

## A New Threat In Nurseries: Phytophthium Root and Crown Rot Caused by *Phytophthium vexans*

Sneha Rashtrapal Patil, Cansu Oksel, Terri Simmons, Kaitlin Barrios and Fulya Baysal-Gurel

Tennessee State University

Otis L. Floyd Nursery Research Center, McMinnville, TN

### FACTS AT A GLANCE:

#### CAUSAL AGENT

*Phytophthium vexans*

#### SYMPTOMS

- Root rot
- Crown rot
- Reduced root system
- Plant stunting and wilting
- Death of plant

#### FAVORABLE CONDITIONS

- Poor drainage, water logged soils
- Excessive irrigation or rainfall

#### SPREAD

- Irrigation water
- Crop debris
- Contaminated soil, tools and planting materials

#### SURVIVAL

As oospores in soil and crop debris

#### MAJOR HOST

Broad host range including fruit crops, forest trees, ornamentals and vegetables

### A hidden threat beneath the soil

*Phytophthium vexans* is an oomycete plant pathogen, commonly referred to as a water mold, exhibiting characteristics intermediate between *Phytophthora* and *Pythium*. It is responsible for root and crown rot, wilting, and damping-off of seedlings in a wide range of economically important plants. The pathogen is common in nurseries, orchards, and forest ecosystems.

### A disease without borders: Global occurrence of *Phytophthium* diseases

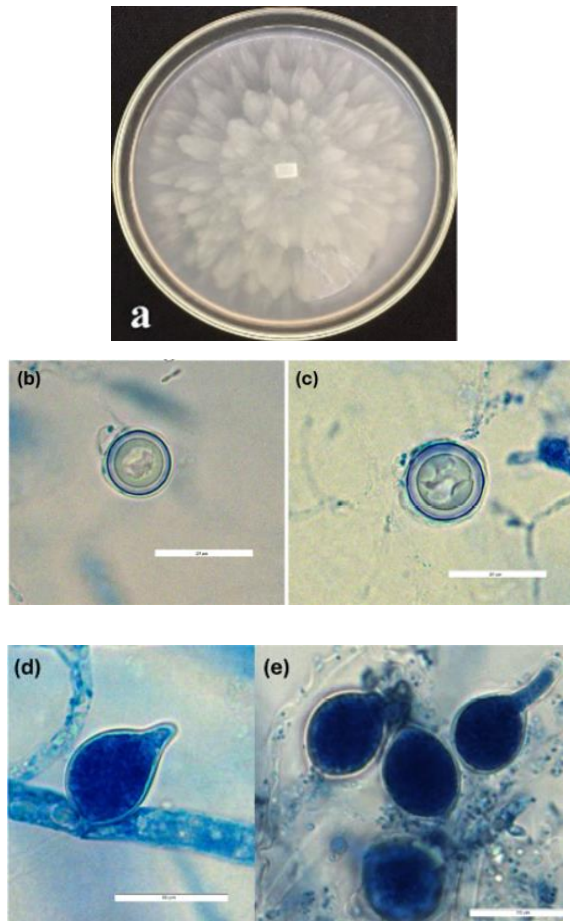
*Phytophthium vexans* is a cosmopolitan pathogen reported across **Asia** (China, India, Iran, Japan, Taiwan, Thailand, Turkey, and Vietnam), **Africa** (Morocco, Rwanda, South Africa, and Tunisia), **Europe** (Italy, Spain), **Australia**, **South America** (Brazil), **Central America** (Panama) and **North America** (several states of the United States, including California, Hawaii, North Carolina, and Tennessee) (Figure 1).



**Figure 1.** Countries with reported occurrence of *Phytophthium vexans* have been marked in red.

## Meet the pathogen

*Phytophthium vexans* exhibits a distinctive white, radiant, chrysanthemum like mycelial pattern on V8-PARPH medium. The pathogen produces globose to ovoid sporangia that show internal proliferation, along with smooth, spherical oogonium measuring 20-30  $\mu\text{m}$  in diameter and aplerotic oospores. The antheridia are predominantly paragynous and the hyphae are coenocytic with irregular branching (Figure 2). Molecular identification is typically based on the ITS, CoxI, CoxII and LSU gene regions which effectively distinguish *Phytophthium* from both *Pythium* and *Phytophthora*.

