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Pythium Root Rot of Herbaceous Plants

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Several species of *Pythium* attack plant roots, and cause cutting rots, stem rots, and foliar blight under the right conditions (Figure 1). These pathogens are a significant problem in the greenhouse and nursery industries (Figure 2).

This publication describes *Pythium* root rot, the symptoms of the disease, the disease cycle, and how to effectively manage the problem.

The three most commonly encountered species of root-rotting *Pythium* species in the greenhouse industry are *Pythium irregulare*, *Pythium ultimum*, and *Pythium aphanidermatum*. The two most commonly encountered species, *P. ultimum* and *P. irregulare*, are ubiquitous pathogens regularly found in the field, sand, pond and stream water, and decomposing vegetation. Identifying which *Pythium* is causing the problem in your greenhouse is important as some *Pythium* species, like *P. ultimum,* have very wide host ranges.

Also, which species of *Pythium* you have may dictate when damage will occur. Infection by *P. aphanidermatum* occurs more often at higher temperatures (above 77°F), whereas *P. ultimum* diseases are most serious at lower temperatures (below 68°F). These different *Pythium* infections are often seen early in poinsettia production during hot weather (by *P. aphanidermatum*), and then again towards the end of production with cooler temperatures by *P. ultimum*.

All *Pythium* species favor wet conditions and high soil soluble salts in the potting medium. *Pythium* species are often found

Photo by Janna Beckerman

Figure 1. *Examination of poinsettia roots show discoloration, symptomatic of root rot.*

Photo by Janna Beckerman

Figure 2. *Mums wilting from root rot due to* Pythium. *Excessive watering creates ideal conditions for* Pythium *infection.*

contaminating commercially available soilless potting mixes. Furthermore, poor sanitation (including the careless use of dirty tools or containers, and proximity to previously infected plants or media) can readily contaminate sterilized soil or soilless mixes. Fungus gnats and shore flies have been shown to vector *Pythium* within greenhouses.

Symptoms

Root rot symptoms, regardless of the pathogen, are surprisingly similar. The first symptoms of *Pythium* infections include stunting; however, careful examination of root tips early in the infection will show only dead tips. With *Pythium* root rots, roots appear water-soaked, and the root cortex easily sloughs off, leaving a strand of vascular tissue. This is not a conclusive symptom, but one to note. On the stems of cuttings, a soft, watery rot may develop. Key signs include the cells of the plant root containing round, thick-walled oospores and/or round zoosporangium (Figure 3).

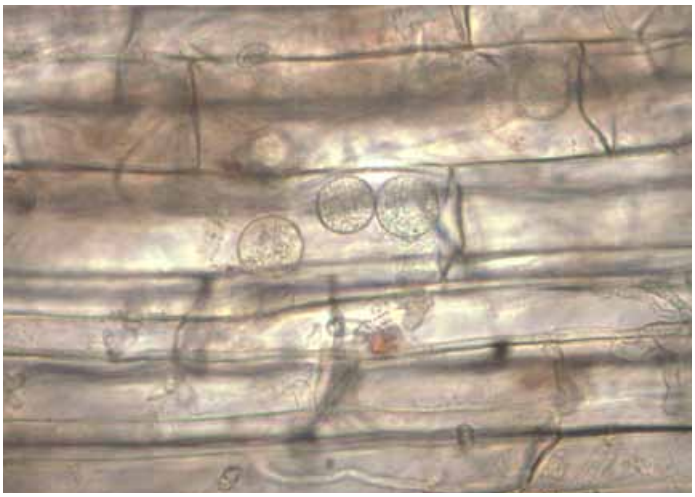

Photo by Tom Creswell

Figure 3. *Large oospores are a key diagnostic sign of Pythium root rot.*

Accurately diagnosing this disease is essential because fungicides labeled to control other root rot pathogens (such as *Thielaviopsis*, *Fusarium*, or *Rhizoctonia*) will not be effective against *Pythium* root rot.

Disease Cycle

Pythium is a fungus-like organism, similar to, but also distinct from fungi. Like a fungus, *Pythium* grows and colonizes a plant by producing hyphae (singular hypha), threadlike, filamentous cells that extract nutrients from the host plant. When hyphae from opposite mating types meet, they produce thick-walled oospores. These oospores serve as overwintering structures. Upon germination, an oospore may produce more hyphae, or develop a zoosporangium, which produces motile zoospores that swim to, and infect plants. Zoosporangia can also germinate and infect plants directly, too.

Zoospores that reach the plant root surface form cysts that then germinate, infect, and invade the plant root. As the hyphae grow, they release enzymes that destroy the root tissue and absorb nutrients as a food source (Figure 4).

