Water and Plant Diseases

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Where waterborne plant pathogens come from

- Greenhouse
- Nursery
- Irrigation source
- Runoff
- Soil

Recycled irrigation water is a source of inoculum in greenhouses

Water molds such as *Phytophthora* and *Pythium* can spread rapidly in recirculating irrigation water and cause serious damage within a few days.

Biofilms

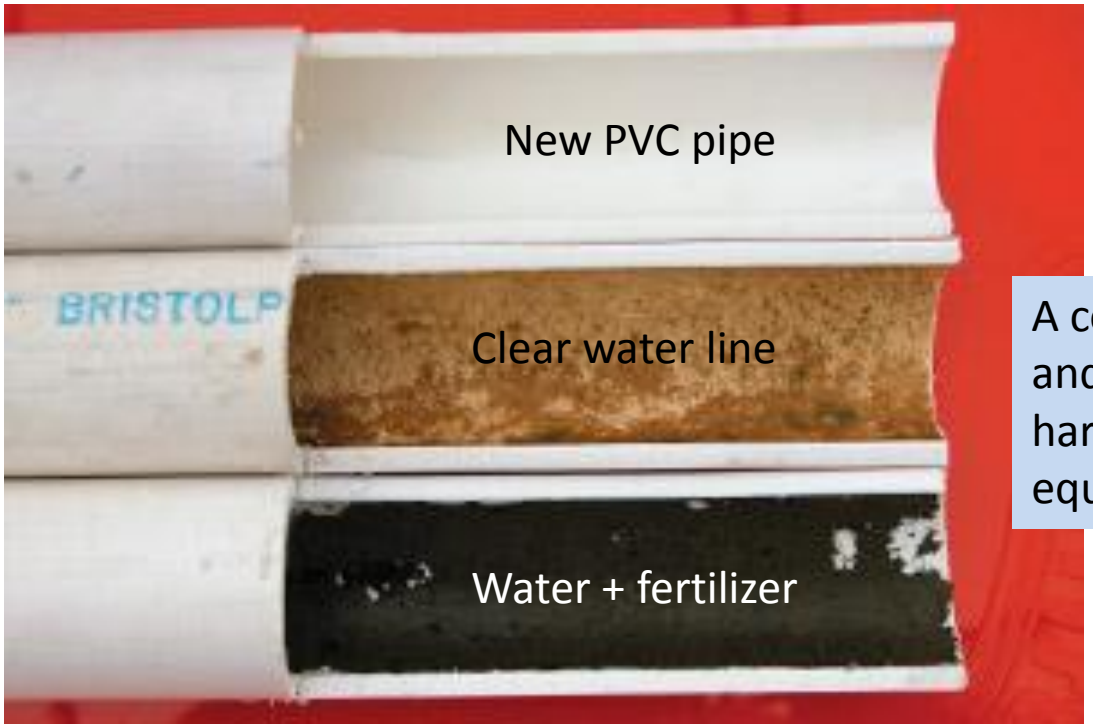
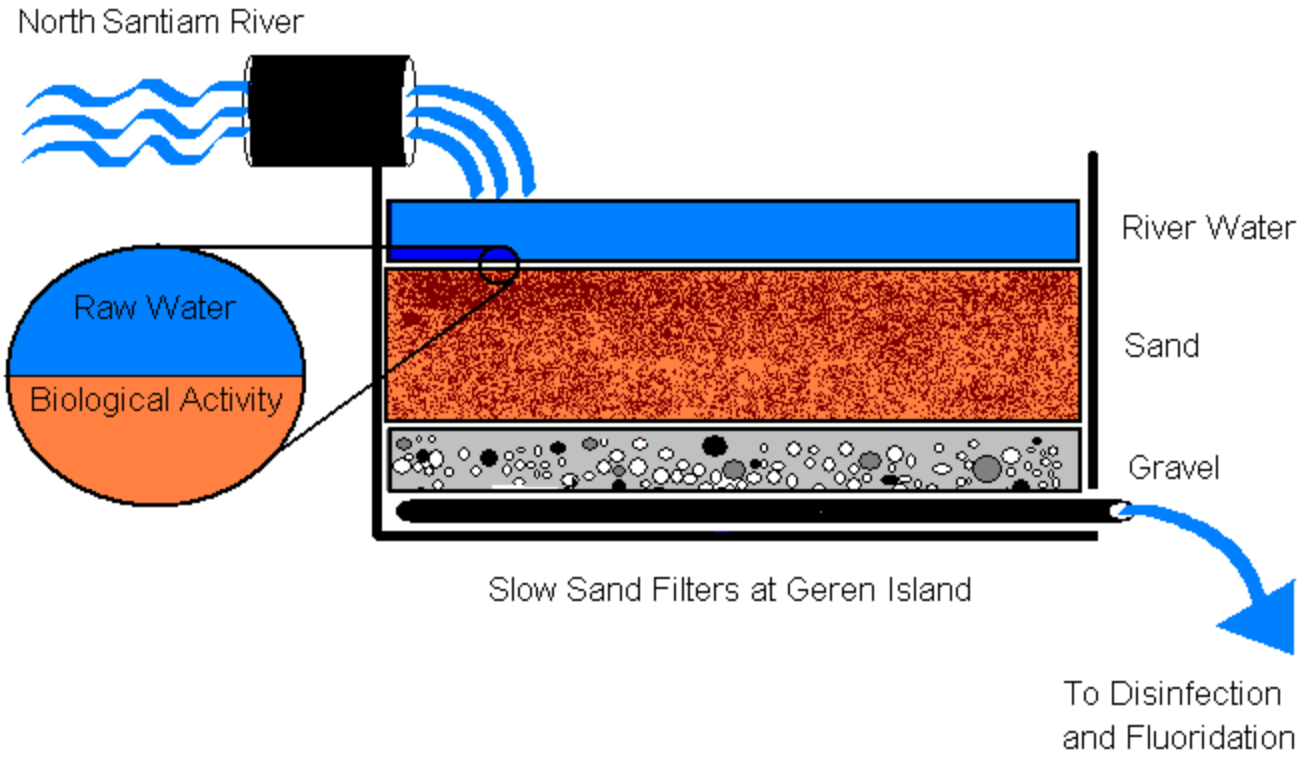