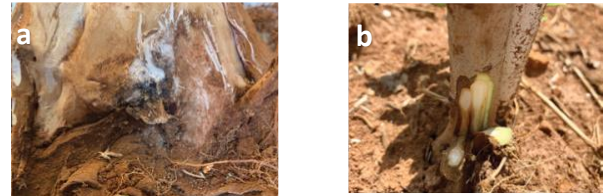


**Figure 2.** Morphological features of *P. vexans*; (a) 7-day-old mycelia of *Phytophthium vexans* on V8-PARPH medium grown at  $25 \pm 2^\circ\text{C}$  with 8 h light/16 h dark cycle, (b) and (c) oogonia and

antheridia (100x magnification, stained with lactophenol blue solution, (d) and (e) papillate sporangium of *P. vexans* (100x magnification).

## How to recognize the disease?

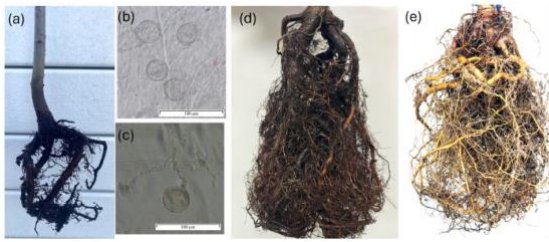
Root and crown rot caused by *Phytophthium vexans* is characterized by damping-off and the development of brown, necrotic lesions on roots, stems, and the collar region (Figures 3, 4 and 5). Infected roots often become water-soaked and discolored, eventually rotting as the disease progresses. As a result, of root and crown damage, aboveground plant parts typically exhibit chlorosis, reduced vigor, overall stunting, and wilting symptoms.



**Figure 3.** Root and crown rot symptoms of ginkgo plants caused by *Phytophthium vexans*. Root necrosis and mycelial growth on root (a) and necrosis of crown region (b).



**Figure 4.** Root rot caused by *Phytophthium vexans* on eastern redbud plants; (a) root rot infected root system of eastern redbud, (b) healthy root system of eastern redbud.



**Figure 5.** *Phytophthium vexans* root rot symptoms on swamp white oak; (a) root rot symptom from natural infection, (b) sporangia of *P. vexans* (40× magnification), (c) oogonium of *P. vexans* (40× magnification), (d) root of artificially inoculated plants two weeks post inoculation, and (e) root of non-inoculated plants.

### When does the disease develop?

Disease development is favored in poorly drained soils under optimal temperatures of 25–30°C (77 – 86°F) and high soil moisture conditions (approximately 0.67 MPa).

### Where does it survive?

The pathogen persists in both soil and water. It can survive on dead plant material, on the fibrous roots of perennial hosts, or as thick-walled oospores in the soil for several months to years.

### How does it spread?

The pathogen spreads primarily through irrigation water, as well as through contaminated soil and tools.

### How to manage the disease?

Healthy roots are the foundation of healthy plants — managing soil conditions is the first step in preventing Phytophthium root and crown rot.

### High Risk Practices to Avoid

- Poor drainage

- Over irrigation and water logging
- Reusing contaminated pots

### Preventative Practices

- Use pathogen free cuttings or seedlings.
- Use clean or disinfected irrigation water (by chlorination, ozonisation or UV-C radiation).
- Sanitize containers or trays before reuse by either method:
  - ✓ **Disinfection:** Remove debris and wash trays with water and mild detergent. Disinfect by soaking or spraying with 10% bleach (sodium hypochlorite) or hydrogen peroxide-based disinfectants for 10-30 minutes, then rinse thoroughly and allow trays to air dry before use.
  - ✓ **Hot water treatment:** soak the trays in hot water (~ 70-80°C/ 158 - 176°F) for about 30 minutes.
  - ✓ Expose to **aerated steam** if facilities are available.
- Sanitize propagating beds and area.
- **Eliminate** weeds, diseased or dead plants and leaf debris as it could serve as potential hosts for pathogen.
- Use winter **cover crops** such as annual rye grass, triticale, Japanese millet, Austrian winter pea, crimson clover and cowpea help to suppress soil borne pathogens, by improving soil chemistry and stimulating soil organic carbon, total nitrogen and fluorescent *Pseudomonad* (bacterial) populations.

