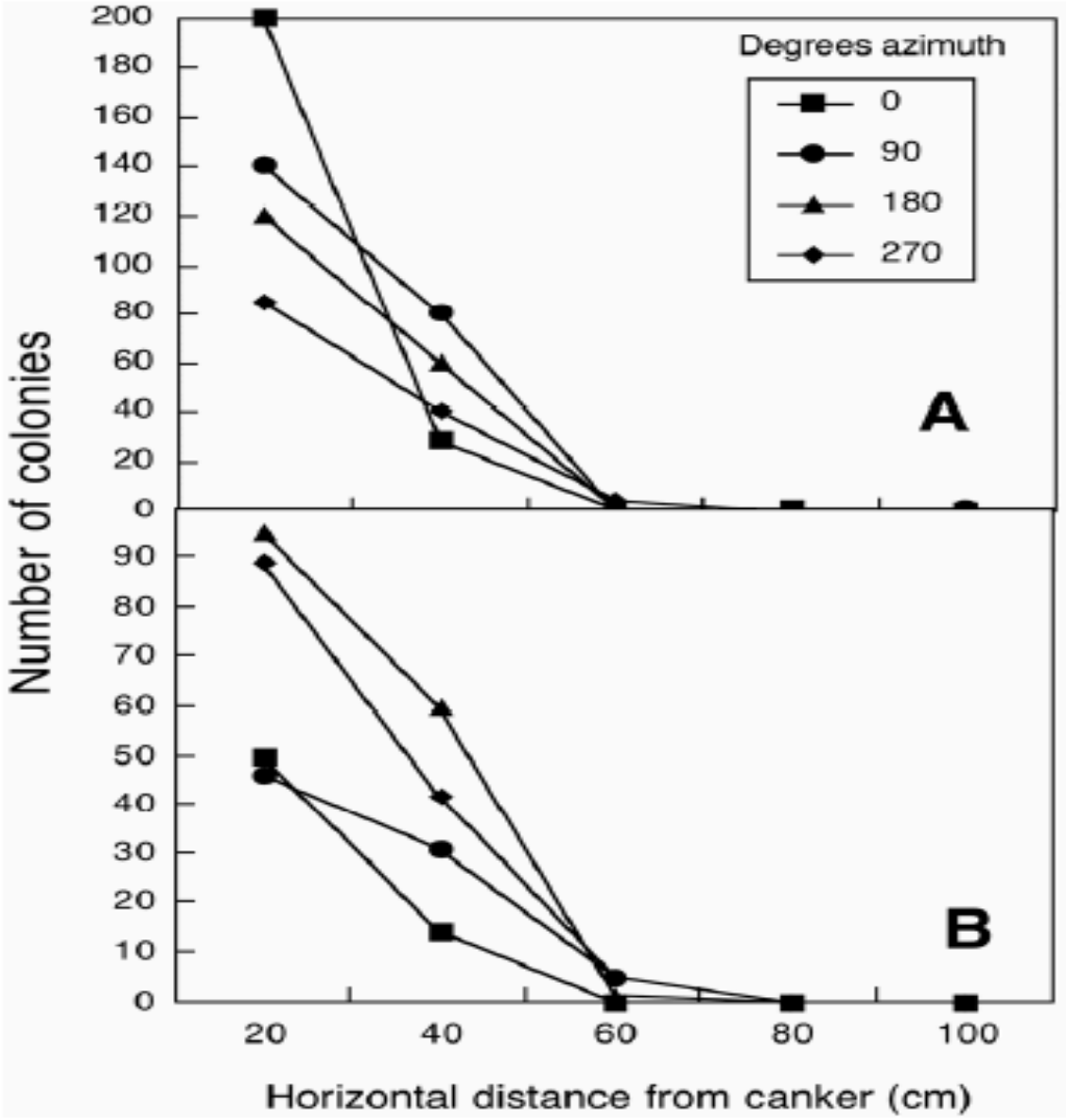
Cytospora canker

Comprehensive program for Cytospora Management

- What chemicals are effective against Cytospora?
- Are cultivars equally susceptible?
- How is Cytospora moving around in orchards?
- What is the economic threshold for Cytospora?
- What cultural practices are associated with infection?

Rain splash is important for inoculum spread

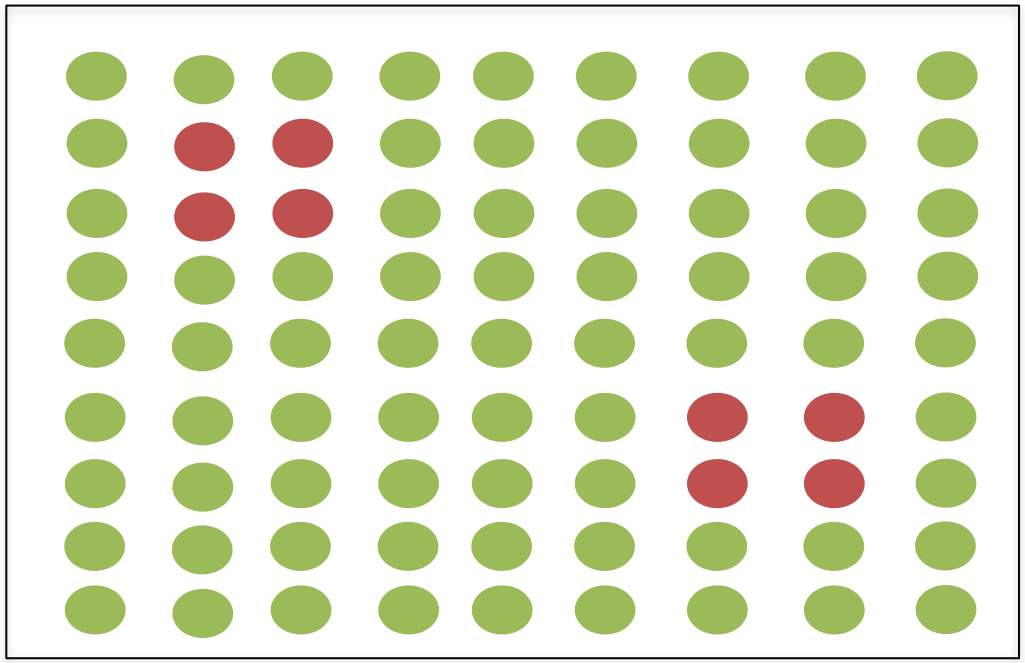
- Maximum spread 2 ft from rain splash
- More inoculum further at angles higher than 90 degrees from canker



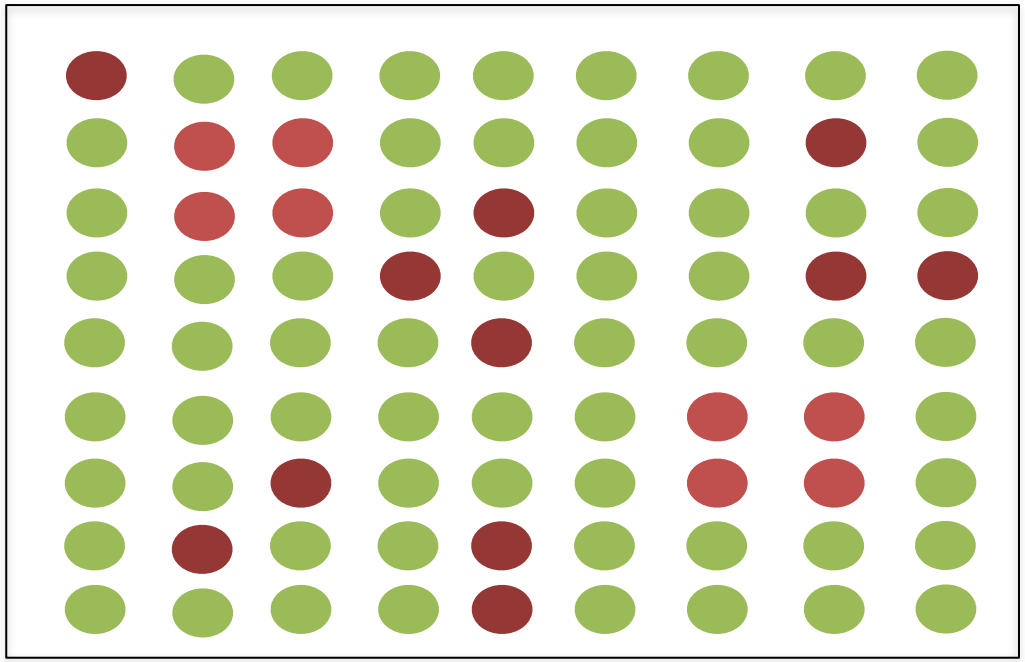
Grove and Biggs 2006. Plant Disease

Is inoculum spread similarly in Colorado?

Pattern of disease if spread only by rain splash



Patterns we observe in orchards in Colorado



What are ways spores travel long distances?

Wind, insects, humans?

Marker development as an epidemiology tool

- A digital drop molecular assay was developed for and tested against closely-related species of *Cytospora*
- Collect aerial samples
- Collect insects and test for vectors
- Test nursery stock