Photo: Peter Konjoian.
http://www.greenhousegrower.com

A complex of bacteria, fungal, and algal growth that can harbor pathogens and clog equipment.

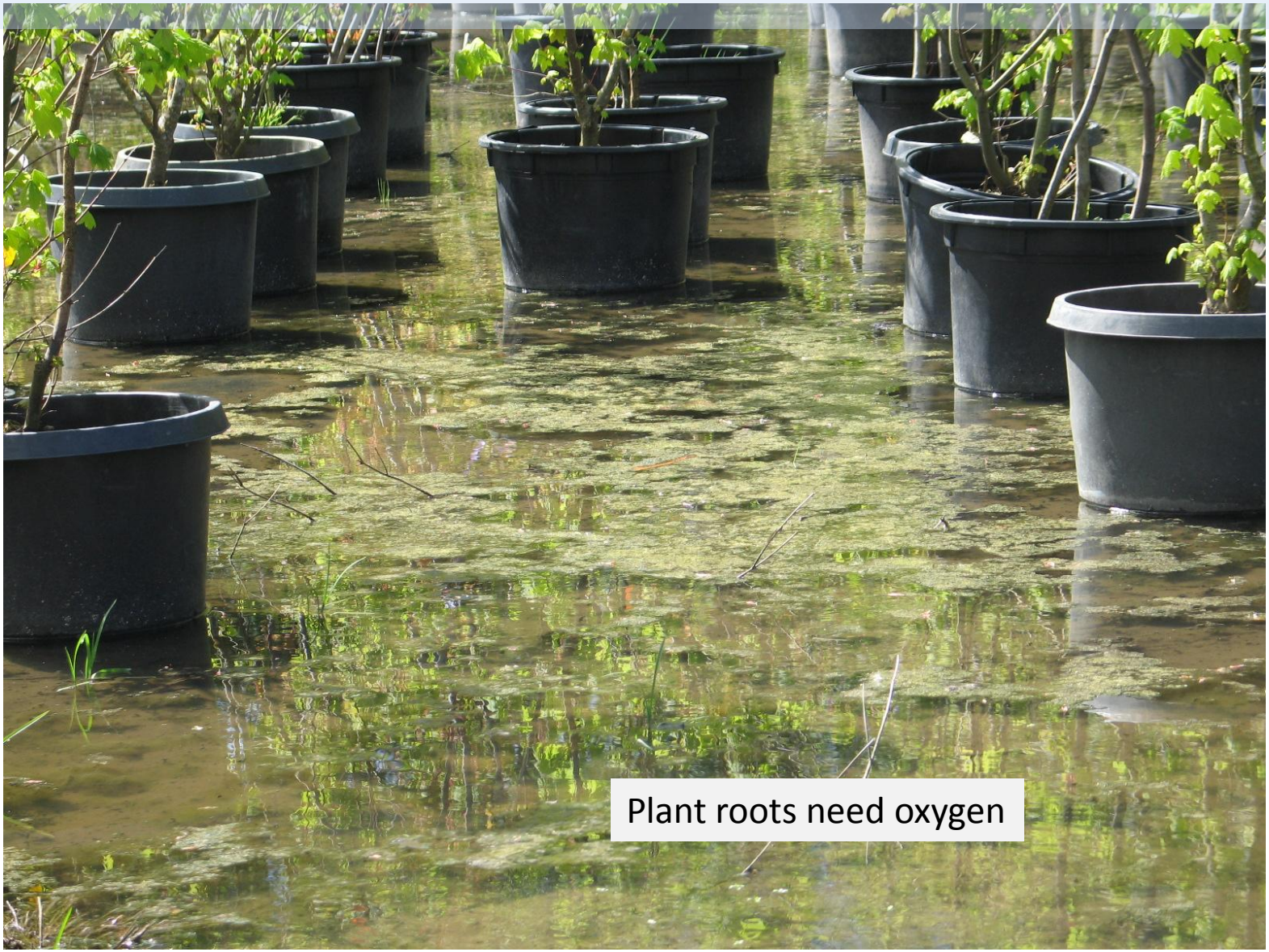
Biofiltration



cityofsalem.net

However, some bacteria and fungi in biofilms can eliminate some waterborne plant pathogens, such as Oomycetes (*Phytophthora* and *Pythium*), as well as excess nutrients.

Symptoms of over-watering



Plant is wilting, but the soil is wet

Pale green or yellow foliage

A sign of nutrient deficiency

Browning

A symptom of root injury

Loss of foliage

Dr. Scot C. Nelson , University of Hawaii at Manoa

Early defoliation and small leaf size are symptoms of root problems caused by flooding.

Stunted growth

University of Delaware Cooperative Extension

Caused by root disease organisms that destroy the roots.

Do not buy plants that look like this!

