Phytophthora root and crown rot of lavender

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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

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)

“Perhaps no other single plant disease has resulted in such widespread human suffering and sociological impact.”
Phytophthora is microscopic and species can be identified by spore stages and/or DNA sequencing.
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

<table>
<thead>
<tr>
<th>Phytophthora species</th>
<th>January</th>
<th>February</th>
<th>March</th>
<th>April</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>August</th>
<th>September</th>
<th>October</th>
<th>November</th>
<th>December</th>
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<tbody>
<tr>
<td><em>Phytophthora syringae</em></td>
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<td><em>Phytophthora ilicis</em></td>
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<td><em>Phytophthora ramorum</em></td>
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<td><em>Phytophthora citricola</em></td>
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<td><em>Phytophthora cactorum</em></td>
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<tr>
<td><em>Phytophthora cinnamomi</em></td>
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**Key**
- Green: Foliar disease
- Dotted green: Foliar disease under wet conditions
- Orange: Foliar, root, and crown disease
- Red: Root and crown disease
Phytophthoras on lavender

**Germination, infection**

**Cool Season – cool, wet soil**
- P. megasperma

**Warm Season – greenhouse, warm soil**
- P. cactorum
- P. capsici/palmivora
- P. cinnamomi
- P. citrophthora
- P. drechlsrei
- P. nicotianae/parasitica
- P. tentaculata

Symptoms of Phytophthora root disease will become obvious in the dry season when plants are under water stress.
“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. ramorum* foliar and shoot blight on *Vaccinium* at a nursery

- *P. cinnamomi* root disease on *Eucalyptus*
  - Root disease
  - Bleeding cankers

- Shoot blight
  - Foliar lesions

- Bleeding cankers caused by *P. citricola* on Alder
Where PRCR comes from

- New plants
- Existing infestation in field soil

<table>
<thead>
<tr>
<th>Phytophthora</th>
<th>Major Host Families</th>
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<tbody>
<tr>
<td>P. nicotianae</td>
<td>Solanaceae</td>
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<tr>
<td>P. cactorum</td>
<td>Rosaceae, Liliaceae</td>
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<tr>
<td>P. megasperma</td>
<td>Rosaceae, Fabaceae</td>
</tr>
<tr>
<td>P. capsici</td>
<td>Solanaceae</td>
</tr>
<tr>
<td>P. drechsleri</td>
<td>Rosaceae, Myrtaceae, Pinaceae</td>
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Phytophthorars 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*

Photo: Jay W. Pscheidt.
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

Use pallets or benches underneath pots

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

Photo: CDC/Dr. David Ford (PHIL #2983), 1972.

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
Temperatures necessary to kill various groups of soil organisms

- Few resistant plant viruses
- Most weed seeds
- All plant pathogenic bacteria
- Most plant viruses
- Soil insects
- Most plant pathogenic fungi
- Most plant pathogenic bacteria
- Worms, slugs, centipedes
- Gladiolus, yellow Feverium
- Botrytis gray mold
- Rhizoctonia solani
- Sclerotium rolfsii and Sclerotinia sclerotiorum
- Nematodes
- Water molds
- Few resistant plant viruses and weed seeds
- Saprophytic Bacillus spp.
- Most weed seeds
- Most saprophytic fungi
- Soil insects
- Plant-pathogenic fungi, bacteria, actinomycetes, and viruses. Worms, slugs, and centipedes
- Nitrifying bacteria (Nitrobacter and Nitrosomonas)
- Fusarium spp.
- Rhizoctonia solani
- Most nematodes
- Pythium, Phytophthora spp.
- Saprophytic Pseudomonas spp.
Solarization

Heats top layer of soil to kill pests and pathogens.

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

Pest Notes: Soil Solarization for Gardens & Landscapes Management. UC ANR Publication 74145
Pots and media can also be solarized.
Soil steaming

Contaminated hoophouse at a nursery
Sheet steaming and steam boiler.
Any questions?

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