Management

Pythium can persist in plant material and even in potting media — it is literally everywhere. There are several management practices that can reduce the risk of *Pythium* infection, and minimize the use of pesticides to control this disease.

Sanitation

Surface clean and disinfect all bench surfaces, tools, trays, containers, and equipment that will contact the potting mix. Use high-quality cuttings, and immediately remove any cuttings or plants that show symptoms of disease.

Media

Cover and store soilless mixes in an area that will not be contaminated. Peat-vermiculite potting mixes often have high soluble salts, which may cause plants to develop root injury that predisposes them to *Pythium*.

Media with moisture holding capacities greater than 70 percent have been reported to seriously increase damage from *P. ultimum*. Using highly decomposed (dark) peat results in worse *Pythium* root rot compared to a nondecomposed medium or light peat.

Watering and Fertilizing

Overwatering and overfertilizing increase *Pythium* infection rates. In addition to overwatering, using poorly draining media, or placing pots or flats in standing water, will also affect drainage and predispose plants to *Pythium* infection.

Excess watering also creates conditions conducive for shore flies and fungus gnats, which feed on roots and damage them, providing a site of entry for *Pythium*. These insects are also effective vectors of the pathogen, spreading the disease throughout the greenhouse or growing area.

Pythium diseases are also more severe on over-fertilized plants. The cause of this damage is two-fold. First, excess nitrogen suppresses the plant's natural defense response. Second, the accumulation of salts in the growing medium damages root tips, providing an easy means for *Pythium* to infect.

When using pond or stream water for irrigation, place the intake pipe well above the bottom of the pond so that it does not draw in sediment. Also, make sure the intake pipe isn't near the surface, either. If *Pythium* contamination is a problem, slow sand filtration is an effective method for removing *Pythium* (and other plant pathogens) from recycled water. Other water