Edema

http://www.ipm.iastate.edu/ipm/hortnews/2006/4-12/edema.html

Brown, corky lesions followed by yellowing and defoliation. Not caused by disease organisms.

On certain herbaceous plants -

Geranium
Begonia
Jade plant
Pansies
Violets

Splitting

www.carodesert.com

After a dry period, then overwatering

Root rot

Raspberry with root rot. Roots are blackened and collapsed.

Healthy *Gardenia* roots are white and profuse.

Symptoms of root disease in trees

Conifers

- Reduced growth, flattening of crown
- Stress cone crop

Hardwoods

- Thin foliage, small leaves
- Wilting
- Branch dieback

Crown symptoms of root disease (right) are most evident when compared to a healthy crown (left).

Susan K. Hagle, USDA Forest Service, www.forestryimages.org

Diseases that thrive in wet soils

Phytophthora (F.W. Schwenk, Kansas State University)

Plant-parasitic and non-parasitic nematodes recovered from soil by sieving. (Greg Tylka)

- Oomycetes or “water molds”
- Certain fungi
- Bacteria
- Nematodes

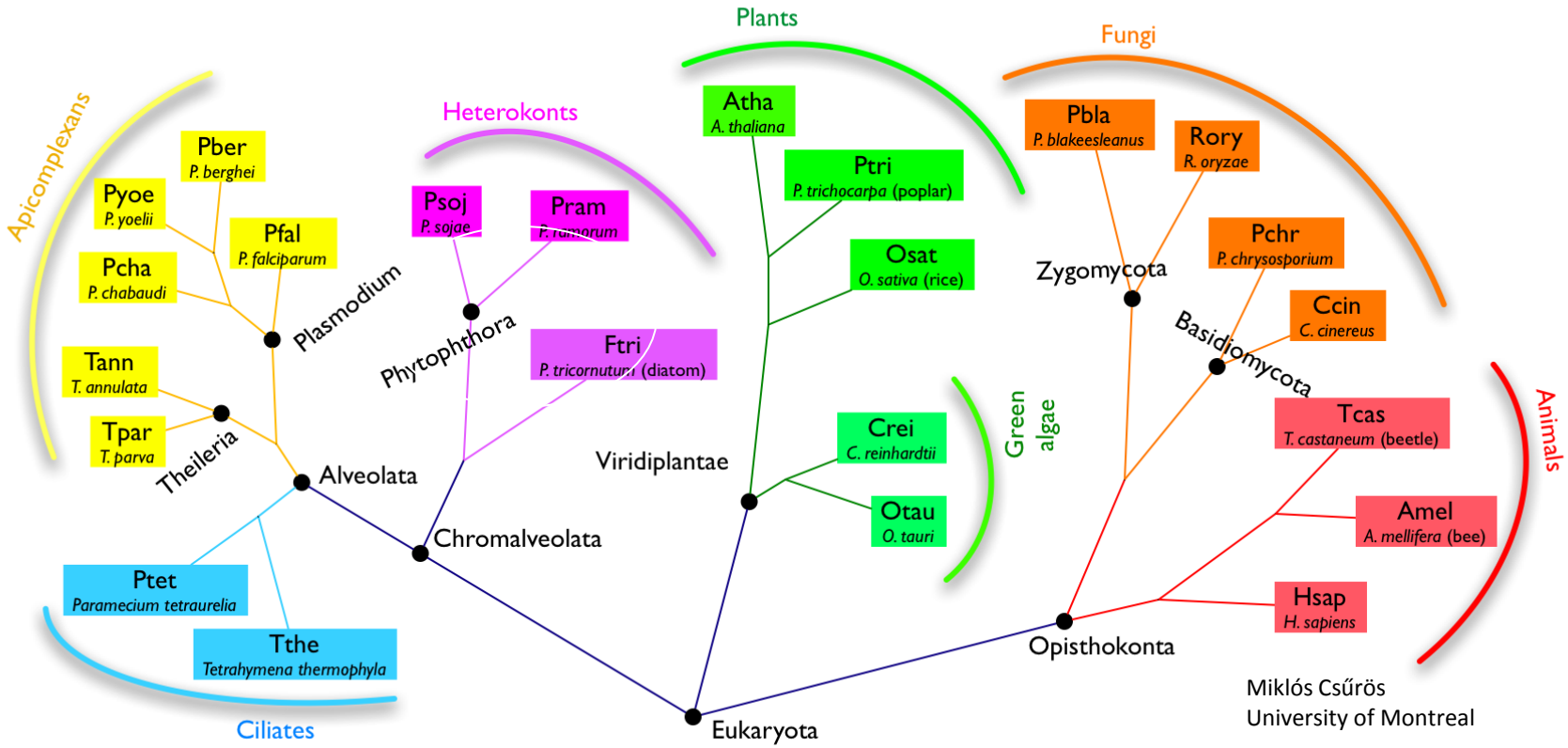
Oomycetes or “water molds”

Adapted to wet soils, they are the most common cause of plant disease in flooded environments.