### Active Protection

Adopt a rotation program with fungicides, biofungicides and host defense inducers to effectively manage the disease and avoid resistance emergence.

- **Biofungicides:**
  - Bacillus amyloliquifaciens* (Stargus®) or *Trichoderma* spp. (RootShield® Plus<sup>+</sup>)
- **Fungicides:**
  - Mefenoxam (Subdue MAXX®)
  - Oxathiaprolin (Segovis®)
- Pyraclostrobin (Empress®)
- Pyraclostrobin and boscalid (Pageant®)
- **Host defense inducers:**
  - Fosetyl-aluminium (Aliette®)
  - Mono and di potassium salts of phosphorus acid (Agri-fos®)

### Which plants are at risk?

Common name	Species	Family	References
Almond	<i>Prunus amygdalus</i>	Rosaceae	Beluzán <i>et al.</i> 2022
Anthurium	<i>Anthurium</i> spp.	Araceae	Guo and Ko 1996; Park <i>et al.</i> 2019
Apple	<i>Malus domestica</i>	Rosaceae	Jabiri <i>et al.</i> 2020; Tewoldemedhin <i>et al.</i> 2011
Avocado	<i>Persea americana</i>	Lauraceae	Hernández <i>et al.</i> 2019; Jabiri <i>et al.</i> 2020
Cardamom	<i>Elettaria cardamomum</i>	Zingiberaceae	Thomas 2000
Cashew	<i>Anacardium occidentale</i>	Anacardiaceae	Davidson <i>et al.</i> 2000
Chinese ginseng	<i>Panax ginseng</i>	Araliaceae	Lan <i>et al.</i> 2023
Cinnamon	<i>Cinnamomum verum</i>	Lauraceae	Chang 1993
Common bean	<i>Phaseolus vulgaris</i>	Fabaceae	Nzungize <i>et al.</i> 2011
Cotton	<i>Gossypium hirsutum</i>	Malvaceae	Hernández <i>et al.</i> 2019; Kaosiri and Siddhipongse 1985
Dendrobium	<i>Dendrobium</i> spp.	Orchidaceae	Tao <i>et al.</i> 2011
Durian	<i>Durio zibethinus</i>	Malvaceae	Thao <i>et al.</i> 2020; Vawdrey <i>et al.</i> 2005
Eucalyptus	<i>Eucalyptus</i> spp.	Myrtaceae	Linde <i>et al.</i> 1994
Flowering cherry	<i>Prunus serrulata</i>	Rosaceae	Baysal-Gurel <i>et al.</i> 2021
Fraser fir	<i>Abies fraseri</i>	Pinaceae	Ivors <i>et al.</i> 2008
Ginkgo	<i>Ginkgo biloba</i>	Ginkgoaceae	Panth <i>et al.</i> 2021
Glehn's spruce	<i>Picea glehnii</i>	Pinaceae	Yamaji <i>et al.</i> 2001, 2005
Kiwi	<i>Actinidia deliciosa</i>	Actinidiaceae	Polat <i>et al.</i> 2017; Prencipe <i>et al.</i> 2020
Mandarin	<i>Citrus reticulata</i>	Rutaceae	Benfradj <i>et al.</i> 2017; Noireung <i>et al.</i> 2020
Maple	<i>Acer</i> spp.	Sapindaceae	Baysal-Gurel <i>et al.</i> 2021; Panth <i>et al.</i> 2021
Norway spruce	<i>Picea abies</i>	Pinaceae	Subedi <i>et al.</i> 2025
Oak	<i>Quercus</i> spp.	Fagaceae	Oksel <i>et al.</i> 2025

Peach	<i>Prunus persica</i>	Rosaceae	Yang <i>et al.</i> 2012
Pear	<i>Pyrus communis</i>	Rosaceae	Jabiri <i>et al.</i> 2020; Tewoldemedhin <i>et al.</i> 2011
Pine	<i>Pinus</i> spp.	Pinaceae	Linde <i>et al.</i> 1994
Potato	<i>Solanum tuberosum</i>	Solanaceae	Santika <i>et al.</i> 2021
Ramie	<i>Boehmeria nivea</i>	Urticaceae	Yu <i>et al.</i> 2016
Redbud	<i>Cercis</i> spp.	Fabaceae	Liyanapathiranage <i>et al.</i> 2023
Rubber tree	<i>Hevea brasiliensis</i>	Euphorbiaceae	Zeng <i>et al.</i> 2005
Sali	<i>Tetragastri panamensis</i>	Salicaceae	Davidson <i>et al.</i> 2000
Strawberry	<i>Fragaria × ananassa</i>	Rosaceae	Ibanez <i>et al.</i> 2022
Taro	<i>Colocasia esculenta</i>	Araceae	Dervis <i>et al.</i> 2014
Tulip poplar	<i>Liriodendron tulipifera</i>	Magnoliaceae	Oksel <i>et al.</i> 2025