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COLORADO STATE UNIVERSITY

CDA CO COLORADO Department of Agriculture

FARM BILL
SECURING OUR FUTURE

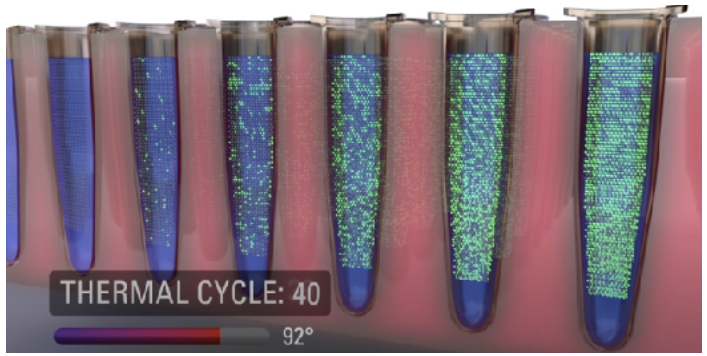
Droplet Digital PCR – detection method

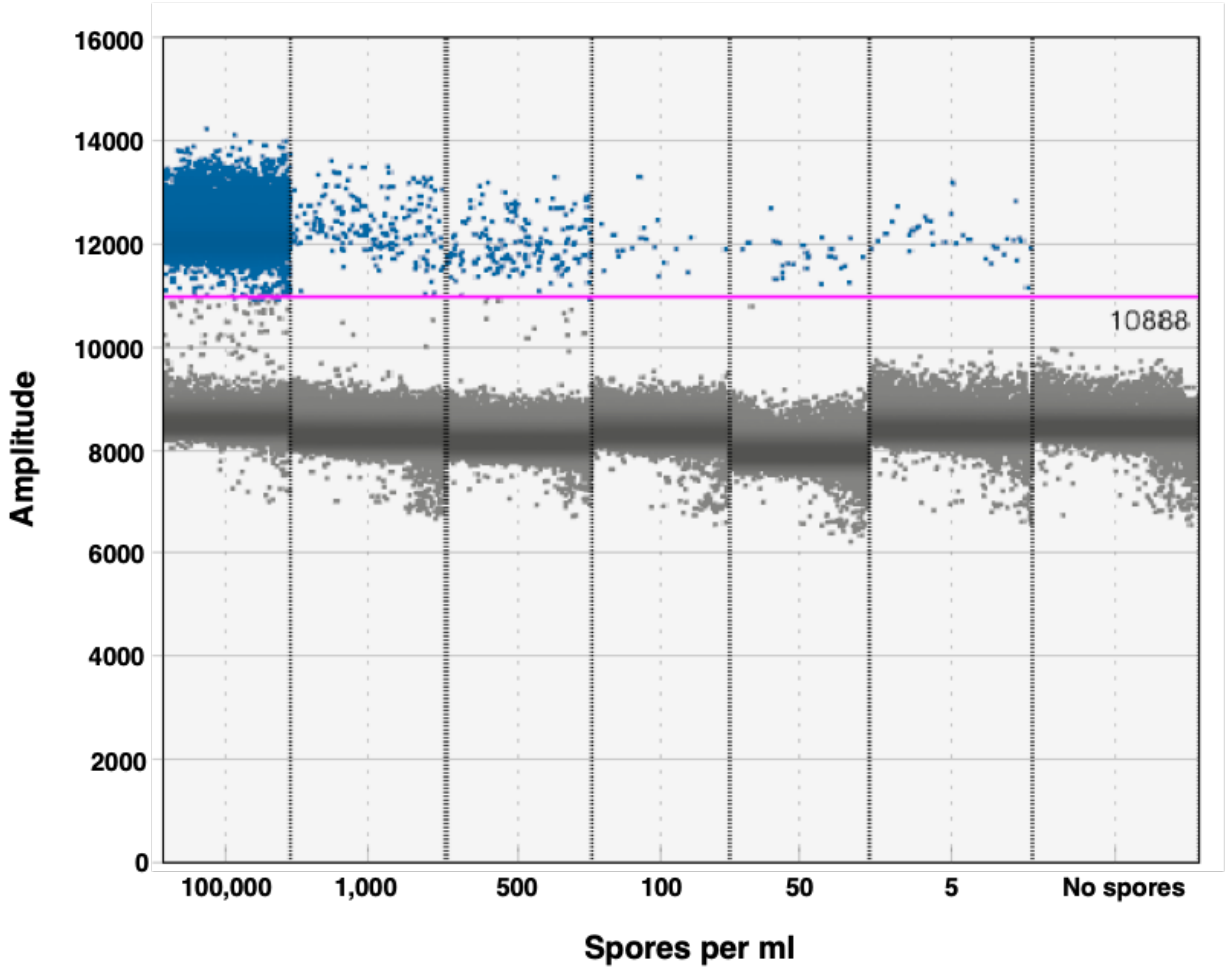

Dr. Jorge Ibarra-Caballero


Dr. Luke Tembrock


Frida Zink

- *C. plurivora specific* molecular assay developed
- PCR performed in 20,000 droplets (1nl) = 20ul reaction
- If target sequence is present in droplet it is amplified, and a reporter dye emits a fluorescent signal
- Fraction of positive to negative droplets determines concentration of target DNA





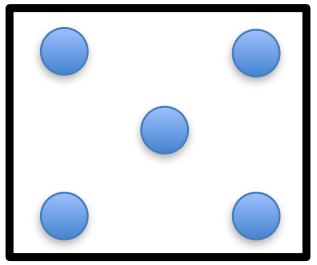
Stewart et al. 2021

How is *Cytospora* moving around in orchards?

Collection Type

1. Insect Collections

- 3 conventional, 3 organic
- 10 weeks of collection
- **MWB** (*Chrysobothris mali)*
- **GPTB** (*Synanthedon exitiosa)*
- **PTB** (*Anarsia lineatella)*



- 1 trap per species in each circle
- Insects collected individually
- Pooled by trap location, orchard, and collection date

2. Aerial Collections

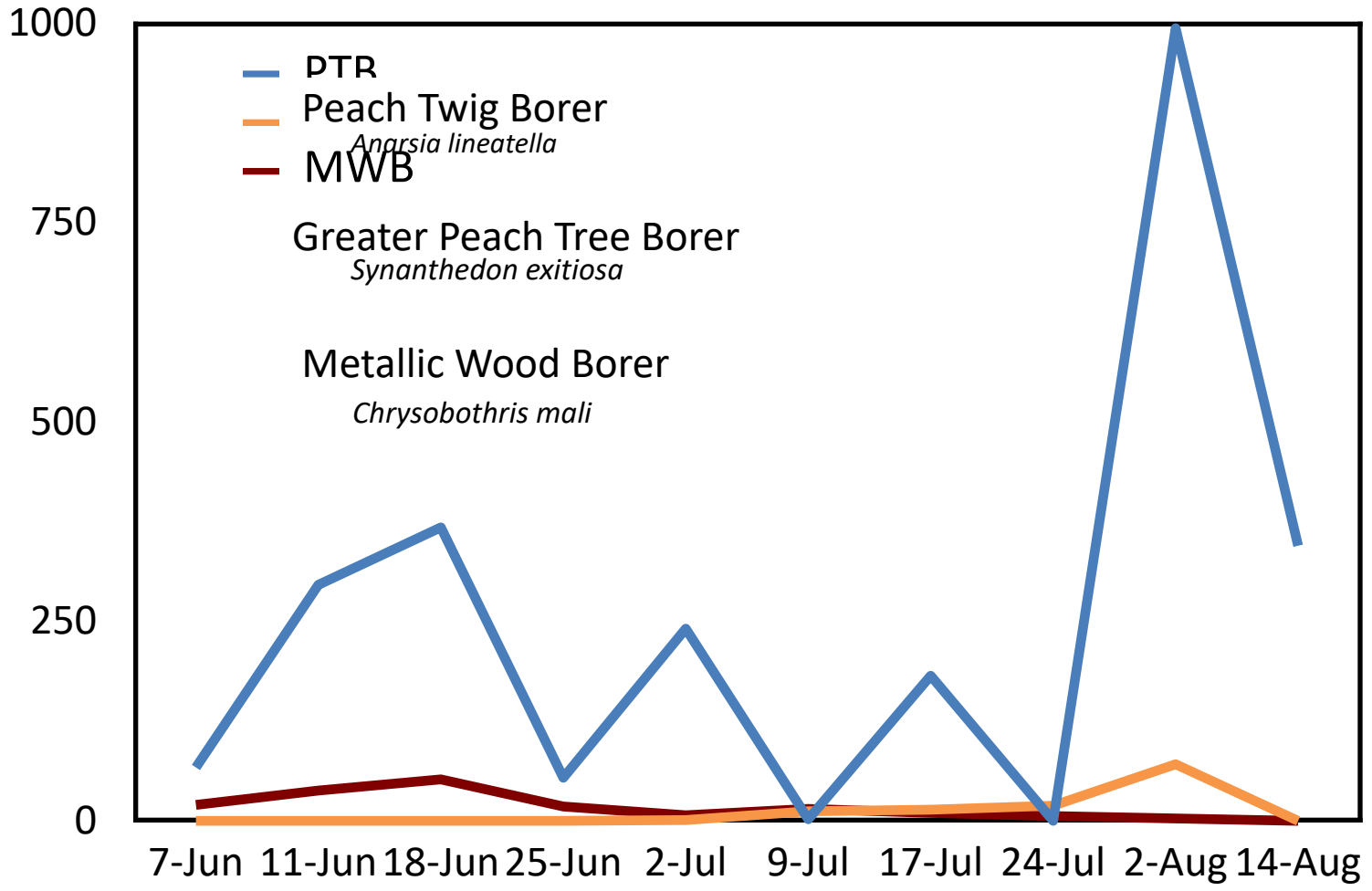
- 3 conventional, 3 organic
- 10 weeks of collection

- 5 mature cankers flagged
- Collections made 0.5m from canker
- Rotary vane sampling pump 20 l/min for 5 mins at each canker
- Pumped onto agar plate
- Plate effluent collected in 15ml tubes
- Pooled by orchard and collection date

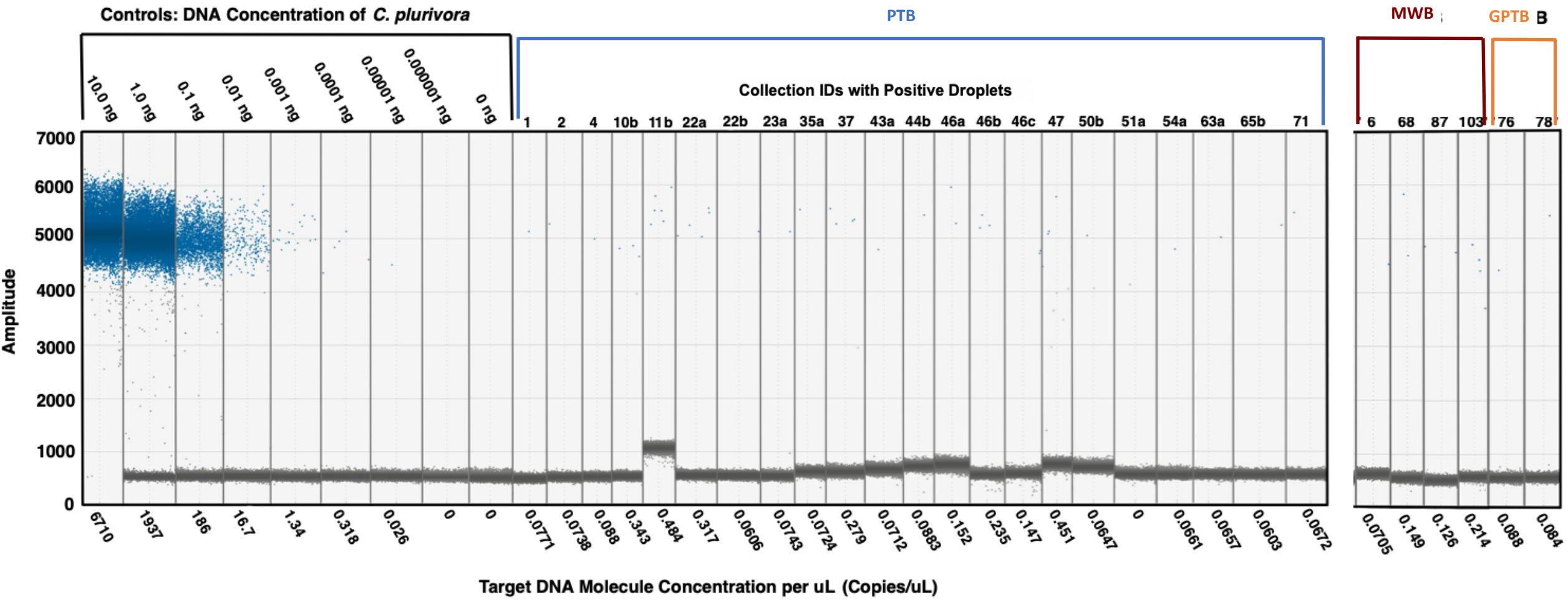
Total numbers of insects collected

Total insects: 2,917

- **Peach Twig Borer:** 2,628
- **Greater Peach Tree Borer:** 119
- **Metallic Wood Borer:** 170



