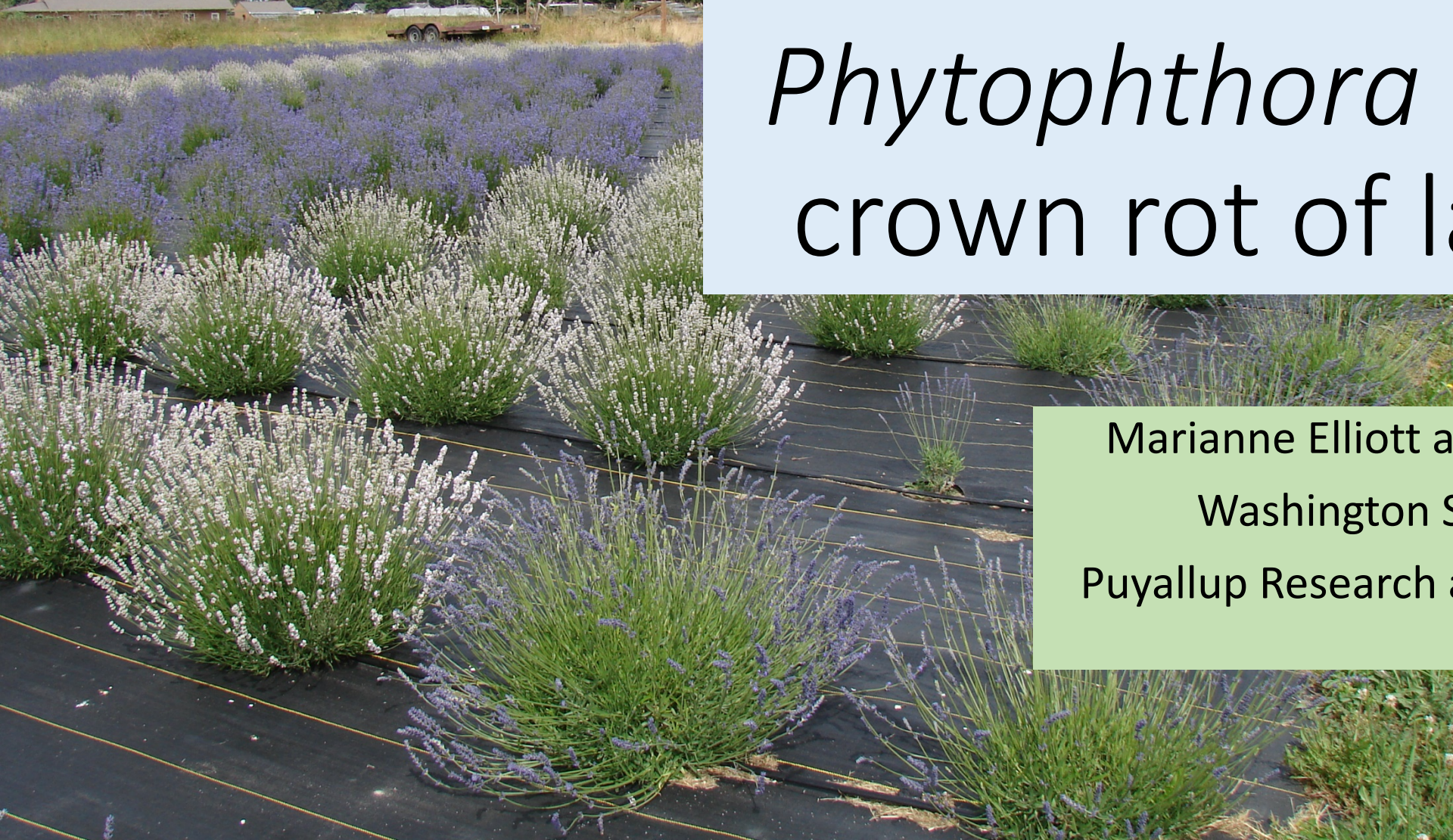
A wide-angle photograph of a lavender field under a blue sky with light clouds. In the background, there is a large building with a blue roof and a smaller structure. A trailer is parked in the field.

# *Phytophthora* root and crown rot of lavender

A close-up photograph of lavender plants growing in a field. The plants are in rows, and the ground is covered with black plastic mulch. Some plants are in bloom, showing purple flowers.

Marianne Elliott and Gary Chastagner  
Washington State University  
Puyallup Research and Extension Center



# Planned research projects

- *Phytophthora* species on lavender in WA
- Screen lavender cultivars for susceptibility/resistance to PRCR
- Best Management Practices for lavender growers