Phytophthora

Pythium

Regina Johnson



- Oomycetes (*Phytophthora* and *Pythium*) were once considered to be fungi
- Fungi and Oomycetes have similar growth forms – convergent evolution
- Control agents for fungi may not work for Oomycetes and vice-versa

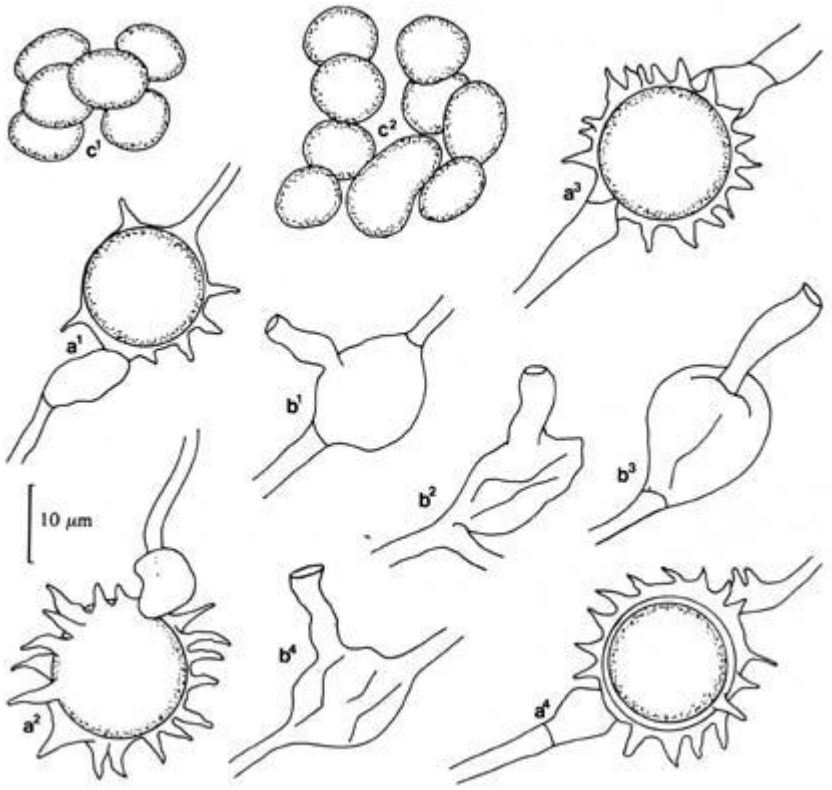
Pythium

More than 100 species identified

“Damping off” of seedlings

Pythium wilt

Root disease



Pythium echinulatum

Pythium diseases

Pythium root rot on Chrysanthemum. Notice the lack of roots.

Pythium root disease on turfgrass can cost thousands of dollars worth of damage on golf courses.

Images by Mary Ann Hansen, Virginia Polytechnic Institute and State University, Bugwood.org

Phytophthora – the plant destroyer

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

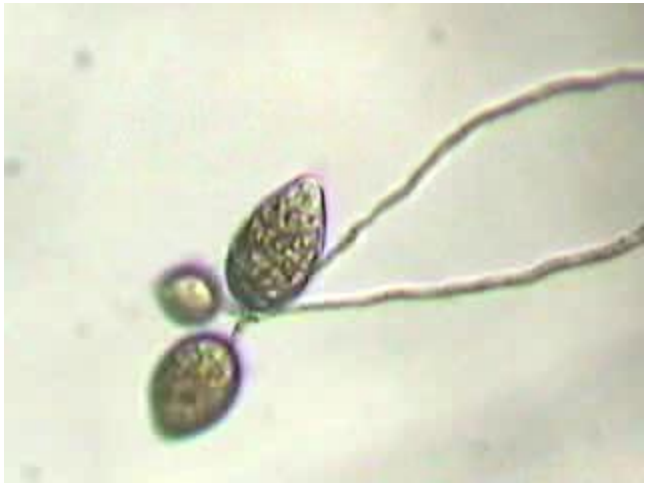
P. sojae - soybean stem and root rot

Several *Phytophthora* spp. cause disease on cacao

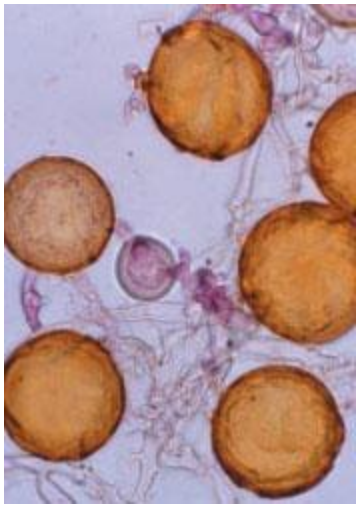
P. cinnamomi – causes damage to forest ecosystems worldwide

P. ramorum – causes Sudden Oak Death (SOD)

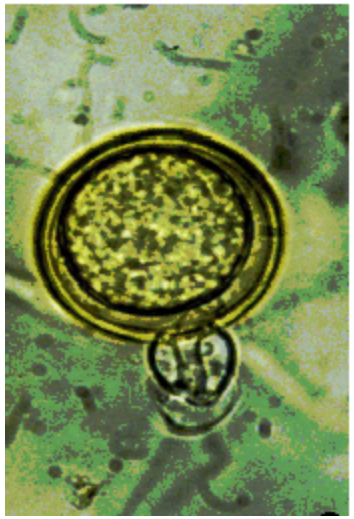
Phytophthora spore stages



Sporangia containing swimming zoospores



Chlamydospores



Oospores (*P. infestans*)

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

Phytophthora root diseases

- Port Orford Cedar root rot (*P. lateralis*)
- *Phytophthora* root rot of ornamentals
  - Several species of *Phytophthora*
  - Many woody ornamental hosts

Symptoms of *Phytophthora* root rot on trees include necrosis on the roots and root collar and brown stain under the bark.