Insect dissemination possible, but rare

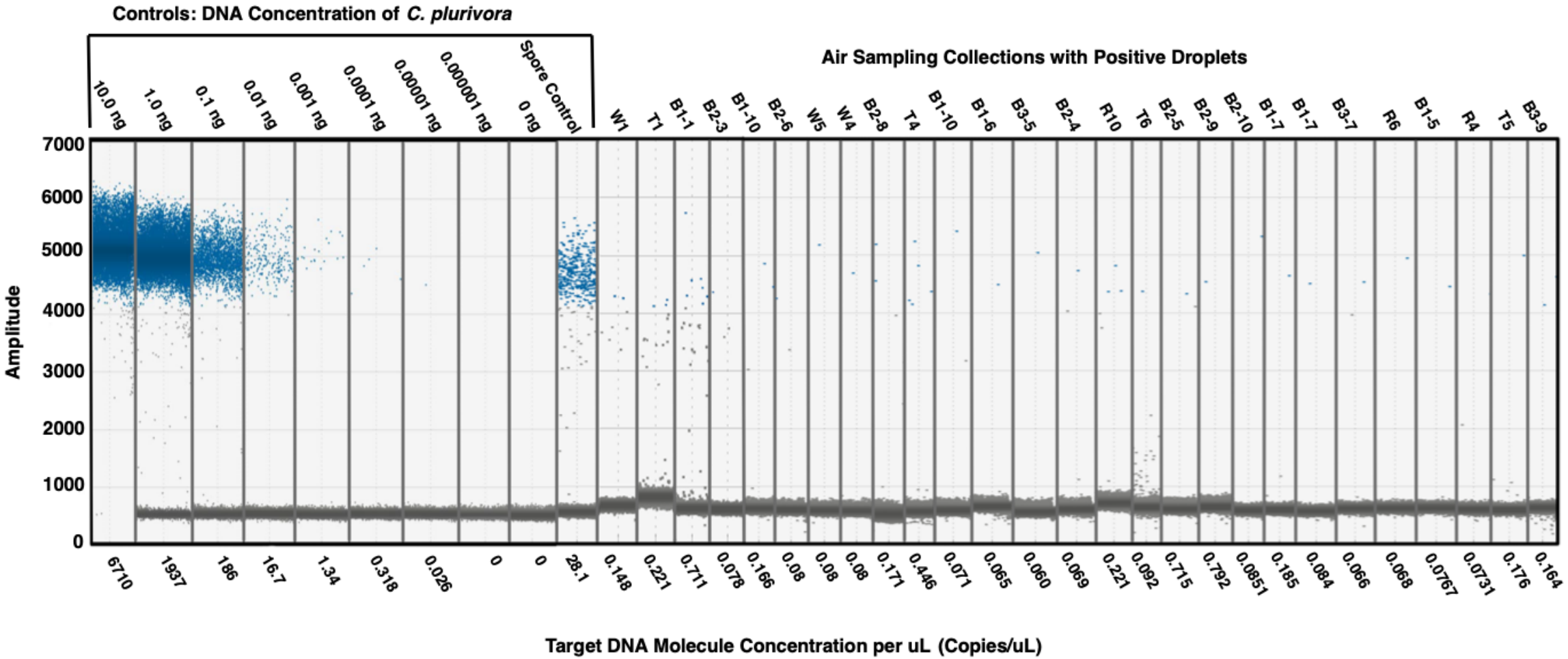


Total fraction of pooled samples with positive amplification

PTB	MWB	GPTB
22 / 119 (18.4%)	4 / 31 (12.9%)	2 / 19 (10.5%)

Peach Twig Borer
Greater Peach Tree Borer
Metallic Wood Borer

Aerial dissemination possible, but…



Total fraction of pooled samples with positive amplification

27 / 64 (42.1%)

Movement of *Cytospora* on Nursery stock?

- Studies have categorized *Cytospora* species as potential endophytes
- Is there a latency period which requires stress before symptoms are present?
  - Nursery to field?


Trees Received from Nursery

Sampled a variety of scion / root stocks from three nurseries at two stages:

1. Upon arrival at CSU (Asymptomatic)

2. Potted and maintained throughout summer (Symptomatic)


Trees in Shade House

Movement of *Cytospora* on Nursery stock?

Scion / Rootstock	Nursery
Cresthaven / Krymsk 1	Nursery 1
Blushingstar FA18 / Krymsk 1	Nursery 1
Reliance / Krymsk 1	Nursery 1
Contender / Krymsk 86	Nursery 1
Blazingstar / Krymsk 86	Nursery 1
PF Lucky 13 / Krymsk 86	Nursery 1
Coralstar / Krymsk 86	Nursery 1
All-star / Krymsk 86	Nursery 1
O'Henry / Krymsk 86	Nursery 1
Glohaven / Krymsk 86	Nursery 1
Redhaven / Krymsk 86	Nursery 1
Flamin' Fury PF17 / Krymsk 86	Nursery 1
Glowingstar / Krymsk 86	Nursery 1
Flamin' Fury PF 28-007 / Krymsk 86	Nursery 1
Angelus / Krymsk 8	Nursery 1
Cresthaven / Halford	Nursery 2
Glohaven / Halford	Nursery 2
Glowingstar / Halford	Nursery 2
Starfire / Halford	Nursery 2
Redhaven / Halford	Nursery 2
Suncrest / Halford	Nursery 2
Flamin' Fury PF23 / Lovell	Nursery 3

Design

- 22 different scion / rootstock combinations
- 25 tree replicates per cultivar / rootstock

Sampling

1. Asymptomatic

- 10 trees per cultivar sampled
- Total: 220 trees
- Sampled immediately upon arrival

- 3 tissue samples removed from the mainstem and from branches of each tree
- Surface sterilized and plated on nutrient agar
- Assessed daily for *C. plurivora* features
- Colonies morphologically similar *to C. plurivora* were sequenced (ITS)

2. Symptomatic

- 15 trees per cultivar sampled
- Total: 330 trees
- Sampled over four months

- Planted in 57.8- liter pots in shade house
- Evaluated weekly for symptoms
- 361 symptomatic isolations made on nutrient agar
- Colonies morphologically similar *to C. plurivora* were sequenced (ITS)

Symptomatic Sample

No *Cytospora* spp. were identified on nursery stock

Are infections originating from nurseries?

- No evidence of *Cytospora* after 922 tissue isolations on 330 trees
  - No signs (fruiting bodies) observed at any point
- No *Cytospora* was confirmed in any of the samples
- Top fungi isolated (based in ITS sequencing)

Evaluate dissemination mechanisms

- Can insects disseminate spores? Yes, but likely rare
- Can spores be aerially dispersed? Yes, but likely rare
- Is *Cytospora* present on nursery stock? No

Nursery	Fungal Identity
N2	*Botrytis cinerea*
N2	*Epicoccum nigrum*
N2	*Rhizoctonia sp.*
N1	*Phoma sp.*
N3	*Phoma sp.*
N2	*Botrytis cinerea*
N3	*Alternaria infectoria*
N1	*Alternaria sp.*
N3	*Alternaria arborescens*
N2	*Epicoccum nigrum*
N2	*Rhizoctonia alpina*
N2	*Alternaria sp.*

Comprehensive program for Cytospora Management

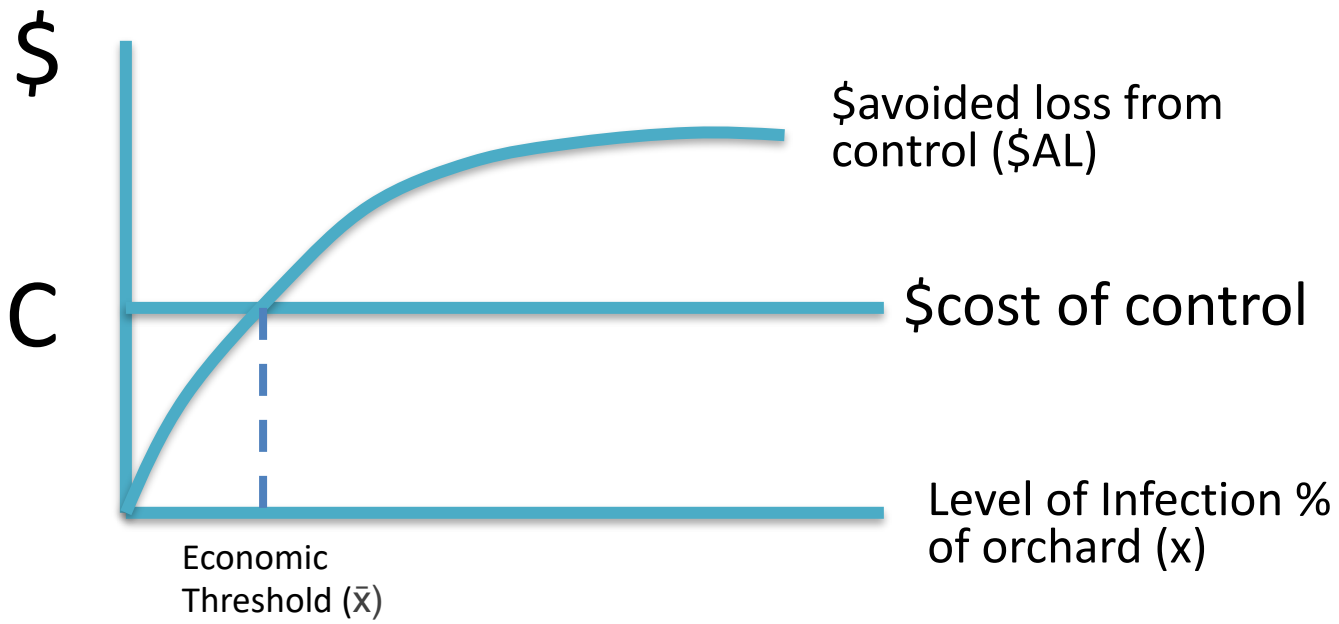
- What chemicals are effective against Cytospora?
- Are cultivars equally susceptible?
- How is Cytospora moving around in orchards?
- What is the economic threshold for Cytospora?
- What cultural practices are associated with infection?

