Solarization

A Simple and Low Cost method for Disinfesting Horticultural Containers

CA Nursery Conference

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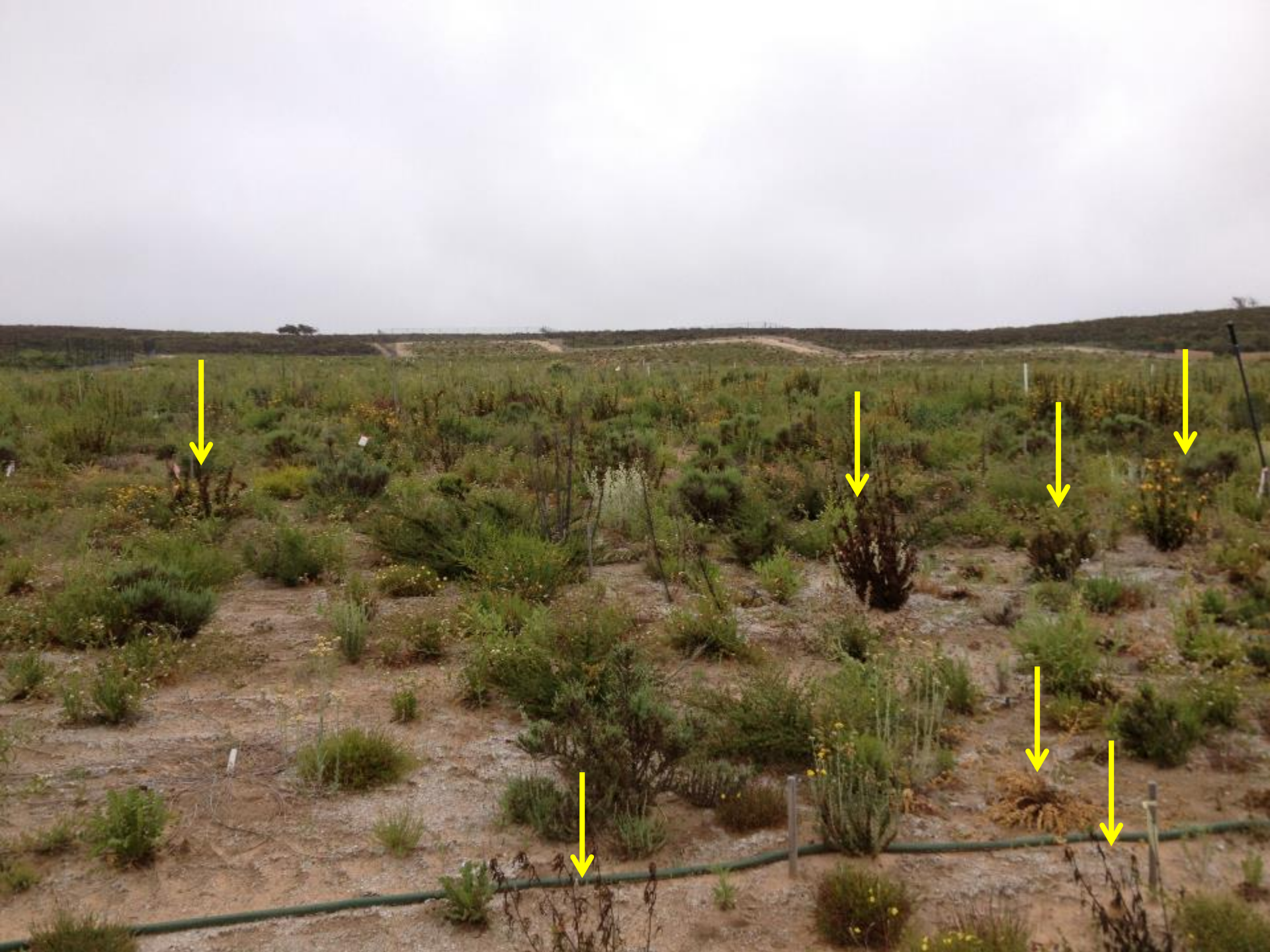
October 2016