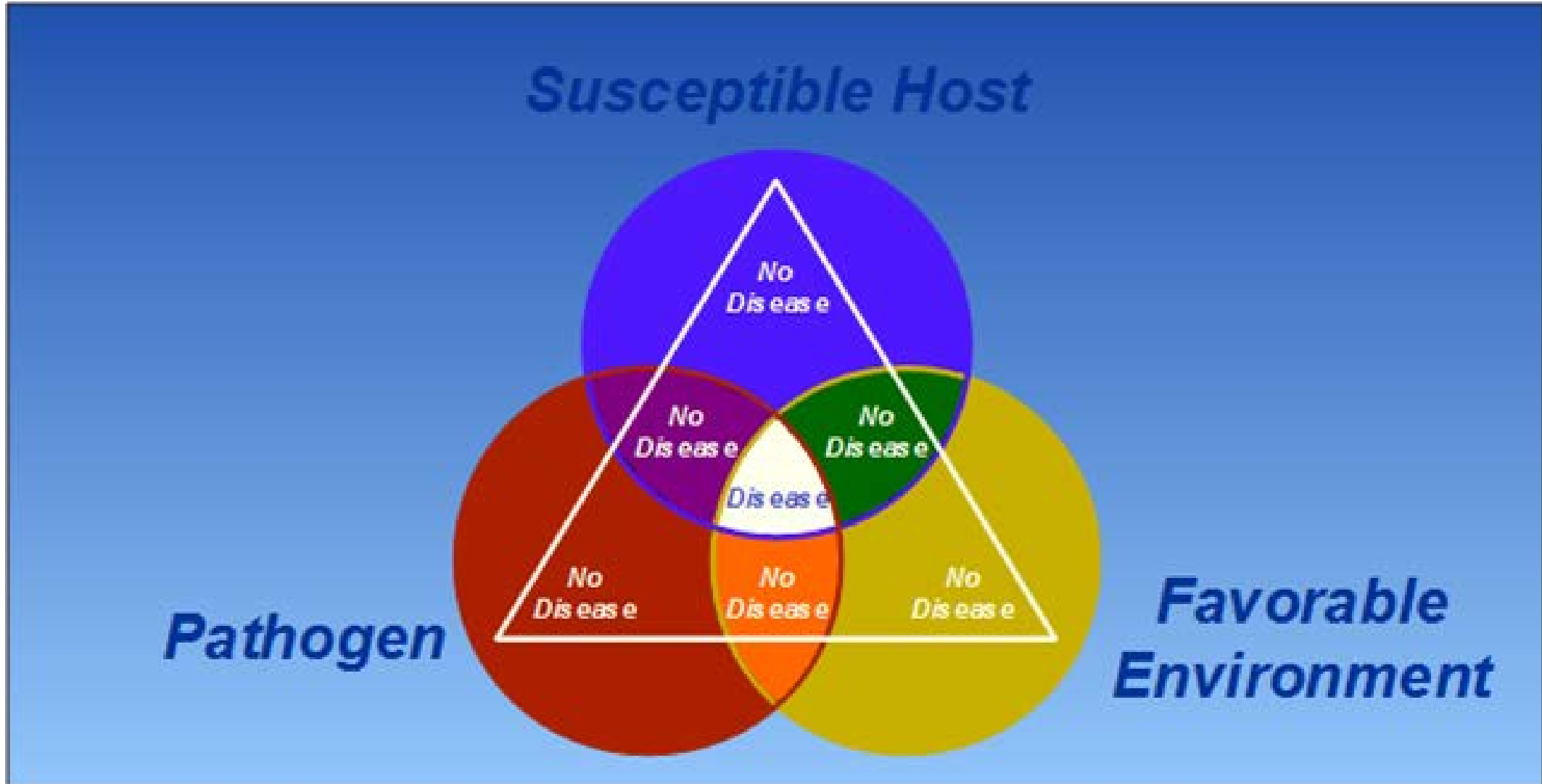
# Lavender root rot

- *Fusarium*
- *Phytophthora*
- *Pythium*
- *Rhizoctonia*

Occurs in wet soils. Overwatering aggravates the problem.



# The disease triangle





# *Phytophthora*

- What is it
- Where does it come from
- How do I know I have it
- How do I get rid of it





# *Phytophthora* – the plant destroyer



“Perhaps no other single plant disease has resulted in such widespread human suffering and sociological impact.”

*More than 100 species identified*

*P. infestans* – responsible for the Irish potato famine in 1845

*P. sojae* - soybean stem and root rot

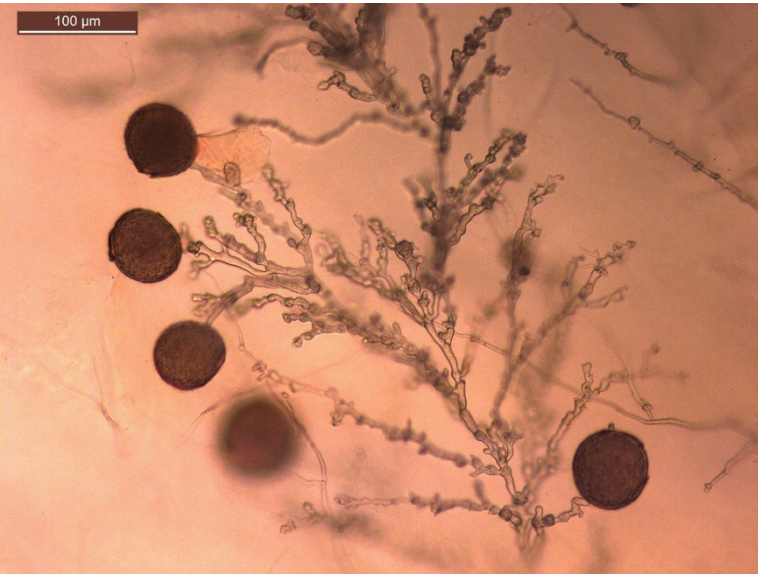
Several *Phytophthora* spp. cause disease on cacao

*P. cinnamomi* – causes damage to forest ecosystems worldwide

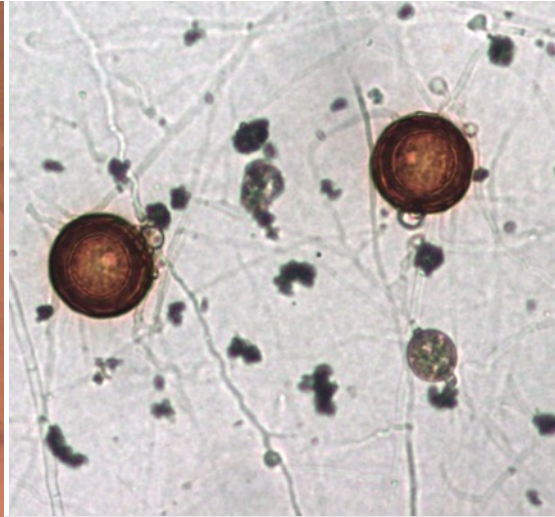
*P. ramorum* – causes Sudden Oak Death (SOD)



# Phytophthora



Chlamydospores  
(*P. ramorum*)



Oospores of *P. megasperma*



*Phytophthora* is microscopic and species can be identified by spore stages and/or DNA sequencing



*P. alni* oospore



# *Phytophthora* Seasonal Activity

What time of year is *Phytophthora* active?