Cytospora economic thresholds

Dr. Dana Hoag

Economics of Cytospora

- Threshold for disease vs. cost of management
  - Working with Dr. Dana Hoag from CSU, Dept. of Ag Economics



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Avoided losses (AL) from Cytospora Management

$Yield *with* control − $Yield *without* control = $AL

Avoided losses (AL) from Cytospora Management

$Yield *with* control − $Yield *without* control = $AL

1 year 18,000x$1.1 = 19,800 - 15,000x$1.1 = 16,500 = $3,300

$Yield savings can include quantity and quality

Avoided losses (AL) from Cytospora Management

$Yield *with* control		$Yield *without* control		$AL
Within tree + across orchard + replanting	−	Within tree + across orchard + replanting	=	

1 year	18,000x$1.1 = 19,800	-	15,000x$1.1 = 16,500	= $3,300

Future 10 years

Infection grows across orchard:

In infected trees

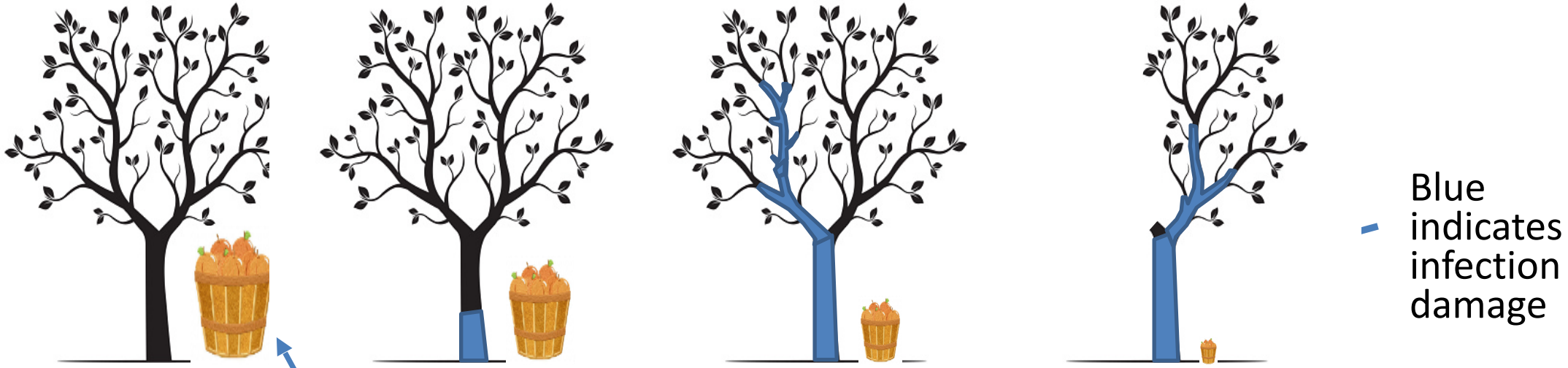
+ New trees infected

+ Worsening infections in newly infected trees

+ Early replacement of orchard

= $63,000

Disease spread within a tree



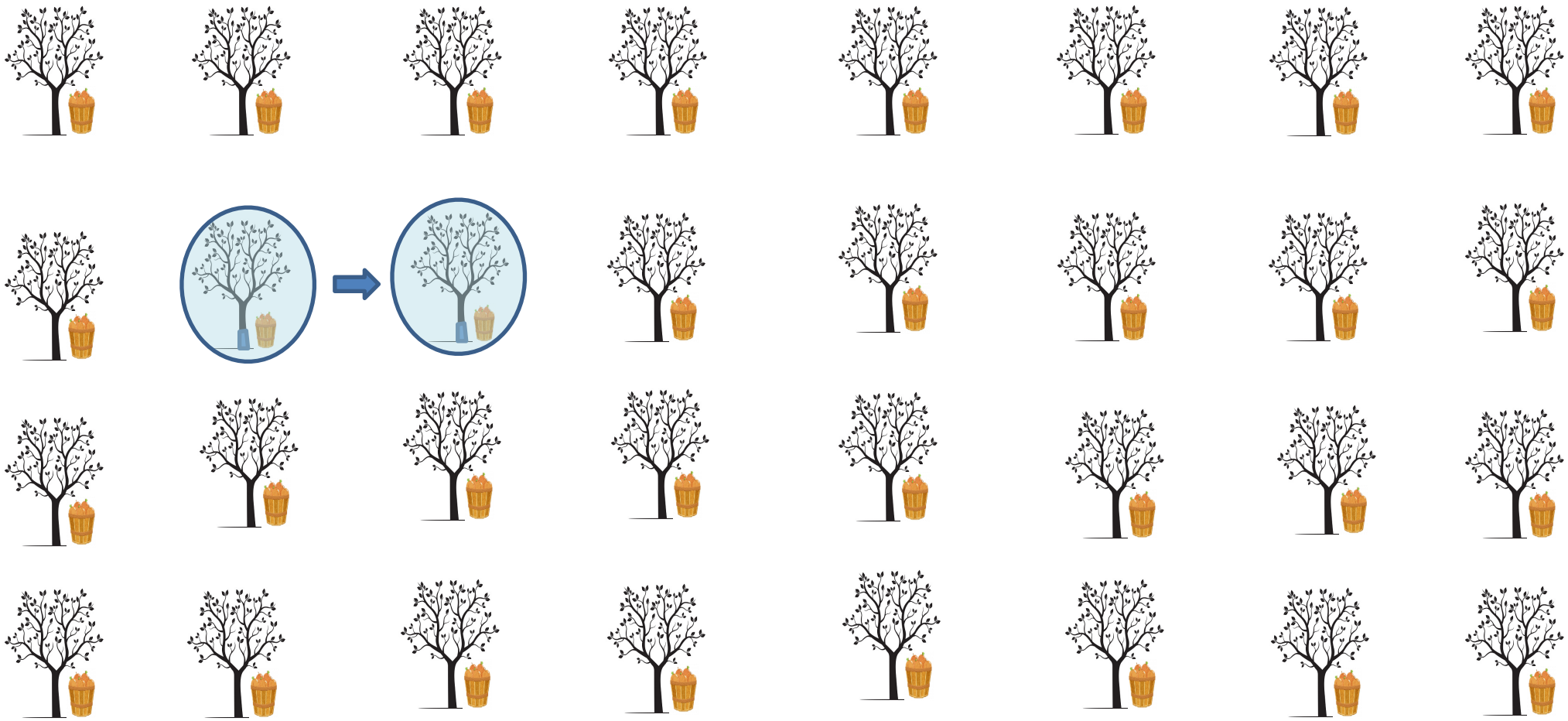
No Disease

Orchard
$Yield

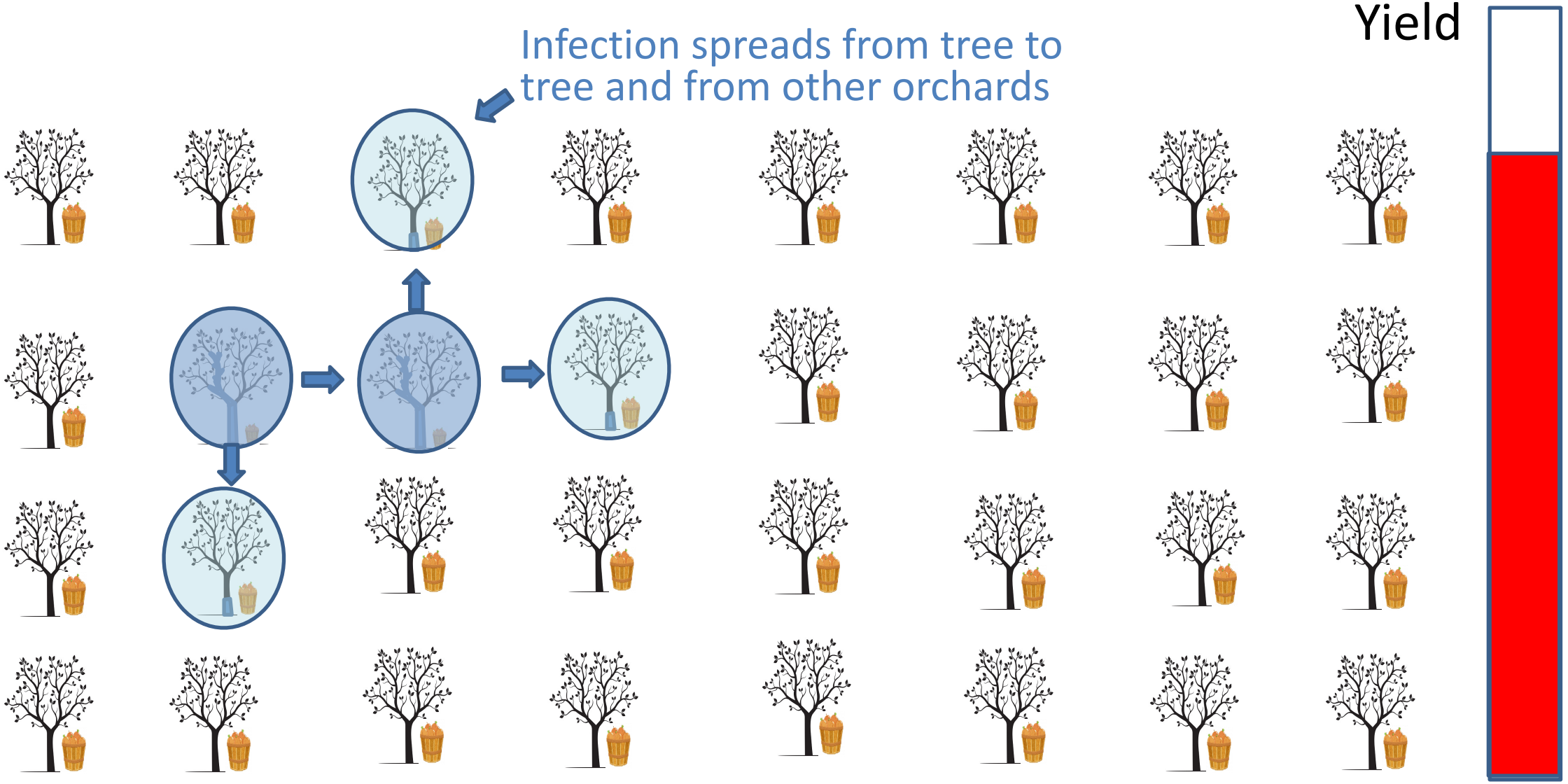
Disease spread across orchard and in trees