***Phytophthora* species**	**Nursery**	**Field**	**Total**	**%**
P. amnicola (6)	0	1	1	0.1
***P. cactorum-like* (1)**	**68**	**59**	**127**	**20.4**
P. cambivora	**7**	**46**	**53**	**8.5**
P. chlamydospora (6)	0	9	9	1.4
P. cinnamomi (7)	2	11	13	2.1
P. citricola (2)	2	4	6	0.9
P. citrophthora (2)	1	0	1	0.1
P. colocasiae (2)	0	2	2	0.3
***P. cryptogea/P. drechsleri/P. kelmania* (8)**	**21**	**75**	**96**	**15.4**
P. gonapodyides (6)	0	23	23	3.7
***P. hedraiandra* (1)**	**10**	**32**	**42**	**6.7**
P. humicola/P.inundata (6)	0	11	11	1.7
***P. lacustris-like* (6)**	**0**	**48**	**48**	**7.7**
P. megasperma (6)	0	28	28	4.5
P. multivora (2)	6	6	12	1.9
P. nicotianae (1)	11	5	16	2.5
P. niederhauserii (7)	8	2	10	1.6
P. pini (2)	2	1	3	0.4
P. plurivora (2)	3	1	4	0.6
P. quercetorum (4)	1	2	3	0.4
P. syringae (8)	0	2	2	0.3
***P. tentaculata* (1)**	**43**	**21**	**64**	**10.0**
P. thermophila-like (6)	0	1	1	0.1
Phytophthora spp. (mixed or unable to speciate)	5	12	17	2.7

More than 25 *Phytophthora* species were associated with nursery and field grown California natives in this survey

Blue: *Phytophthora* found only in wildlands Red: *Phytophthora* found only in nurseries **Bold One of the most commonly detected *Phytophthora* species in our survey from California Department of Food and Agriculture Diagnostic Lab**



How was *Phytophthora* being moved around in native plant nurseries

Pot Cleaning

Pot Cleaning

Pot Cleaning

Pot Steaming Unit
J. Parke

Pot Cleaning

Portable Pot Steaming unit

J. Parke

Solarization

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Pot Solarization

- Conducted in a cool climate & a hot climate

- Used a common nursery pathogen *Phytophthora cactorum*

- All components bought off the shelf at a mass merchant store

- Pot selection based on those commonly used by native plant nurseries

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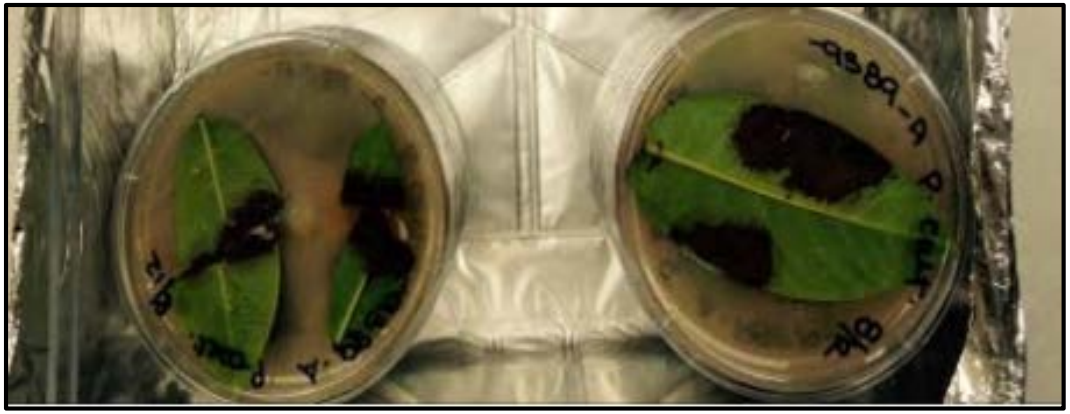
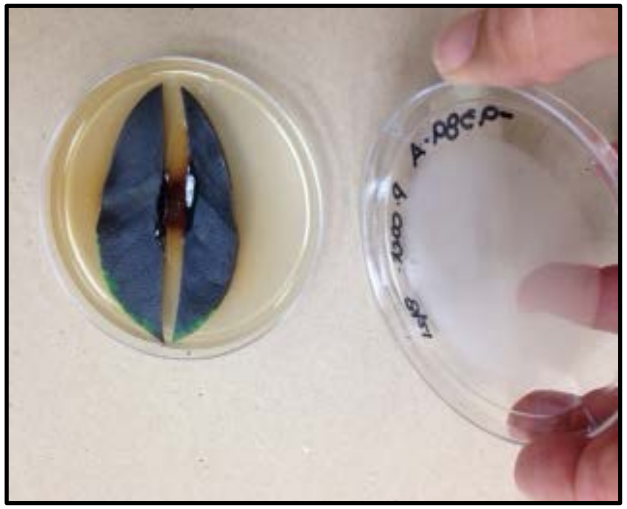
Pot solarization experiment:

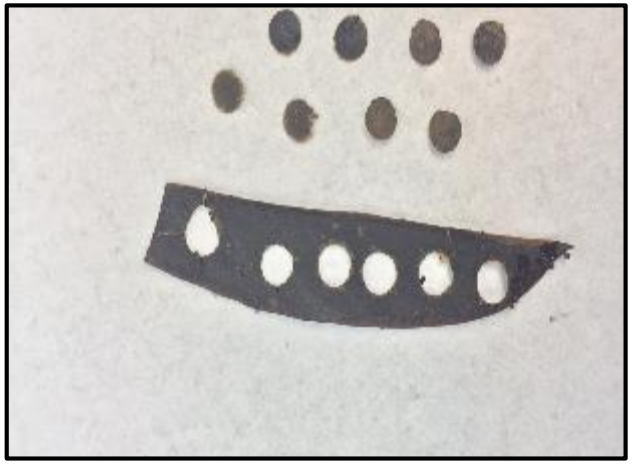
- Tubex tubes
- 1G pots
- D40 pots

Pot solarization -

P. cactorum infected rhododendron leaves

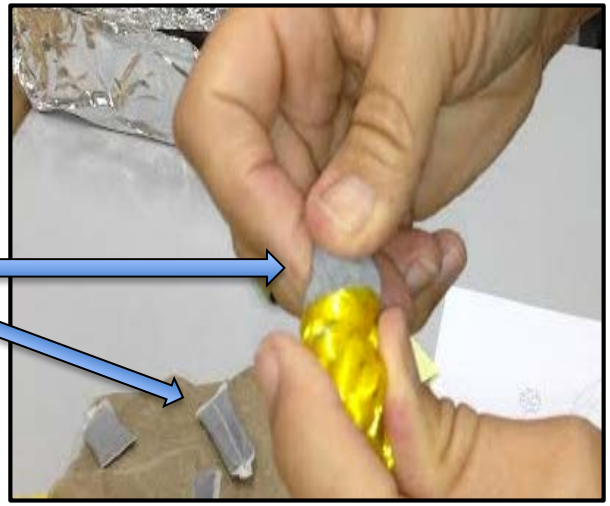






Lab Prep

- Filling Sachets w/ 10 *P. cactorum*-infected leaf disks + 10ml of soil



- Inserting filled sachets into hollow-core woven rope

- Three sachets, spaced 10” apart inserted into each 3’ rope

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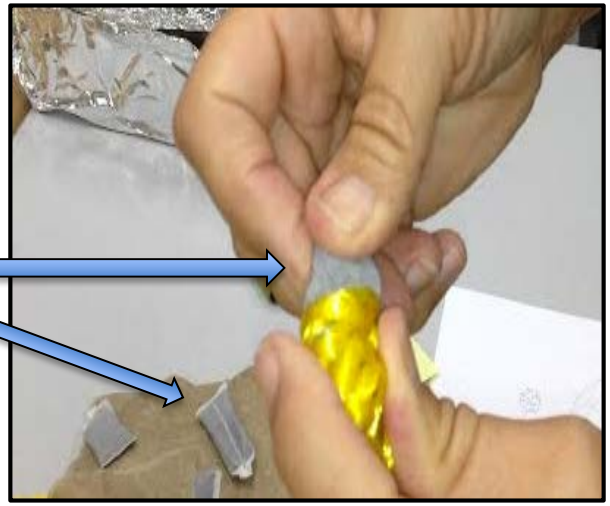