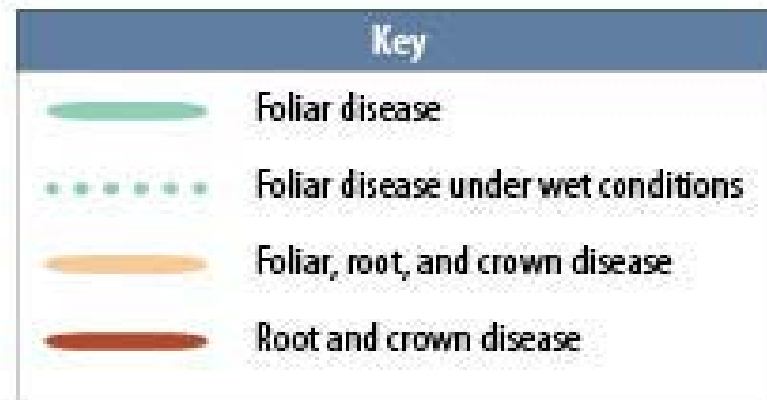
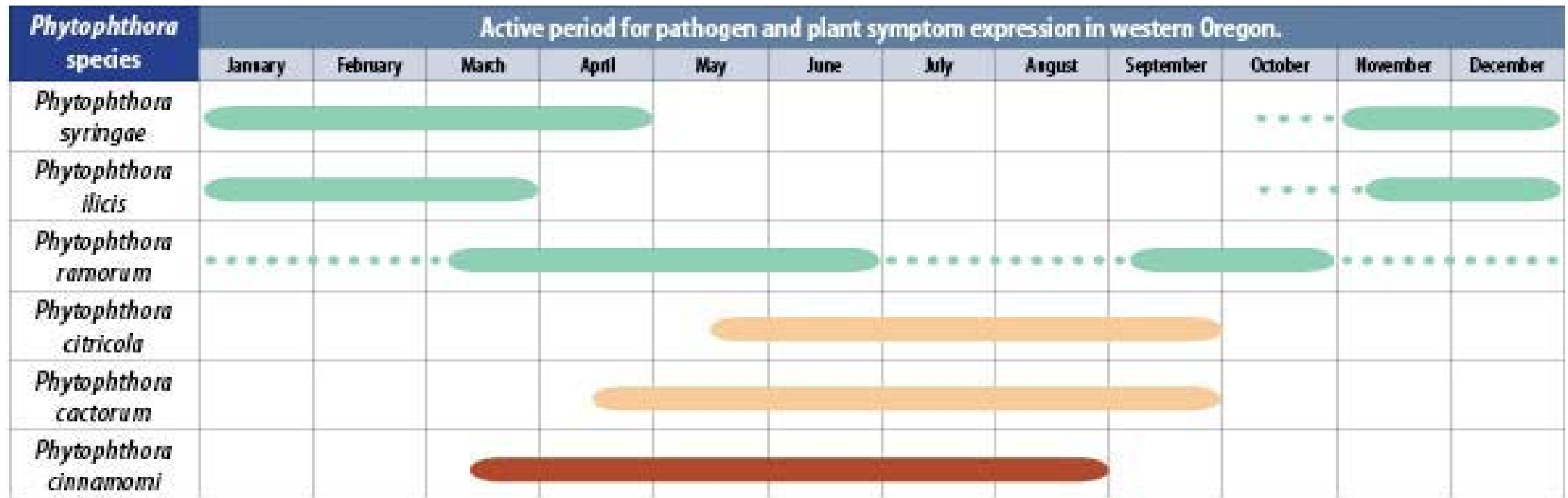
Not all species are active at the same time

- Germination and infection – wet season
- Symptom expression – in dry season





# Seasonal activity for *Phytophthora* species





# Phytophthoras on lavender

## Germination, infection

Symptoms of Phytophthora root disease will become obvious in the dry season when plants are under water stress.

### Cool Season – cool, wet soil

- *P. megasperma*

### Warm Season – greenhouse, warm soil

- *P. cactorum*
- *P. capsici/palmivora*
- *P. cinnamomi*
- *P. citrophthora*
- *P. drechlserei*
- *P. nicotianae/parasitica*
- *P. tentaculata*



# “Root nibblers”

- Attack fine roots
- Opportunistic in flooded habitats
- Very common in water and soil

*P. gonapodyides*  
*P. chlamydospora*  
*P. lacustris*



Photo: Natural Resources Wales



# Damage caused by *Phytophthora* spp.



*P. cinnamomi* root disease on *Eucalyptus*

Root disease  
Bleeding cankers

Shoot blight  
Foliar lesions

*P. ramorum* foliar and shoot blight on *Vaccinium* at a nursery



Bleeding cankers caused by *P. citricola* on Alder





# Where PRCR comes from

- New plants
- Existing infestation in field soil

| Phytophthora         | Major Host Families           |
|----------------------|-------------------------------|
| <i>P. nicotianae</i> | Solanaceae                    |
| <i>P. cactorum</i>   | Rosaceae, Liliaceae           |
| <i>P. megasperma</i> | Rosaceae, Fabaceae            |
| <i>P. capsici</i>    | Solanaceae                    |
| <i>P. drechsleri</i> | Rosaceae, Myrtaceae, Pinaceae |



Phytophthoras that attack lavender tend to have many hosts



# Symptoms of PRCR

Dead patches – sudden wilting or dieback during summer

Brown staining under bark at root crown

Black, necrotic roots



Above ground symptoms often do not appear until most of the root system is destroyed.