Phytophthora root disease

- Flooding
- Poor drainage
- At bottom of slope

Some of these raspberries are resistant to *Phytophthora rubi*

Phytophthora root disease on *Rhododendron*

Several species including

- *P. cinnamomi*
- *P. citricola*
- *P. cactorum*
- *P. parasitica*

Phytophthora breeds in standing water

Plants that tip over into puddles containing inoculum (zoospores) become infected within 10 seconds!

Invasive *Phytophthora* diseases

Root diseases
P. cinnamomi
P. alni

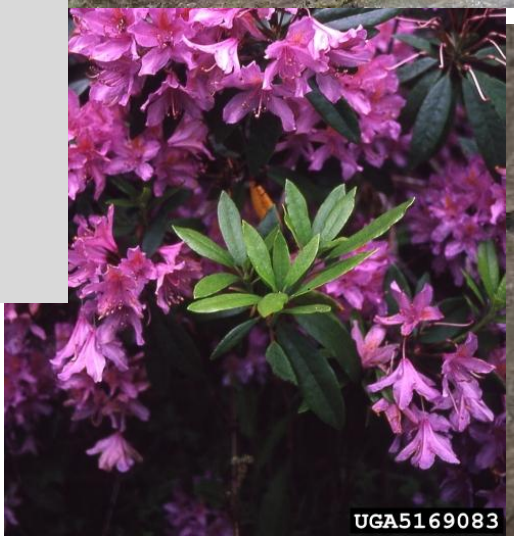
Aboveground
P. ramorum
P. kernoviae

Shrubs killed by *P. cinnamomi* root disease

Photo: William Fountain, University of Kentucky, Bugwood.org

How *P. ramorum* spreads

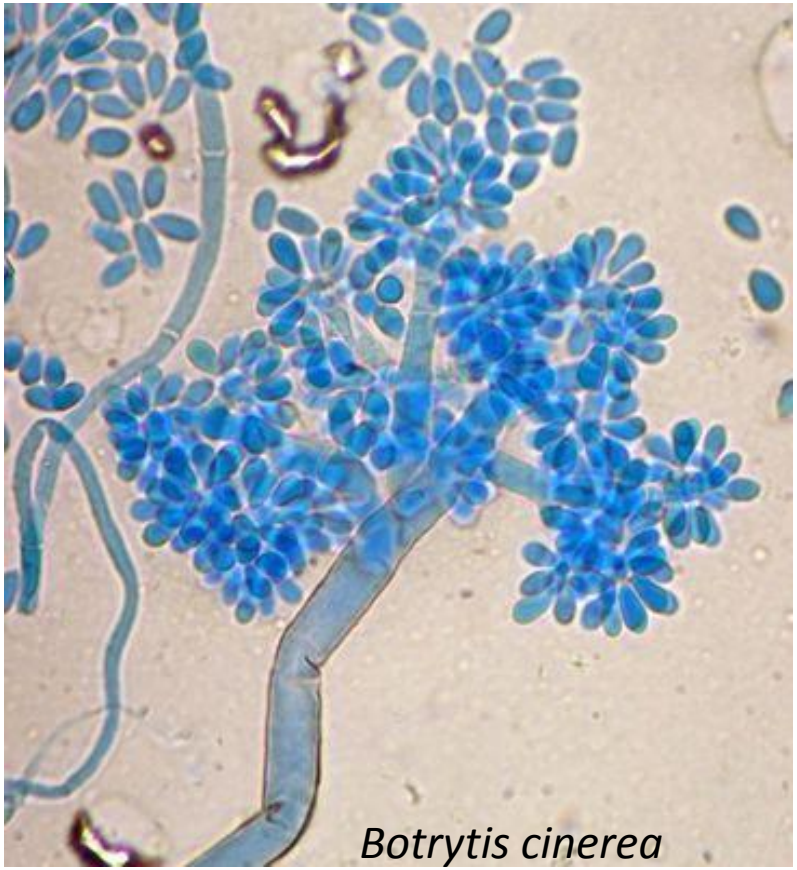
- Water: wind-driven rain, irrigation, runoff
- Humans: soil on hiker's boots and bicycle tires, nursery plants
- Wildlife

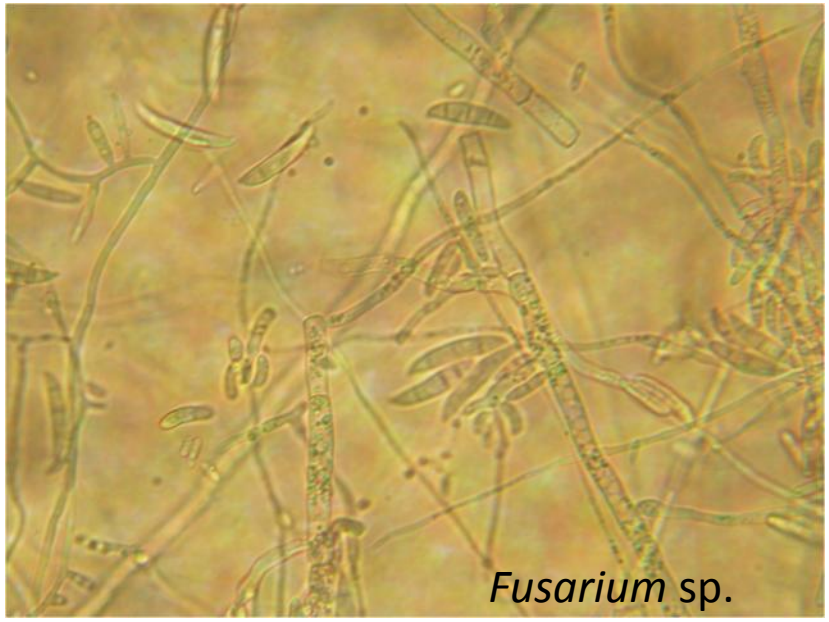


Fungi

Fungi with small spores can be transported in soil water.