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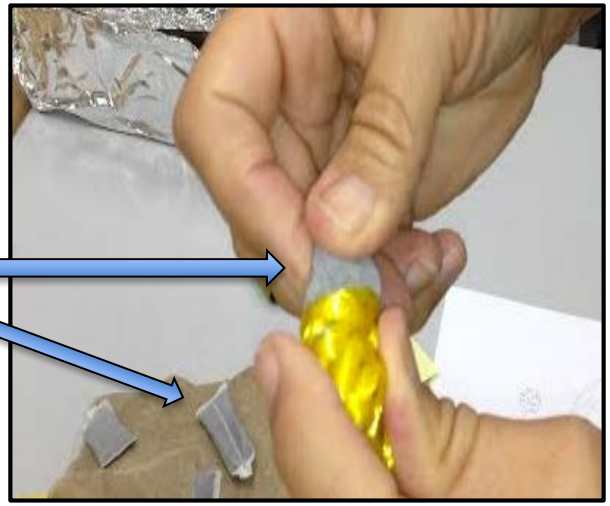

- Inserting filled sachets into hollow-core woven rope

- Three sachets, spaced 10” apart inserted into each 3’ rope

Water sprayed on sachets inside the woven rope

Field Setup

- Rope and data logger in center pot of stack

- Hole drilled for easy rope access

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Field Layout

- “Treatment” wrapped in clear plastic

-“Control” no plastic encasement

- Incision made in clear plastic to extract sachet in rope on a weekly basis; hole resealed after each extraction

- Each bundle placed on black plastic garbage bag

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Results- first experiment

Hot climate

- **Pathogen killed within first week in Treatment and Control**
- Lab study demonstrated *P. cactorum* would be killed at 122^0F for 30 minutes, as is case for *P. ramorum* and *P. tentaculata*
- **Treatment temperature reached 135^0F** (remaining above 122^0F for 33 hrs. cumulatively in first week)
- **Control temperature reached 116^0F** (remaining above 104^0F for 35 hrs. cumulatively in first week)
- **Ambient temperature reached 106^0F** briefly but primarily remained in the 86-95^0F range

Results – first experiment

Cool climate

- **Pathogen killed** within the first week in the **Treatment** (1G and D40 pots)
- **Pathogen was not killed** in the 1G **Controls** (3/3) during the six-week trial but was in 2 out of 3 of the D40 Controls within the first two weeks
- **Treatment temperature reached 113^{0}F** (remaining above 104^{0}F for 16 hours cumulatively in first week)
- **Control reached a high of 88^{0}F** in the first week
- **Ambient air temperatures ranged between 66-79^{0}F** for the first week (data logger was placed at 5’ ht.)

Results – First experiment

Table 1. Cumulative hours attained during First week of Winters and Pacifica Trial for 1G

Winters, CA Ambient temp: 30-41^{0}C	**40-45^{0}C**	**46-50^{0}C**	**≥ 51^{0}C**	**Pathogen killed**
Treatment	12 hrs	14 hrs	25 hrs	YES
Control	30 hrs	2 hrs	0	YES
Pacifica, CA Ambient temp: 19-26^{0}C				
Treatment	18 hrs	0	0	YES
Control	0	0	0	NO