Cinnamon colored stain under the bark





Look for dead patches at  
base of plants



Extensive symptom development  
on in-ground plant





# Winter damage or *Phytophthora*?



Winter damage – top of plant



New shoots grow at base = healthy root system





*Phytophthora* infestation in field –  
Dead plants have been removed

Area of poor drainage, heavy soil

*Phytophthora* spores were probably  
already in soil



# You might have contaminated soil if



- In-ground plants are symptomatic in an area
- Batches of potted plants from a media pile are symptomatic
- There is standing water indicating a drainage problem
- The soil tests positive for *Phytophthora*



# Testing plants for Phytophthora using Agdia test strips

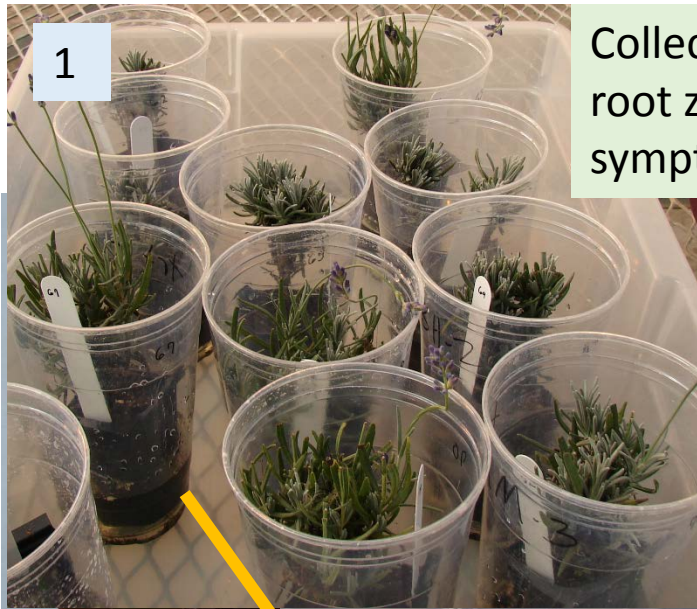


- Direct testing of roots and stem tissue does not work for lavender
- Use baiting method