Orchard Yield

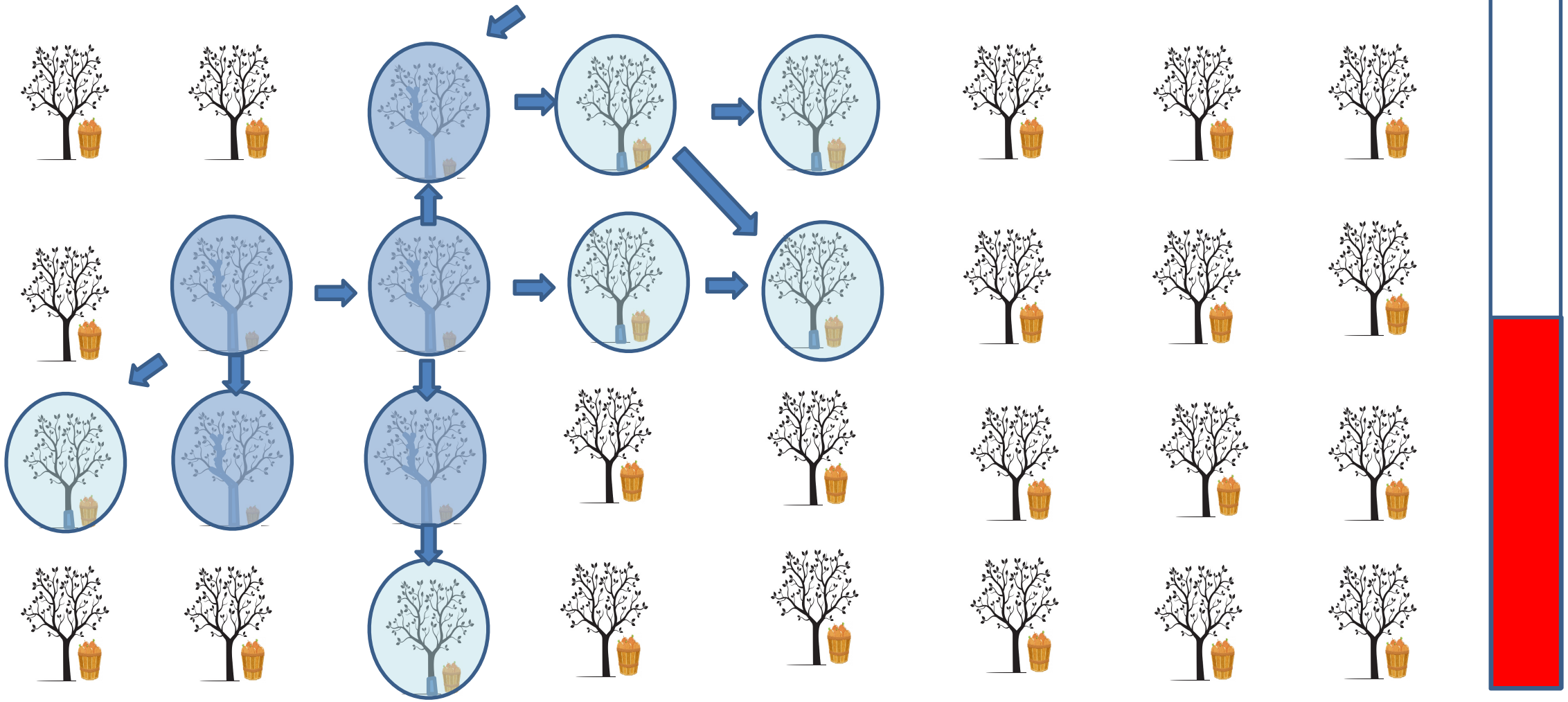
Disease spread across orchard and in trees



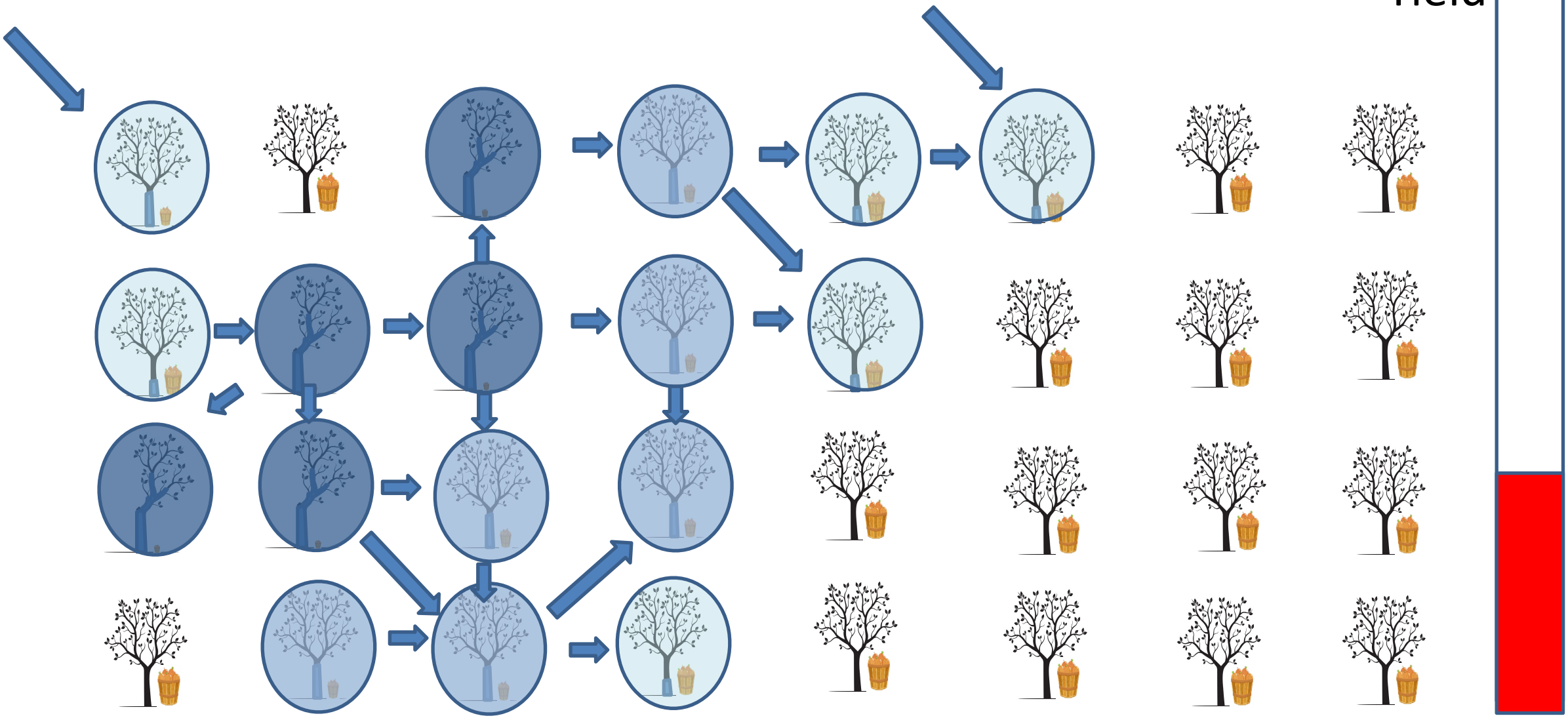
Disease spread across orchard and in trees



Disease spread across orchard and in trees

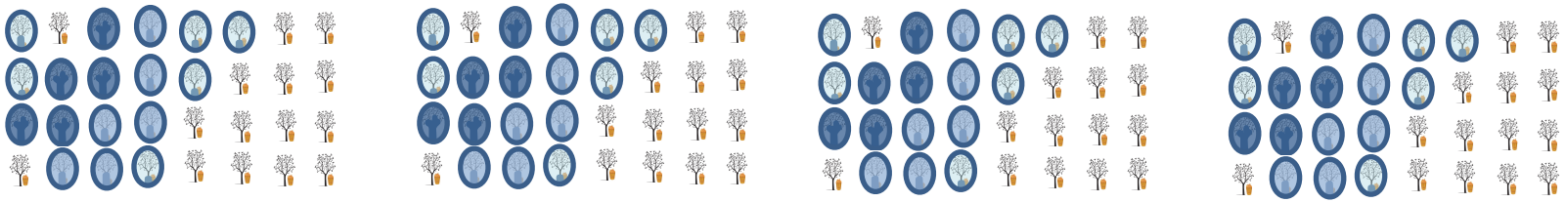


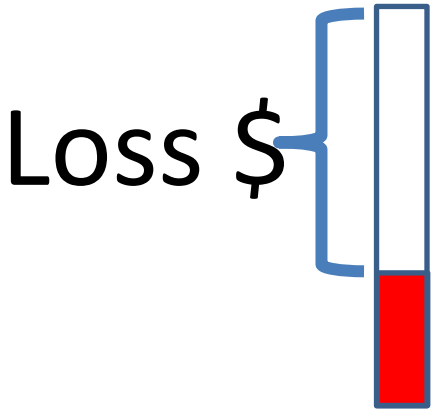
Disease spread across orchard and in trees