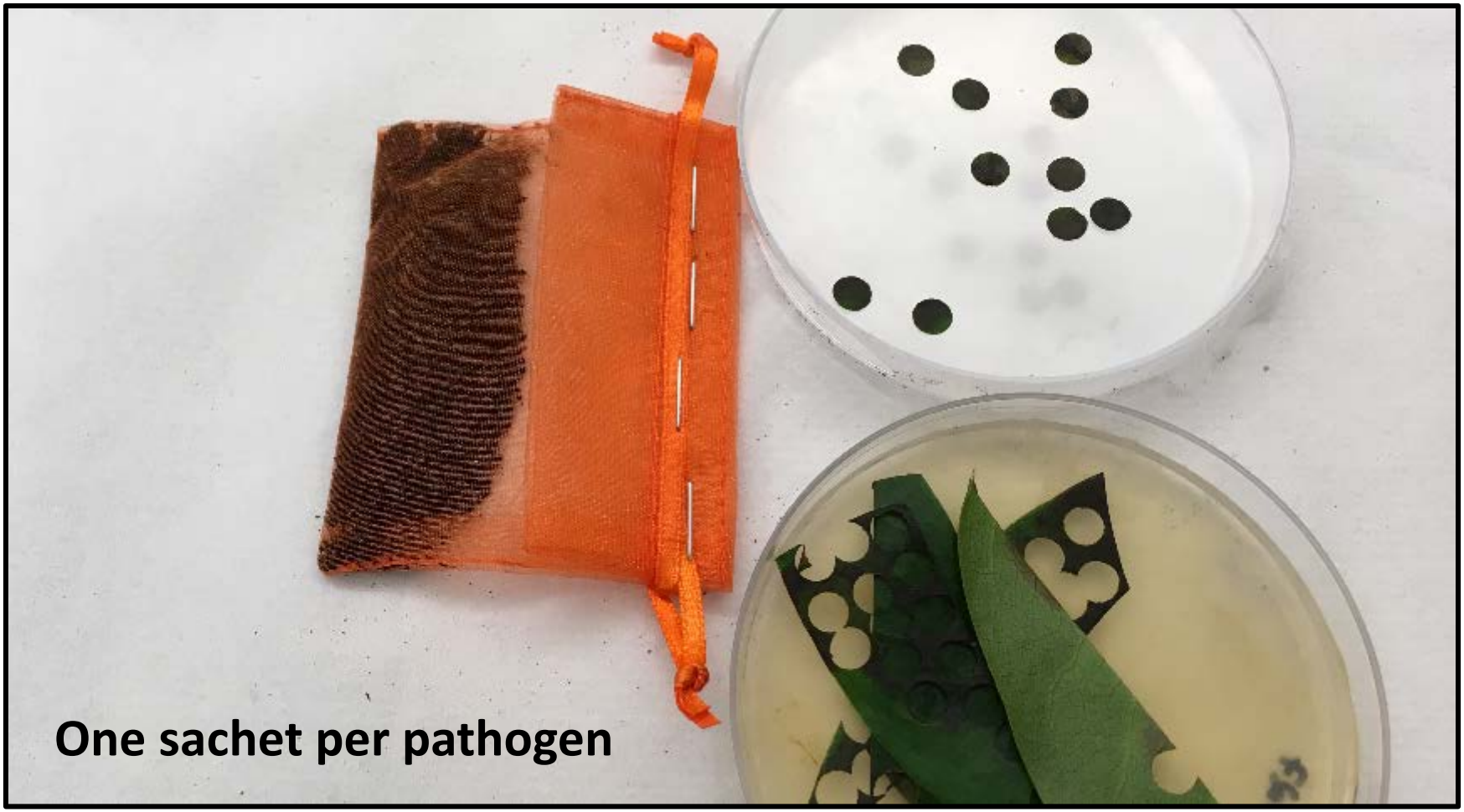
Design of Second Experiment

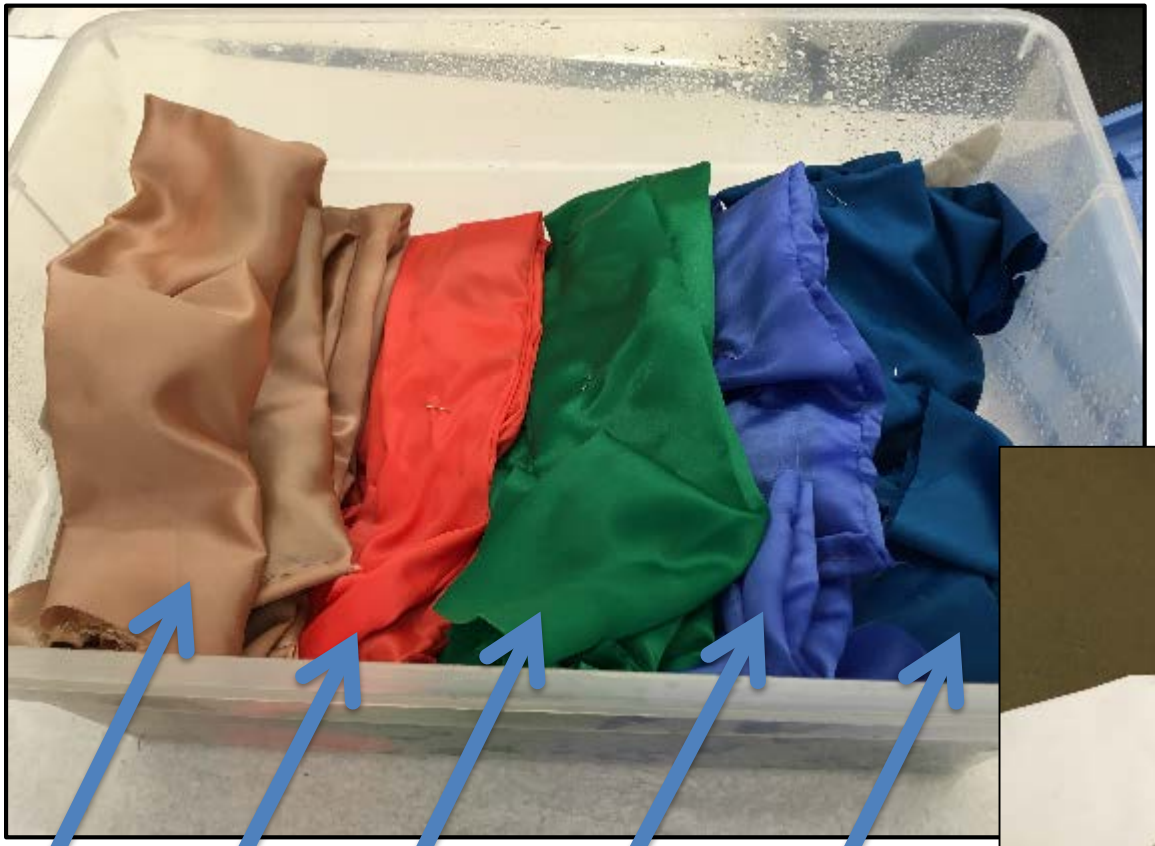
- Included three plant pathogens (*P. cactorum, P. tentaculata, P. ramorum*)
- Conducted at NORS-DUC (quarantine field site)
- Experiment conducted for one week
- Sampled daily