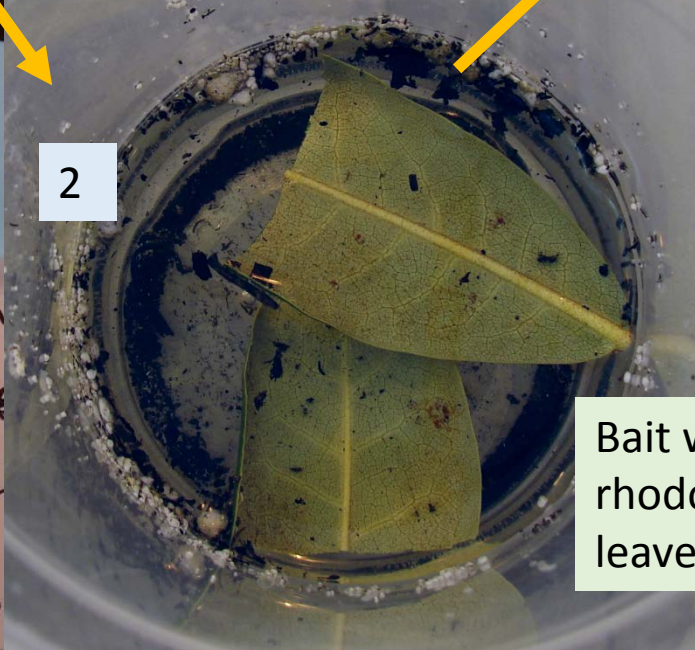


# Testing for PRCR on lavender roots or soil



1

Collect water from root zone of symptomatic plants



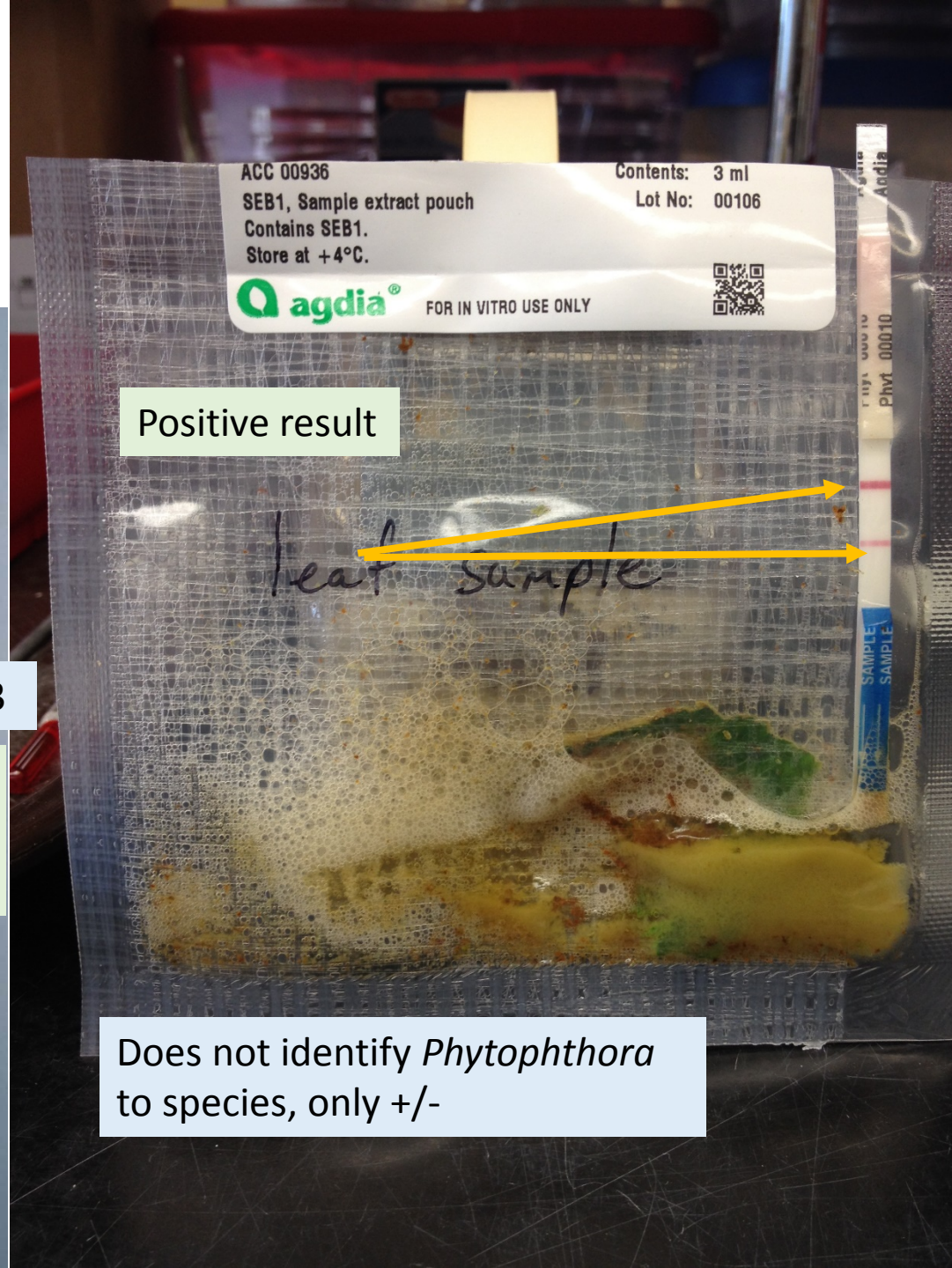
2

Bait with rhododendron leaves



3

Test symptomatic leaf bait with Agdia kit



Positive result

Does not identify *Phytophthora* to species, only +/-





*Pythium* symptoms:  
water soaked lesions

*Phytophthora* symptoms:  
dry, brown lesions





# Critical Control Points

Concept originally developed for food safety to prevent hazards rather than destroy contaminated foods at the end of the production cycle.

It has been adapted for ornamental nurseries in response to *P. ramorum* but will prevent outbreaks of any pathogen or pest.



**Maintaining a clean operation prevents unwanted pests and diseases from entering the nursery or farm.**

**It is much easier to prevent than to eradicate.**



# Recommended cultural control for PRCR

- Prevention – keep it out
- Sanitation
- Plant in well drained soil and avoid areas prone to standing water
- Do not incorporate large amounts of compost or mulch that will retain water around plants
- Excess N fertilizer will produce succulent growth that is susceptible to *Phytophthora* and other diseases



# Sources of inoculum

- People and their vehicles
- Plants
- Dirty pots, tools, and equipment
- Soil
- Water
- Plant debris and cull piles
- Weeds, algae, and associated insects (shoreflies and fungus gnats)





# People and their footwear

The Sequim Lavender Festival attracts many visitors that move from farm to farm.





# Preventing soil movement

- Control access
- Create a barrier between feet and soil: boardwalk, bark chips, etc.
- Avoid standing water and muddy areas
- Manage equipment - tires, hoses, tools





# Potted plants in nursery or retail area



Pots should not be in contact with soil

Gravel layer of 4-6" will provide drainage and separate plants from soil surface

Use pallets or benches underneath pots





# Potting mix

Re-using media is risky

Composting may not kill everything

Loads of media can be treated with aerated steam at the rate of ~1 cu yd/hr using a cart or conveyor belt system.





# Plants



Incoming plants should be examined on arrival


Plants can be quarantined for at least 30 days and monitored for symptoms, insect pests

Reject plants that are symptomatic or test positive for *Phytophthora*




# Pots

- Soil and plant material clinging to used pots and trays are a source of pests, diseases, and weeds
- Pots can be treated with disinfectant, steaming, or hot water dip



Hot water dip tank for 4" pots



This steam cabinet was built on a relatively low budget by a nursery in OR



# Managing *Phytophthora* in a field

Dig up and remove infested plants and also at least 1 adjacent plant on each side

Remove soil around root zone of infested plants

Prevent spread of disease –

- Restrict water movement through the area
- Cover soil in mulch, gravel, or cover crop
- Prevent movement on machinery, footwear, equipment

Improve drainage

Do not plant new lavender into infested soil –  
Make it a feature or plant a non-host species