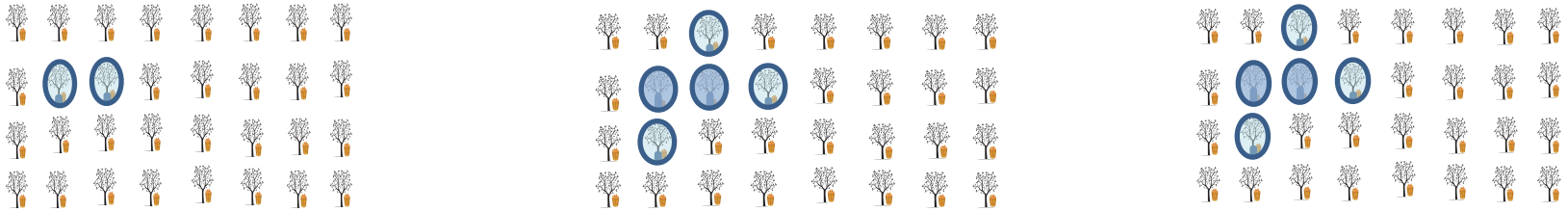
Total Avoided loss

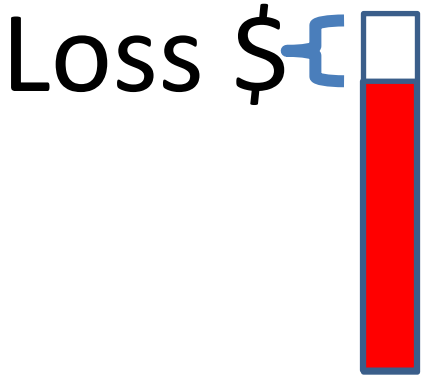
Weak Control



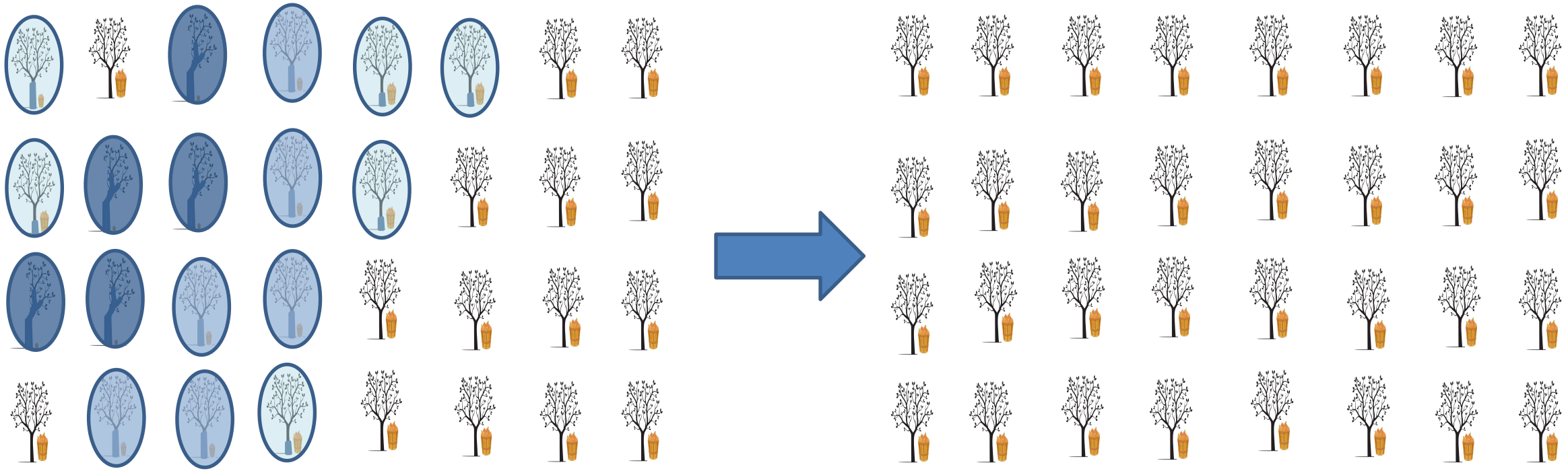


Strong Control





Early Replant of Orchard



Control Options and Costs

- Light control = pruning and flailing branches; canopy sprays 1 per year

  Cost estimate: Additional pruning and flailing 6 hours/acre ($16.50/hr), Canopy spray $50/ac = $149/ac

- Medium = pruning and flailing branches; canopy sprays 2 per year; chemical controls on pruned branches; removing highly infected trees

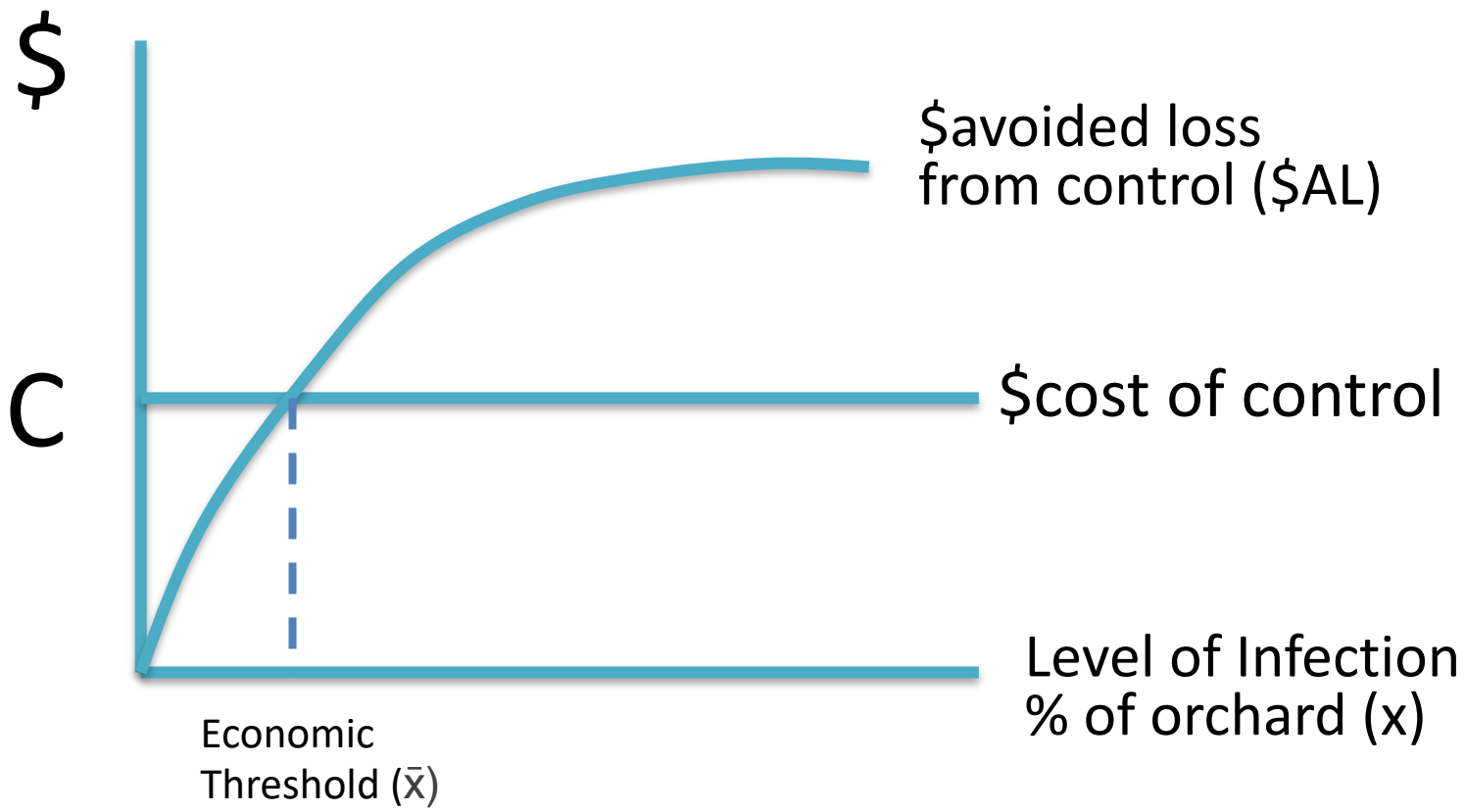
  Cost estimate: Same as light control, but takes 10 hours labor plus chemicals ($65/ac), plus 2 sprays = $330

- High = Pruning and removing (burning) infected branches; second pass to prune and flailing non-infected branches; canopy sprays 2 per year; chemical controls on pruned branches; well-watered trees – reduce tree stress.

  Cost estimate: Same as medium control, but add 6 hours for second pass, 4 for burning, and $50/acre for more attention to water in the winter, = $545

Economic threshold questions

- Infection rate from year to year
- Probability of infection
- How infection intensifies over time
- Correlation between grower practices and infection levels



Comprehensive program for Cytospora Management

- What chemicals are effective against Cytospora?
- Are cultivars equally susceptible?
- How is Cytospora moving around in orchards?
- What is the economic threshold for Cytospora canker?
- What cultural practices are associated with infection?

Sean Wright–MS student

1. Efficacy of chemical treatments in winter canopies over time (Sean's presentation)

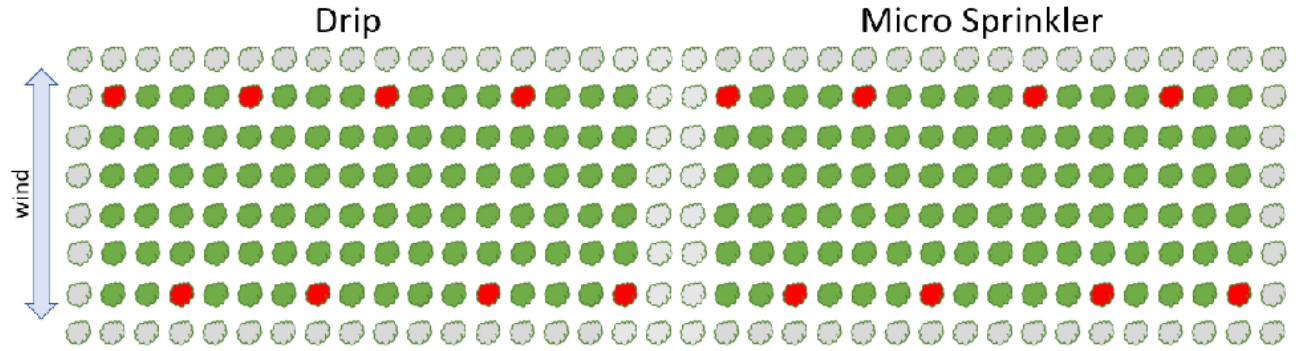
2. Test *Cytospora* spread under micro-sprinkler and drip irrigation

3. Test *Cytospora* viability in mulch – starting this winter

Examination of drip vs. micro irrigation on spread of *Cytospora* in orchard settings