Most fungi require oxygen and do not infect in anaerobic environments such as flooded soils, but will germinate after flooding subsides.


Botrytis cinerea


Fusarium sp.

Grey mold, caused by *Botrytis*

USDA Forest Service Archive, USDA Forest Service, Bugwood.org

Photos: R.K. Jones, North Carolina State University, Bugwood.org

Fusarium

Causes plant diseases such as damping-off, root disease, wilt, and canker.

Some are pathogenic to fish and crustaceans in fresh and salt water.

Several species produce toxins that can move into stream water via runoff from infected fields, as well as inoculum.

Bacteria

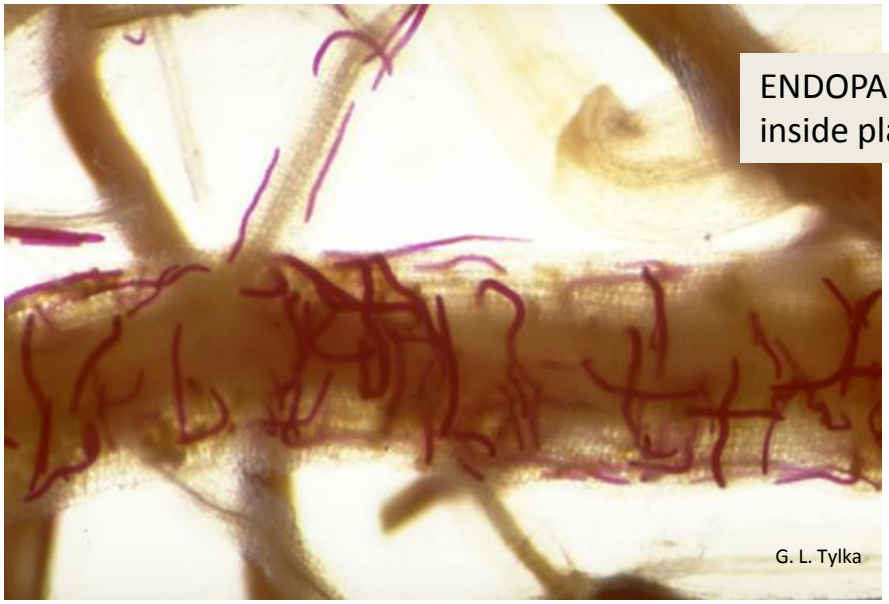
Require moisture to spread and wounding to gain access to plant.

Some bacteria are beneficial to plants while others cause disease.

Genes from plant pathogenic bacteria have been found in plant parasitic nematodes.

Early symptoms of bacterial wilt on muskmelon
[Picture by R. Latin]

Nematodes

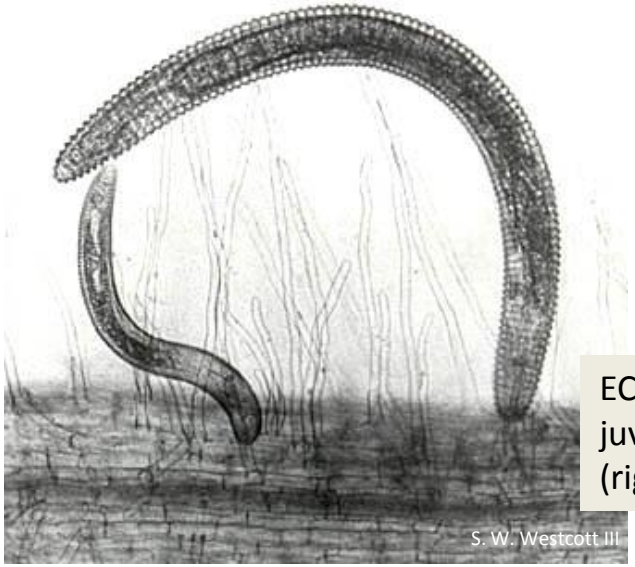


ENDOPARASITE: Lance nematodes feeding inside plant roots.

Microscopic worms that feed on plant roots and are transported in soil water.