# Treatments for contaminated soil

Soil amendments/  
Biocontrol

Solarization

Steam

Fumigation

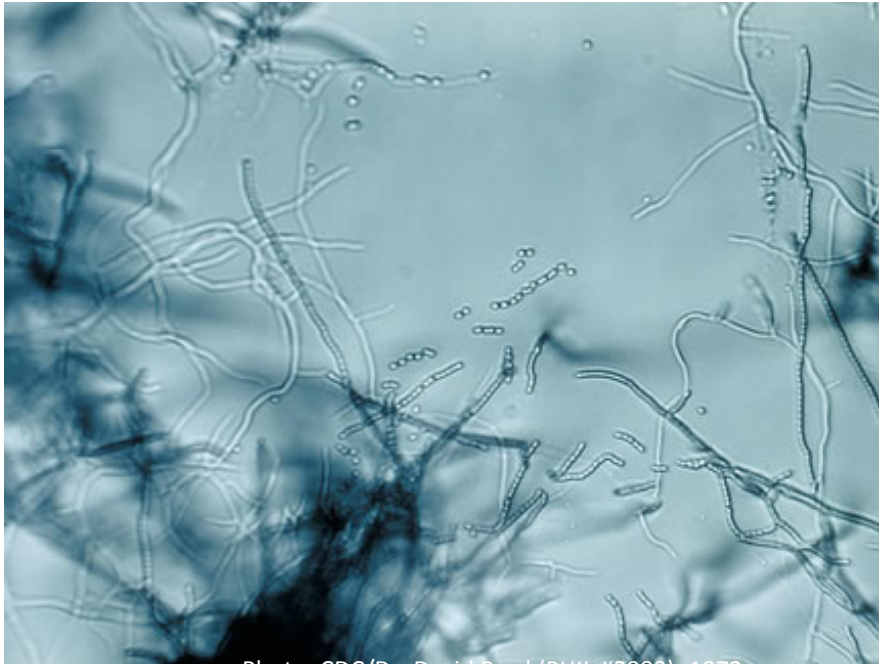




# Some soil organisms are beneficial

Cellulase producing fungi

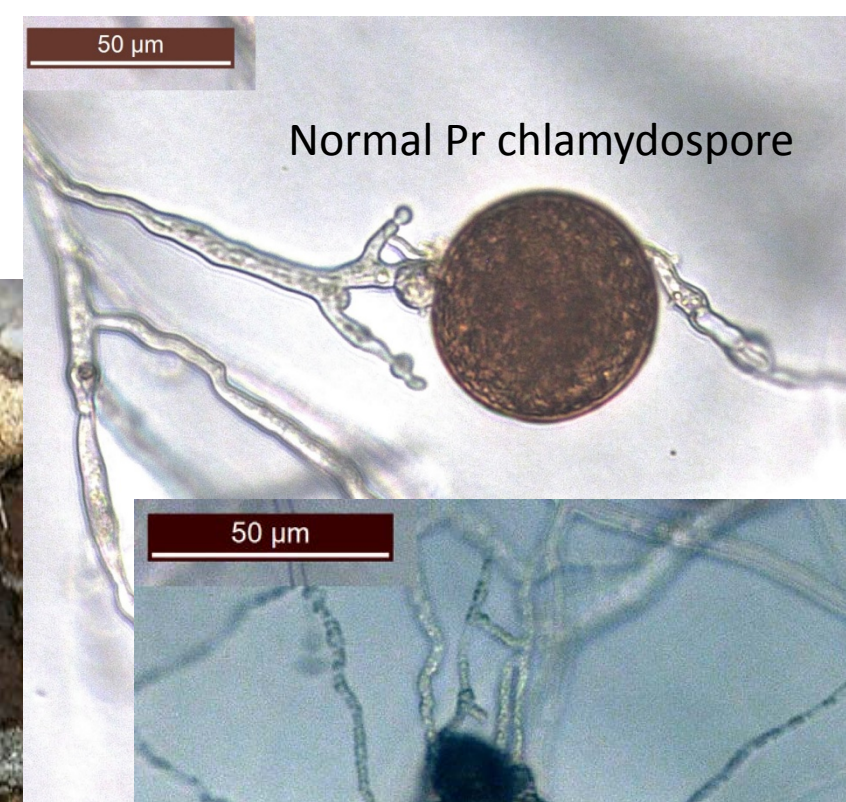
Bacteria and actinomycetes  
produce antibiotics



*Streptomyces* spp. are common in soil and produce antibiotics



Several species of *Trichoderma* are antagonistic to *Phytophthora* spp.