Methods

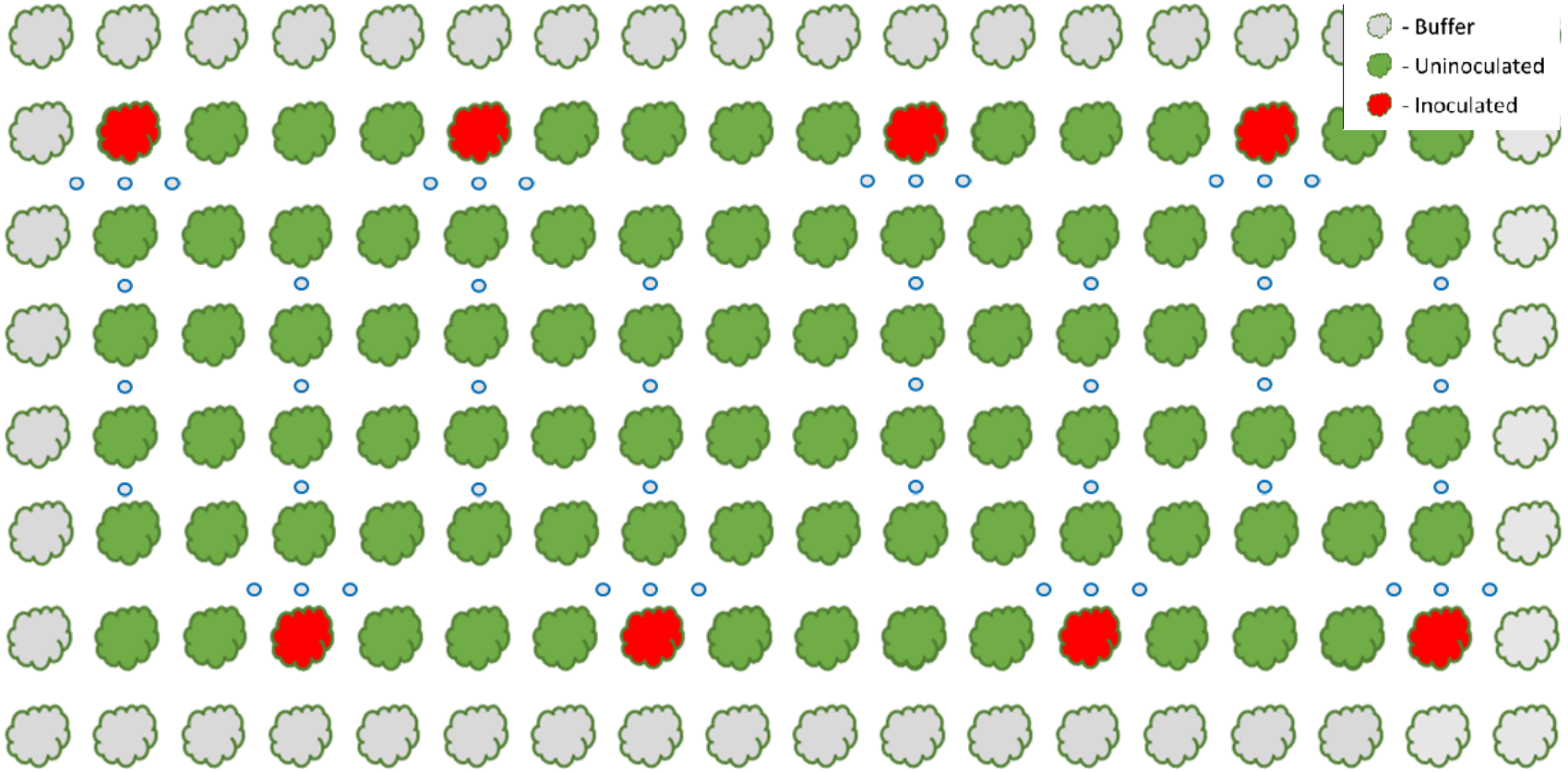
- 2 blocks with 288 trees each
  - two treatments per block (1 drip and 1 micro sprinkler)
  - Row spacing 3.6m, tree spacing 1.8m
  - Trees trained in V-shape
- Each tree trunk painted with Topsin and latex (Miller et. al. 2019)
  - Reduce viability of *C. plurivora* and conidia extrusion
- Inoculation of *C. plurivora* on selected peach trees
  - 8 trees per treatment
- Regular watering intervals




Drip irrigation


Micro sprinkler

Methods – Cont.



- Spore traps placed at basal area of tree, leeward side of wind
  - 6 traps per canker
  - Located at 45°, 90°, and 135° from canker
    - 90° transect traps will continue for 3 rows centered in row
  - Spore traps centered in row from inoculation
    - Total of 6 traps per inoculated tree
- Spore trap suspension collected weekly
  - ddPCR to quantify conidia collected

Sean's Current Progress

- All samples from the irrigation project have been processed and are awaiting ddPCR – this will be completed by this spring
  - Second season will begin this summer

- Second season chemical efficacy trial is underway
  - Results from first year show that efficacy decreases after 2 to 3 months, depending on chemical type

Ongoing funded projects – 2022-2024



Grace Ganter, Claudie Bertin, Sean Toporek

1. Survey peach, cherry, and apple orchards in CO to estimate *Cytospora* spp. incidence and severity (Grace's presentation)

2. Estimate *Cytospora* species distribution, genetic diversity within and among orchards, and develop an epidemiological model of the spread of the pathogen.

3. Perform pathogenicity assays to determine host range within fruit crops of each of the identified *Cytospora* species.

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National Institute of Food and Agriculture

Increases in *Cytospora* severity over 4 years

Cultivar	Cresthaven				Suncrest				Redhaven				Newhaven				Red Globe			
Year	2016		2020		2016		2020		2016		2020		2016		2020		2016		2020	
Tree Number	615		615		670		670		262		262		246		246		178		178	
Dead or Missing	6	1%	120	20%	15	2%	82	12%	0	0%	8	3%	2	1%	16	7%	7	4%	8	4%
Live trees with lost scaffolds	0	0%	161	26%	0	0%	52	8%		0%	3	1%	0	0%	2	1%	0	0%	9	5%
Live trees with observed gummosis	130	21%	517	84%	170	25%	426	64%	20	8%	60	23%	33	13%	37	15%	54	30%	55	31%

Greg Litus

Orchard surveys and *Cytospora* spp. collections

- Surveyed 6 peach, 2 cherry, and 2 apple block, thus far
- Continue surveying orchards
- Collected 56 *Cytospora* isolates that represent 6 different species
- Estimate spread of *Cytospora* within and across orchards
- Perform pathogenicity assays on peach, cherry and apple

Overview of results from Cytospora program

1. Management

Chemical

Described effective fungicides based on:

1. Lesion size
2. Pathogen Viability

Cultural

Relationship between abiotic tree stress and pathogen infection severity

Extension Recommendations

- Captan, thiophanate-methyl, lime sulfur, VitiSeal
- Latex only combined with a fungicide
- Maintaining tree vigor by avoiding abiotic stress
  - Testing of soils and irrigation water quality

2. Epidemiology

Annual Pathogen Patterns in Colorado

1. Monthly spore production rates
2. Monthly infection rates

> Lowest during dormant season

Dissemination Mechanisms

1. Water dissemination (high amounts of spores)
2. Insect & aerial dissemination possible

Extension Recommendations

- Dormant season pruning when possible
- Reducing borer wounds in field
  - Mating disruptors very effective for GPTB
- Removing pruned branches from field

Overview next steps of Cytospora program

1. Management

Chemical

Described effective fungicides based on:

1. Lesion size
2. Pathogen Viability

Cultural

Relationship between abiotic tree stress and pathogen infection severity

Next Steps

- Continue to be explore OMRI approved fungicides should
- Test efficacy of canopy sprays

- Rootstock role in tree susceptibility?
- Investigate potential *C. plurivora* antagonisms; Bio-controls?
- Analyzing nutrient availability differences within an orchard

2. Epidemiology

Annual Pathogen Patterns in Colorado

1. Monthly spore production rates
2. Monthly infection rates

Lowest during dormant season

Dissemination Mechanisms

1. Water dissemination (high amounts of spores)
2. Insect & aerial dissemination possible

- Evaluate spread over time with different cultivars

- Do irrigation methods disseminate spores?
  - Sprinkler vs drip?
- Mulched infected branches?

Cytospora Working Group

Objectives

- Collaborate with local commercial growers to prioritize research efforts
- Prevention/Protection measures
- Disease management/spread measures
- Support funding opportunities – Letters of support
- Next Meeting in Spring 2022

Want to join? Contact:

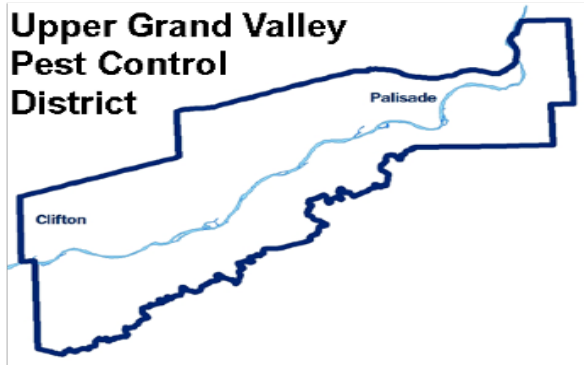
Jane Stewart: Jane.Stewart@colostate.edu

Thanks!

Jane.Stewart@colostate.edu

Western Colorado Horticultural Society
70+ years dedicated to the future development of agriculture in Western Colorado

AGRICULTURAL EXPERIMENT STATION
COLORADO STATE UNIVERSITY



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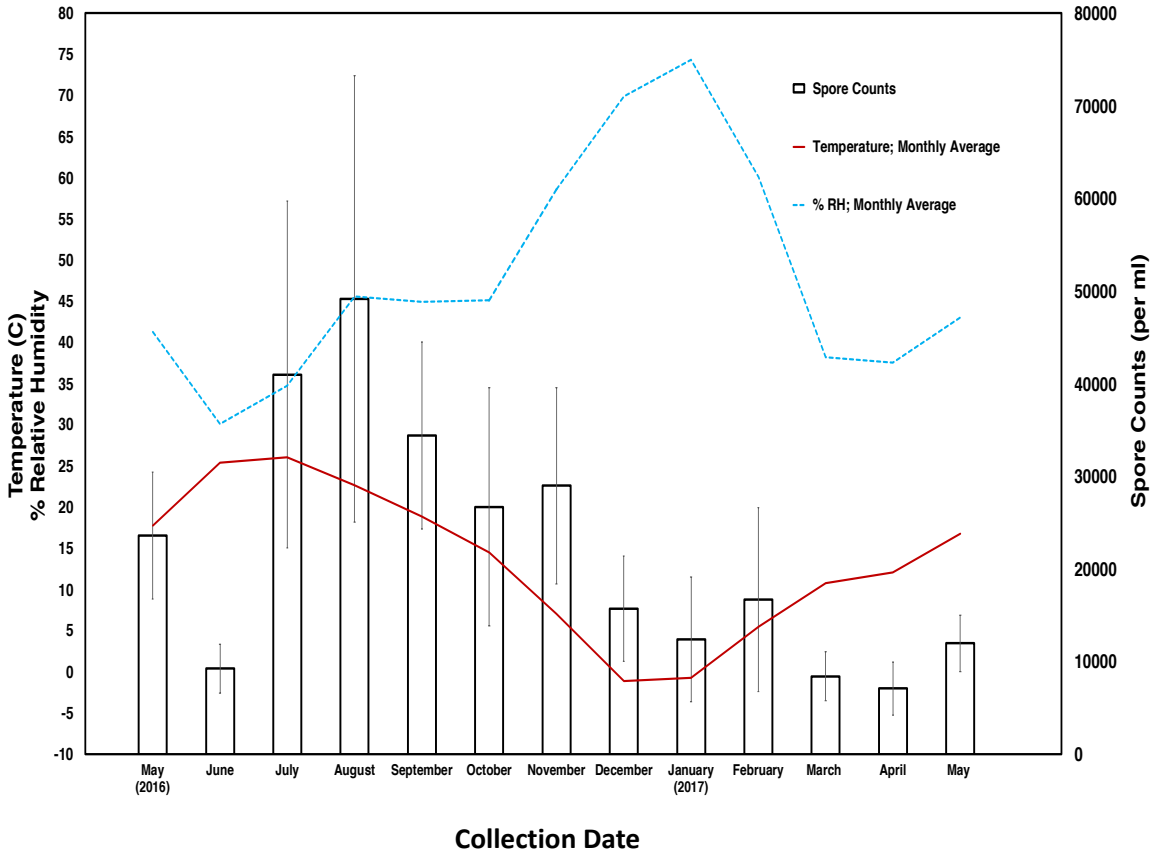
Colorado State University EXTENSION Tri River Area