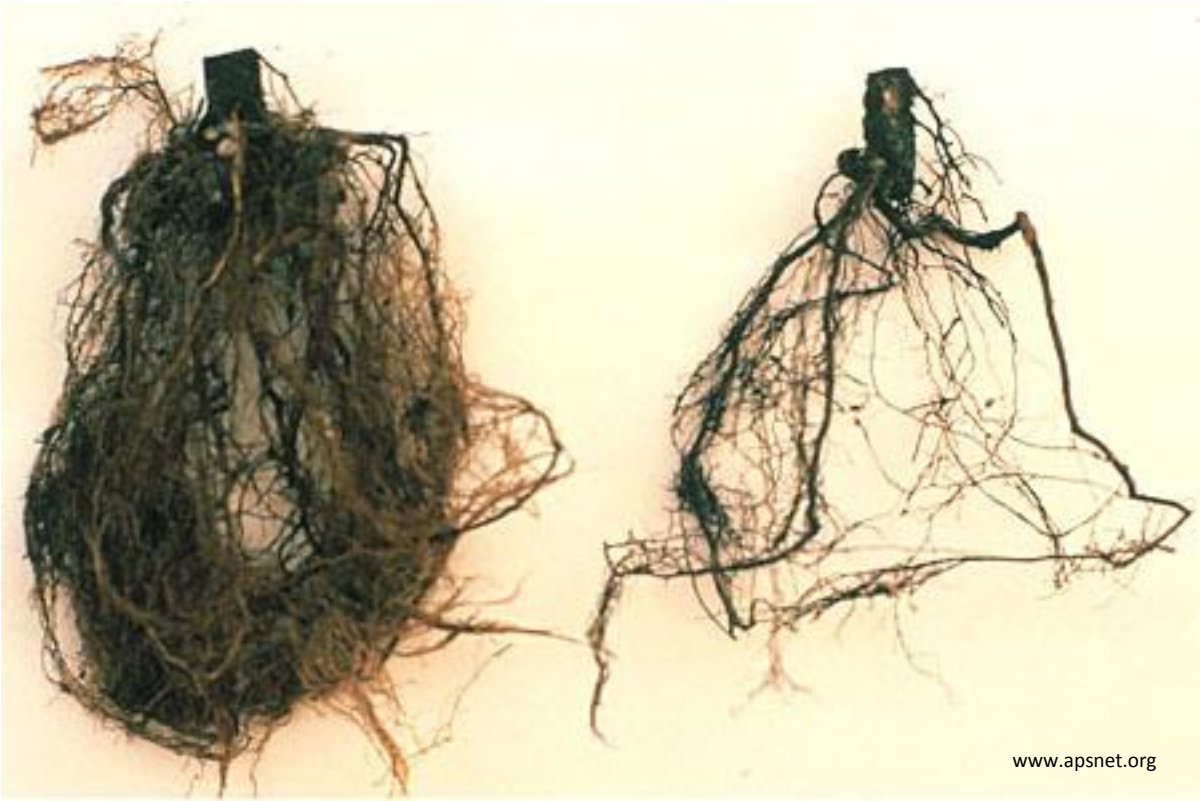
They need free water for hatching and movement.

Many are not a problem unless plant is under stress.



ECTOPARASITE: Ring nematode juvenile (left) and adult female (right) feeding on a plant root.

Nematode damage to roots



Poor root growth of rose infected by nematodes (right) compared with healthy roots (left).

Fungus gnats

Found in wet soil environments

Feed on algae and fungi.

Larvae feed on plant roots.

Adults can spread plant diseases by moving from plant to plant.

Whitney Cranshaw, Colorado State University, Bugwood.org

Secondary diseases and insects

Attack stressed trees after flooding subsides

Canker fungi

Wood and phloem boring insects

Management of waterborne plant diseases

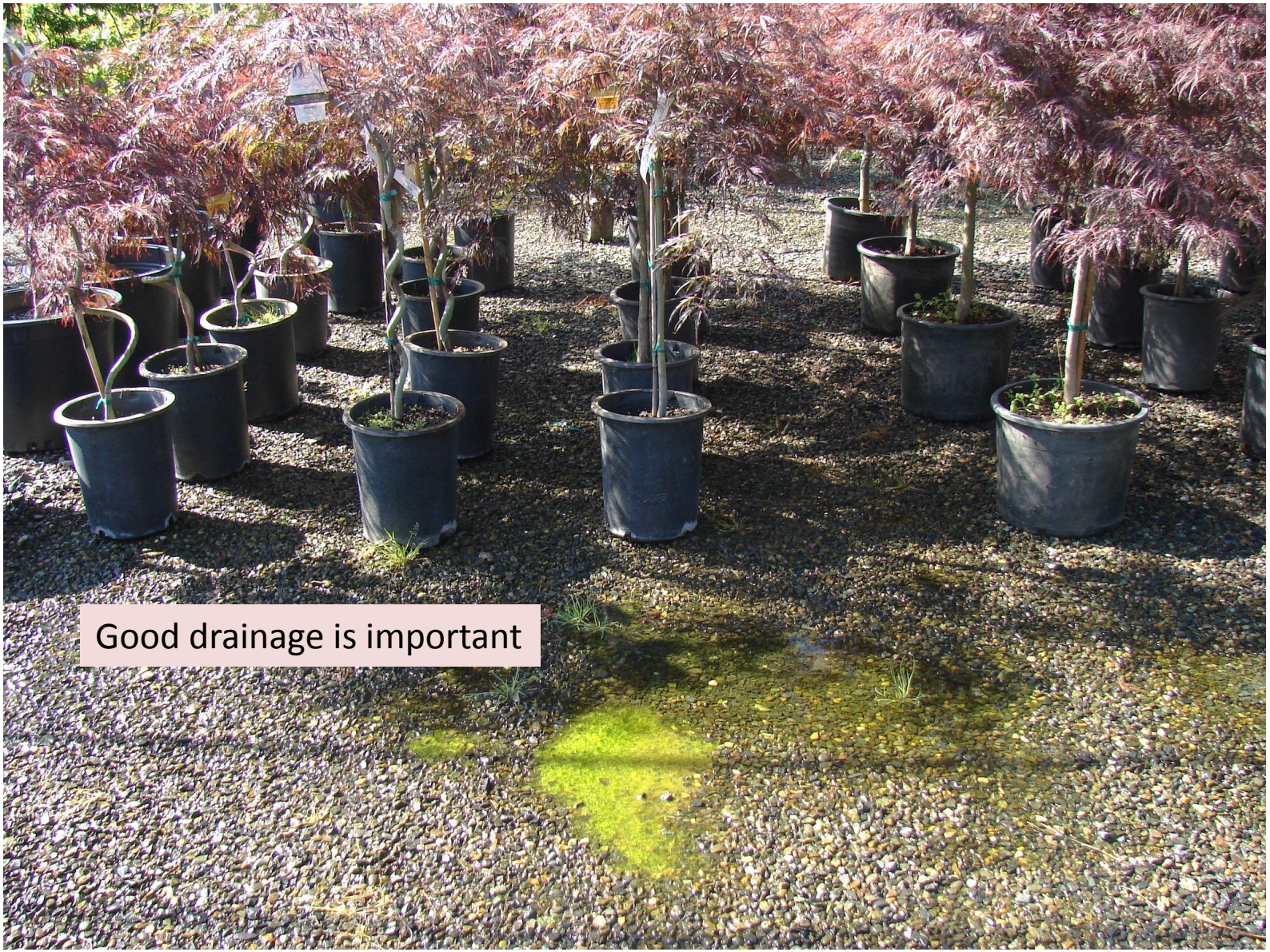
Prevention is the most effective method.