Normal Pr chlamydospore



Pr chlamydospore parasitized by *Trichoderma*



# Chemical fumigation

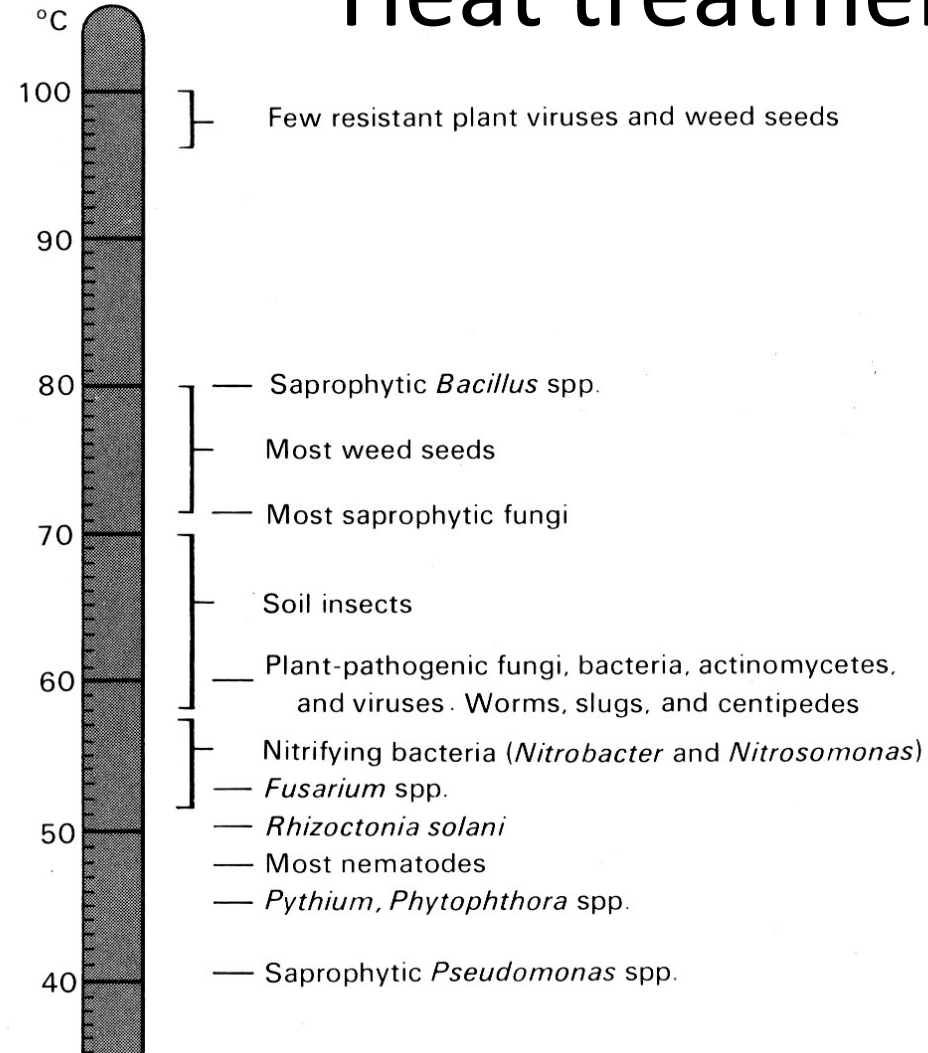
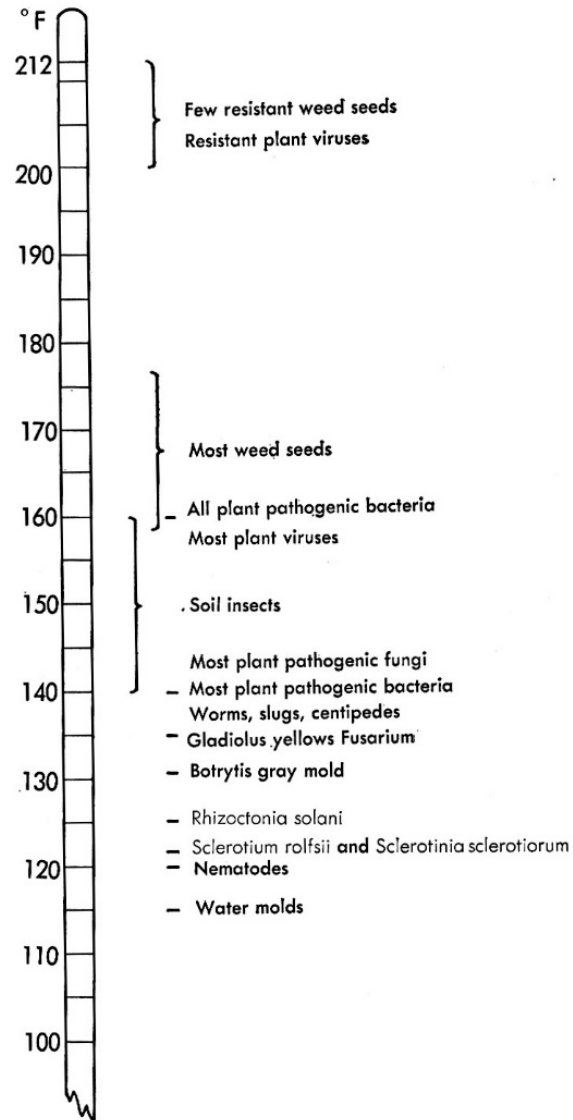
- For large areas of soil
- Kills beneficial organisms
- Dazomet – granular formulation
- Chloropicrin
- Metam sodium – can be worked into soil or applied through irrigation