USDA NIFA

FARM BILL
SECURING OUR FUTURE

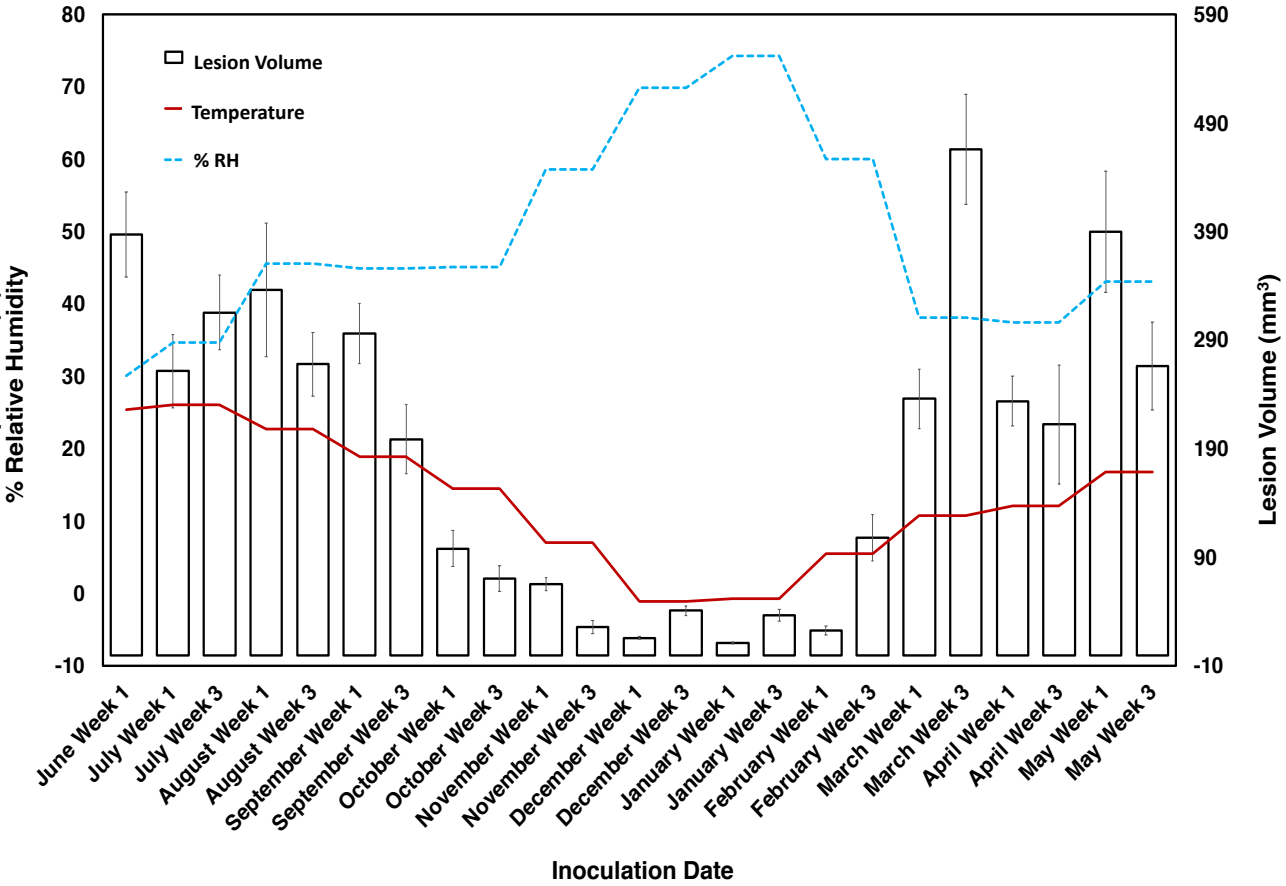
Collaborators:
Cytospora working group, CropWorx, Ioannis Minas, David Sterle, EmilyDowdy, Jeff Pieper, Bryan Braddy, Meredith Shrader, Jorge Ibarra Caballero, Luke Tembrock, Greg Litus, Frank Stonaker, Harold Larsen, Conner Henderson

Spore Production Occurs Year-Round



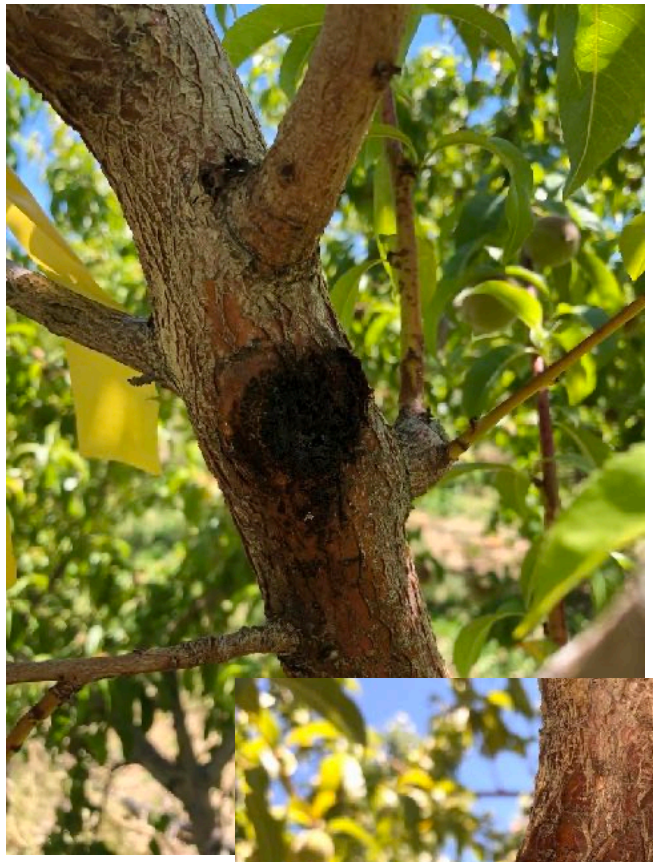
n= 10 observations per date

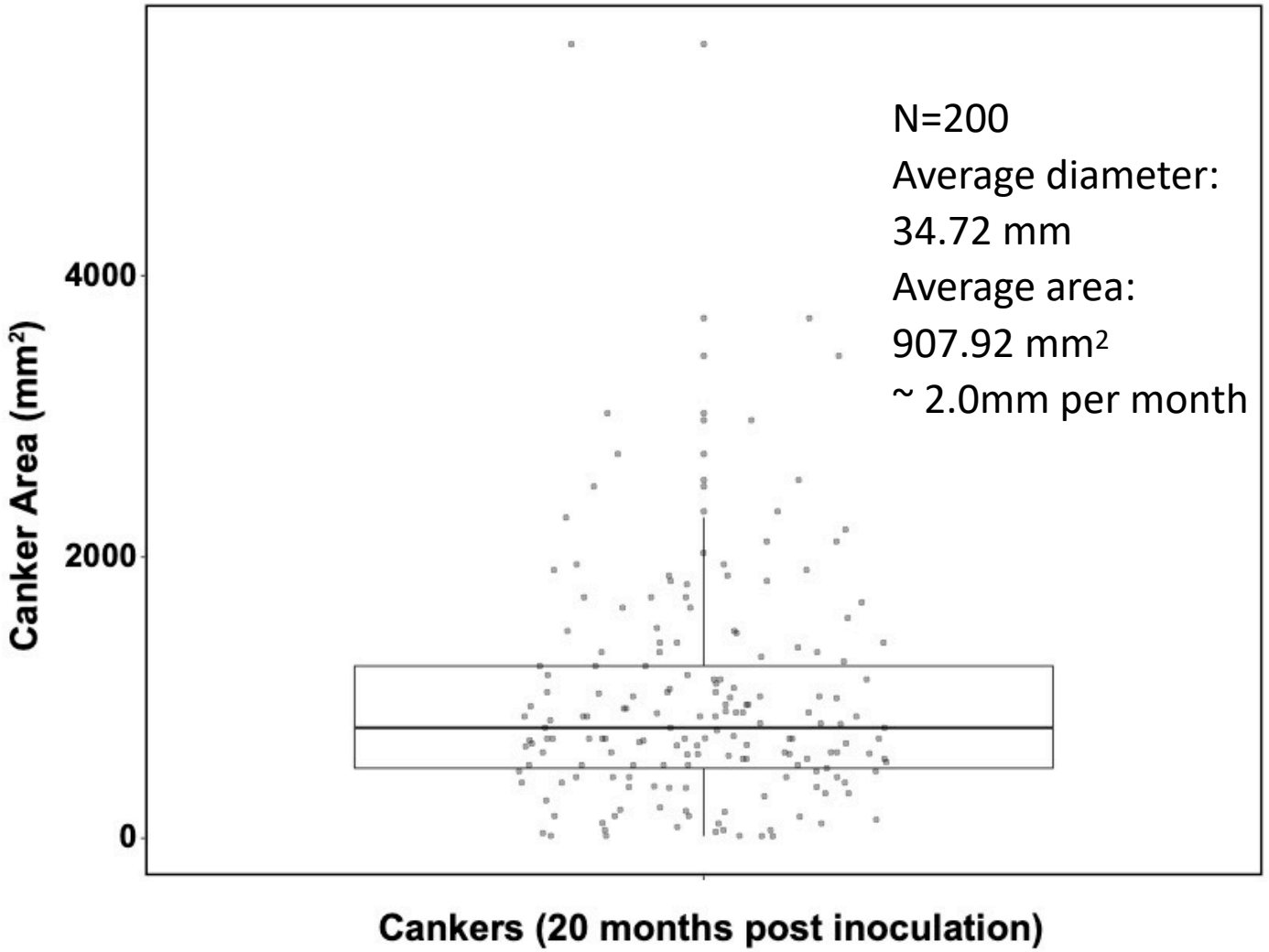
Infections Possible Year-Round; Largest Lesions >10°C



n= 25 repetitions, 5 averaged observations per date.

Canker growth over 20 months





Environmental Conditions drive Cytospora canker

Year- Round Spore Production and Infection Rates Driven by Temperature