## References

- Baysal-Gurel, F and Ghimire, B. 2023. A Diagnostic Guide to *Phytophthium helicoides* and *Phytophthium vexans* causing Root and Crown Rot Diseases. *Plant Health Progress*, 24(4). <https://doi.org/10.1094/PHP-01-23-0003-DG>
- Baysal-Gurel, F and Ghimire, B. 2023. Impact of *Phytophthium vexans* on Plant Health: Hosts, Symptoms, Detection and Management. CABI Plant Health Case. <https://doi.org/10.1079/planthealthcases.2023.0017>
- Baysal-Gurel, F. 2021. Ornamental Plant Pathology Handbook, Tennessee State University, College of Agriculture, Otis L. Floyd Nursery Research Center.
- Liyanapathiranage, P., Avin, F. A., Oksel, C., Parajuli, M., Scott, M., Simmons, T., and Baysal-Gurel, F. 2023. First report of root rot of redbud caused by *Phytophthium vexans* in Tennessee and the United States. *Plant Disease*, 107(12). <https://doi.org/10.1094/PDIS-07-23-1276-PDN>
- Oksel, C., Subedi, P., Liyanapathiranage, P., Arik, B., Avin, A, Farhat., Simmons, T., and Baysal-Gurel. 2025. First Report of *Phytophthium vexans* causing Root Rot of *Quercus bicolor* in Tennessee and the United States. *Plant Disease*, 109(2). <https://doi.org/10.1094/PDIS-11-24-2355-PDN>.
- Oksel, C., Subedi, P., Simmons, T., Avin, F. A., Arik, B., and Baysal-Gurel, F. 2025. First report of *Phytophthium vexans* causing root rot on tulip poplar in Tennessee and the United States. *Plant Disease*, 109(4). <https://doi.org/10.1094/PDIS-11-24-2343-PDN>
- Panth, M., Baysal-Gurel, F., Simmons, T., Adesso, K., and Witcher, A. 2020. Impact of winter cover crop usage in soil borne disease suppressiveness in woody ornamental production system. *Agronomy*, 10(7), 995 <https://doi.org/10.3390/agronomy10070995>
- Subedi, P., Oksel, C., Liyanapathiranage, P., Simmons, T., and Baysal-Gurel, F. 2025. First report of *Phytophthium vexans* causing root rot on Norway spruce (*Picea abies*) in Tennessee and the United States. *Plant Disease*, 109(6). <https://doi.org/10.1094/PDIS-01-25-0157-PDN>

If you encounter plants in nurseries or managed landscapes with Phytophthium root and crown rot symptoms, contact:

Tennessee State University  
College of Agriculture  
3500 John A. Merritt Blvd., Box 9635 Nashville, TN 3720-1561  
<http://www.tnstate.edu/extension>

Tennessee State University, Otis L. Floyd Nursery Research Center  
472 Cadillac Lane McMinnville, TN 37110 <http://www.tnstate.edu/agriculture/nrc/>

#### Precautionary Statement

To protect people and the environment, pesticides should be used safely. This is everyone's responsibility, especially the user. Read and follow label directions carefully before you buy, mix, apply, store or dispose of a pesticide. According to laws regulating pesticides, they must be used only as directed by the label.

#### Disclaimer

This publication contains pesticide recommendations that are subject to change at any time. The recommendations in this publication are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. The label always takes precedence over the recommendations found in this publication. Use of trade, brand, or active ingredient names in this publication is for clarity and information; it does not imply approval of the product to the exclusion of others that may be of similar and suitable composition, nor does it guarantee or warrant the standard of the product. The author(s) and Tennessee State University assume no liability resulting from the use of these recommendations.

---

**TSU-26-380(C)-11i-61065** – Tennessee State University is an EEO employer.