Check label for approved crops and application methods before use





# Heat treatment



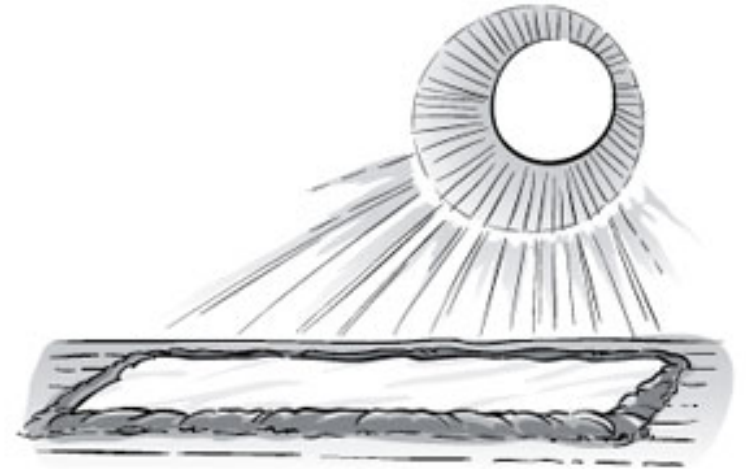
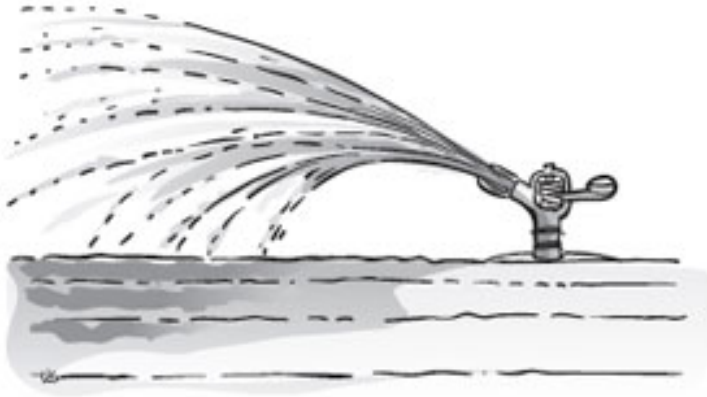
Temperatures necessary to kill various groups of soil organisms



# Solarization

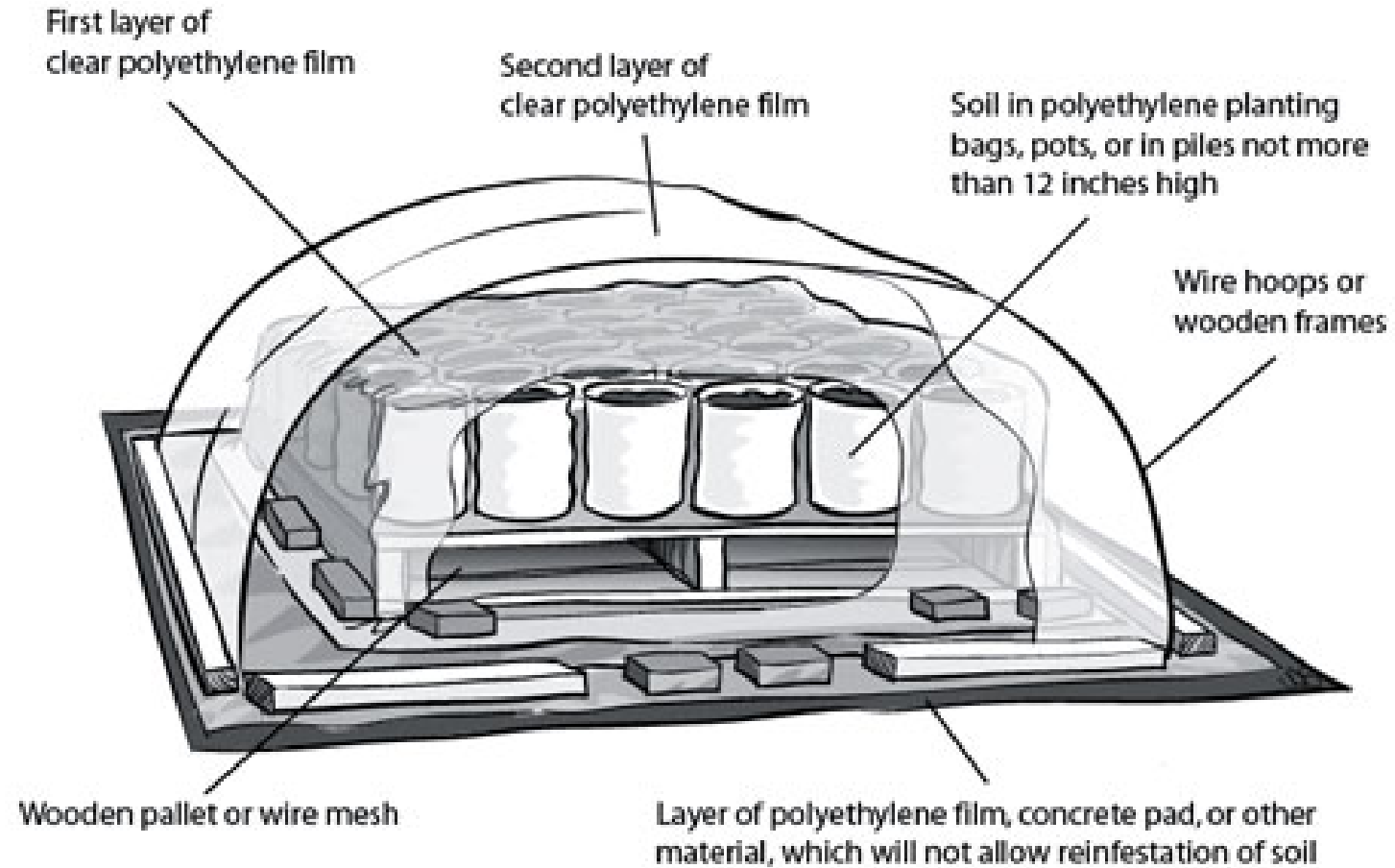
Heats top layer of soil  
to kill pests and  
pathogens.

Need 4-6 weeks of clear  
skies, long days, high  
temperatures.





# Pots and media can also be solarized





# Soil steaming



Contaminated hoophouse at a nursery







Sheet steaming and steam boiler.



# Any questions?



## Website

<http://ppo.puyallup.wsu.edu/>

[melliott2@wsu.edu](mailto:melliott2@wsu.edu)