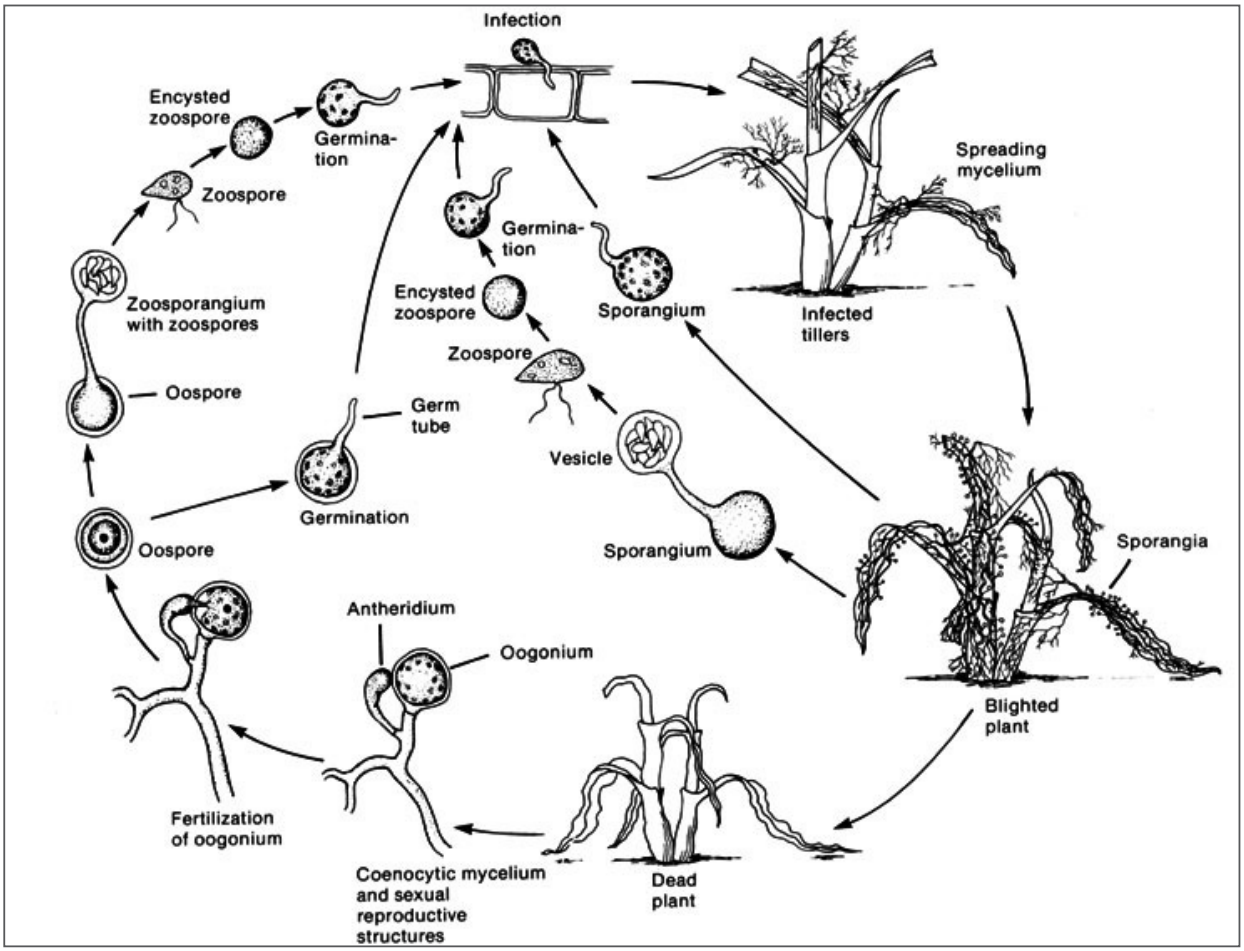

Illustration from C.B. Kenaga, E.B. Williams, and R.J. Green, Plant Disease Syllabus (1971).

Figure 4. *The* Pythium *pathogen disease cycle.*

treatment options include ultraviolet radiation, ozonation, and chlorination.

Plan Ahead

If you have had problems with *Pythium* in the past, be proactive to prevent outbreaks. Biological control agents such as *Trichoderma harzianum* or *Gliocladium virens* do provide some protection when disease pressures are low; however, overwatering or excessive fertilization will reduce their efficacy to the point that severe outbreaks of *Pythium* can occur despite the use of biological controls.

If severe outbreaks have occurred in the past, consider incorporating a granular fungicide (such as Banrot 8G®) in your potting mix in lieu of a biological control agent, and re-evaluate your cultural practices that may result in excess water or fertilizer.

Prevention is the key to managing this disease as *Pythium* root rot is difficult to control once rot has begun.

Chemical Controls

Numerous fungicides are labeled for *Pythium* control. All of these provide their best results if applied to prevent infection from occurring. Growers should regularly scout their greenhouses for disease, confirm diagnoses, and quickly provide effective fungicide programs to minimize losses from this disease.

Developing an effective program is challenging, and growers must recognize that misusing these fungicides (and some very adaptable *Pythium* species) has resulted in fungicide resistance. In work done by Moorman et al. (2002), almost 40 percent of the *P. aphanidermatum* and *P. irregulare* isolates were found to be resistant to mefenoxam. This is important because these two species were encountered in 74 percent of all *Pythium* cases from 1996 through 2001 in Pennsylvania. If Subdue Maxx® or other chemicals do not appear to be protecting your plants, switch to another product.

Fungicide applications for *Pythium* control work best when applied as a protectant. Table 1 provides a list of fungicides labeled for disease control. When developing a fungicide rotation, be sure to choose fungicides that have different FRAC codes to minimize the risk of fungicide resistance developing in your greenhouse.

Table 1. *Fungicides for* Pythium *root rot management*

Common Name	FRAC Code*	Trade Names
etridiazole	M	Terrazole®, Truban®
etridiazole + thiophanate methyl	1+M	Banrot®
fosetyl-Al	U	Aliette®
phosphorous acid	U	Alude®, Biophos®, Rampart®
mefenoxam	4	Subdue Maxx®
propamocarb	28	Banol®
cyazofamid	21	Segway®
fluopicolide	43	Adorn®
fenamidone	11	Fenstop®
Premixes	**FRAC Code***	**Trade Names**
etridiazole + thiophanate methyl	1+M	Banrot®
mefenoxam + fludioxanil	1+12	Hurricane®

Fungicide Resistance Management *— With repeated use, microbes like Pythium can develop resistance to certain fungicides if they are used repeatedly. In an effort to reduce the development of resistance, the Fungicide Resistance Action Committee has developed a numbering system in which chemicals with the same FRAC Code have the same mode of action, so should not be used sequentially, but in combination or in rotation with chemicals that have different modes of actions (that is, different FRAC codes). For more information, see:*

- *Fungicide Resistance Action Committee — www.frac.info*
- *Purdue Extension publication BP-71-W, Disease Management Strategies for Horticultural Crops: Fungicide Rotations for Nursery, Greenhouse, and Landscape Professionals, available online from the Purdue Extension Education Store, www.the-education-store.com.*

References

Martin, Frank N., and Joyce E. Loper. 1999. Soilborne Plant Diseases Caused by *Pythium* spp.: Ecology, Epidemiology, and Prospects for Biological Control. *Critical Reviews in Plant Sciences*, 18:111-181.

Moorman, G. W., S. Kang, D.M. Geiser, and S.H. Kim. 2002. Identification and characterization of *Pythium* species associated with greenhouse floral crops in Pennsylvania. *Plant Dis*. 86:1227-1231.

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