Second Experiment

- Only 1G pots
- One large sheet of black plastic

New sachet design





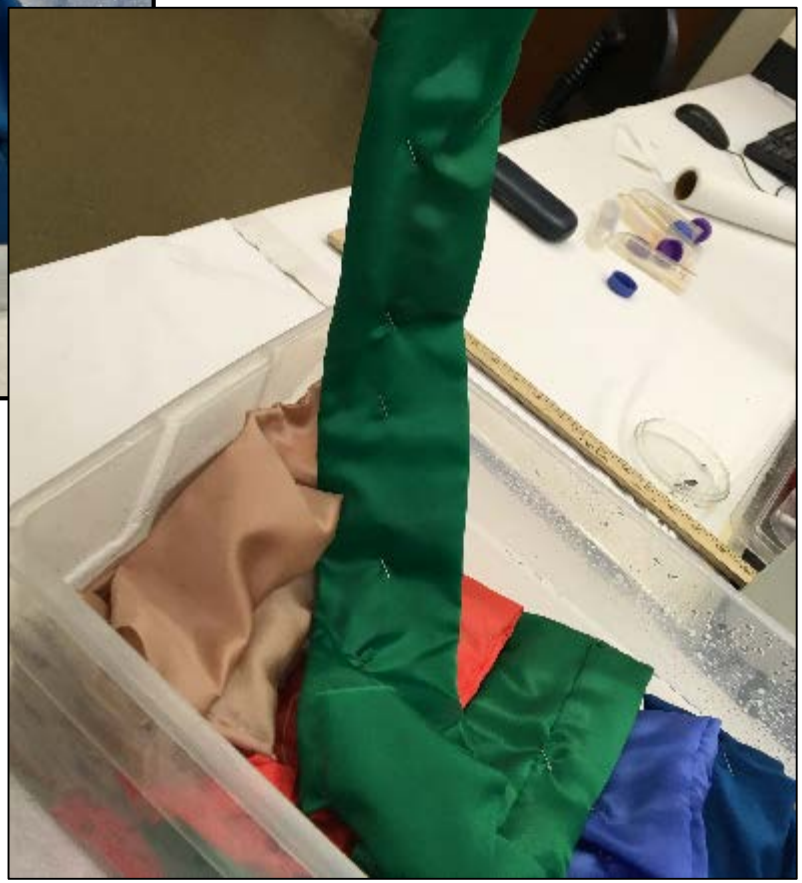
DAY 1

DAY 2

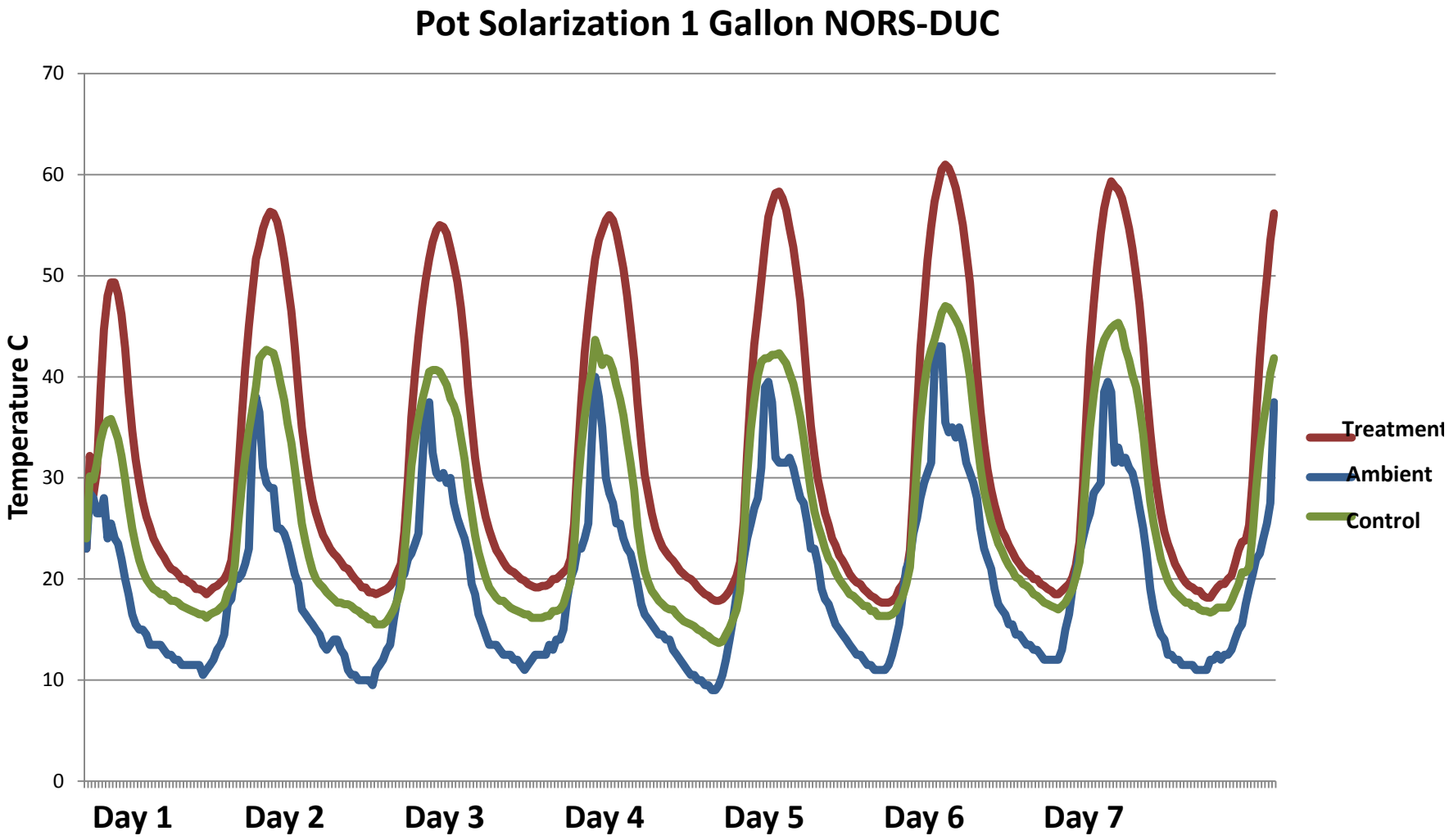
DAY 3

DAY 4

DAY 7



Results- Second experiment



P. cactorum, P. tentaculata, P. ramorum

Results- Second experiment

Ambient Temperature peaked at 28^{0}C = 82^{0}F

	40-45^{0}C	40-45^{0}C	40-45^{0}C	46-50^{0}C	46-50^{0}C	46-50^{0}C
Treatment	0.5 hrs	1.5	1	3	1.5	5.5
Control	0	3	2.5	0	0	0
	51-55^{0}C	**51-55^{0}C**	**51-55^{0}C**	**56-60^{0}C**	**56-60^{0}C**	**56-60^{0}C**
Treatment	0	3	4.5	0	1.5	0
Control	0	0	0	0	0	0
	Day 1	**Day 2**	**Day 3**	**Day 1**	**Day 2**	**Day 3**