Plant selection

Phytophthora and *Pythium* diseases can spread from infested soil. Avoid buying plants with obvious symptoms or waterlogged soil.

Plant flood-tolerant species in areas prone to flooding or waterlogging of soil.

Substrate



Keep potted plants on gravel or raised display areas.

These plants will be less likely to have waterborne disease problems.

Water treatment in the nursery

Chemical – chlorine bleach

UV irradiation

Water treatment in landscapes

For prevention of disease problems

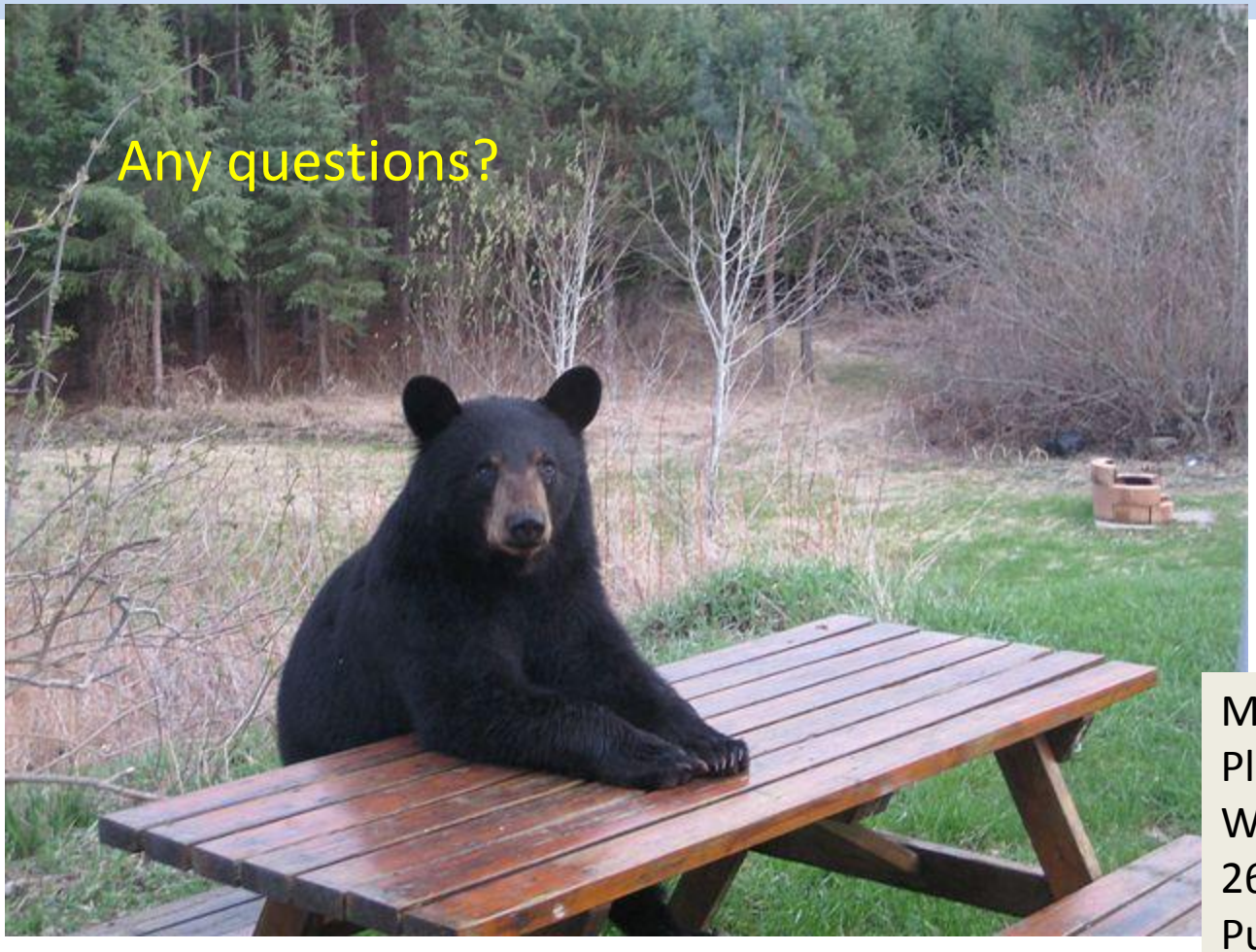
Filtration – slow sand, biofilters, constructed wetlands, etc. to clean up water contaminated with nutrients and/or pathogens.

Runoff water

Divert runoff water from problem areas such as downspouts, concrete, and other impervious surfaces.

Savannah Environmental Consulting

Thanks for listening



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