In all 1G replicated Treatments- All 3 Pathogens killed after 24 hours

All lab-maintained infested leaf disks, which were plated out daily, remained viable during the course of the trial

All Controls remained viable until Day 3

Ambient temperatures reached 28^{0}C (82^{0}F) for 3 hours, All *Phytophthoras* in Treatment were killed

Cumulative hours attained during 'Day 1' of NORS-DUC Pot Solarization Trial

San Rafael NORS-DUC, CA	40-45 ^{0} C (104-113^0 F)	46-50 ^{0} C (115-122^0 F)	51-55 ^{0} C (124-131^0 F)	Pathogens killed
Treatment (high 49^{0}C or 120^{0}F)	.5 hrs	3 hrs	0	YES
Control (high 36^{0}C or 97^{0}F)	0	0	0	NO
Ambient temp 20-28^{0}C or 68-82^{0}F				
P. cactorum, P. ramorum, P. tentaculata				

Solarization

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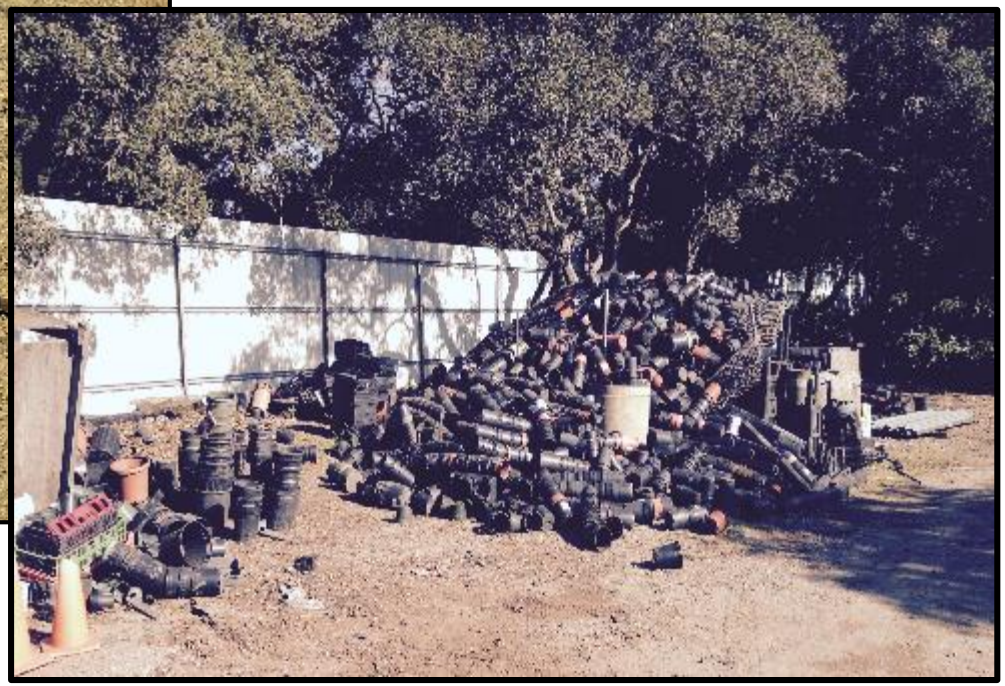
When solarizing used 1G pots in the warm months of the year:

- Wet the nested pots
- If have a temperature probe, place it in the coolest part of the stacked pots
- Seal pots in clear plastic
- Align them in a single layer horizontally on the ground
- Place a black tarp under the plastic wrapped containers
- Expose fully to the sun
- Confirm temperatures reach 50^0C for minimally 30 minutes
- This can potentially be achieved within a day in a warm climate
- Without a temperature probe, track ambient temperatures and when it reaches 82^0F for a constant 3 hours, know that your sealed pots have attained the necessary temperature to kill *Phytophthoras* and *Pythiums*.

Pot Solarization

Solarizing used pots is an effective method to eliminate *Phytophthora* species



Pot Storage


What did not work

Other options


7ft
6ft
4ft
2ft