BRITISH COLUMBIA | Ministry of Agriculture

Pythium Diseases on Greenhouse Vegetables

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Pythium species are fungal-like organisms (Oomycetes), commonly referred to as water molds, which naturally exist in soil and water as saprophytes, feeding on organic matter. Some *Pythium* species can cause serious diseases on greenhouse vegetable crops resulting in significant crop losses. *Pythium* infection leads to damping-off in seedlings and crown and root rot of mature plants. In Canada, several *Pythium* species, including *P. aphanidermatum*, *P. irregulare* and *P. ultimum*, are known to cause damping-off and crown and root rot in greenhouse cucumber, pepper and tomato crops. There are no *Pythium* resistant varieties available although some varieties may have disease tolerance. Over watering, poor root aeration, root injury and improper root zone temperatures can weaken the crop and, thus, trigger *Pythium* outbreaks. Saturated growing media that are either too cold or too warm can be conducive to *Pythium* build up and spread in water and recirculating nutrient solution. Plants grown under optimal environmental conditions are less susceptible to *Pythium* than plants grown under poor conditions.

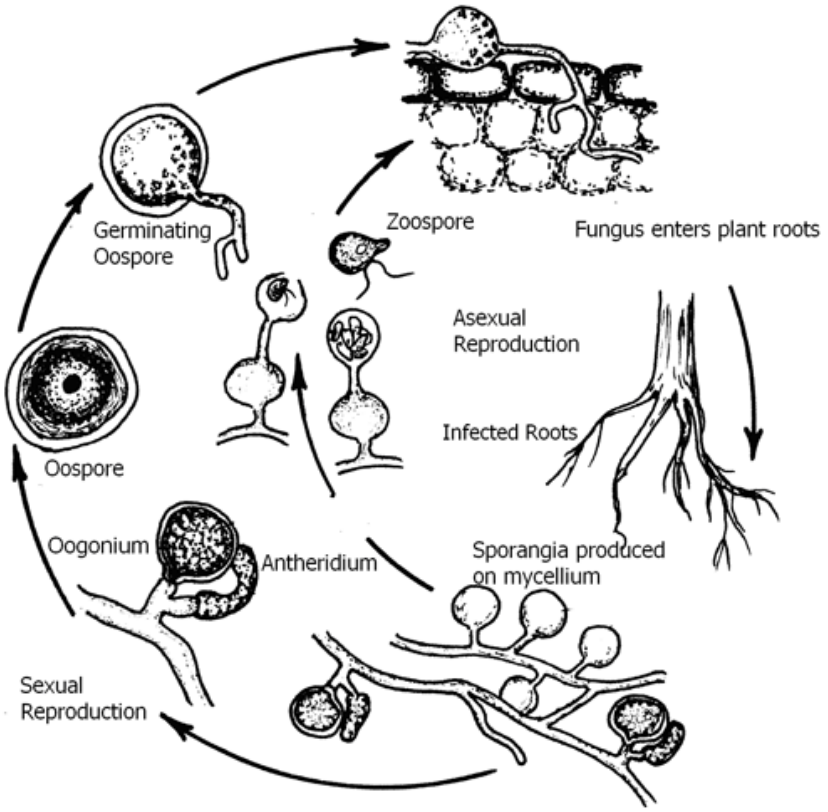

Figure 1. The disease cycle of Pythium damping-off and crown and root rot of greenhouse vegetable crops.

Disease cycle

Pythium can be introduced into a greenhouse in plug transplants, soil, growing media, plant refuse and irrigation water. Greenhouse insects such as fungus gnats (*Bradysia impatiens*) and shore flies (*Scatella stagnalis*) can also carry spread *Pythium*. *Pythium* spreads by forming produces sporangia, sack-like structures, each releasing hundreds of swimming zoospores (Figure 1). Zoospores that reach the plant root surface encyst, germinate and colonize the root tissue by producing fine thread-like structures of hyphae, collectively called mycelium. These hyphae release hydrolytic enzymes to destroy degrade the root tissue and absorb nutrients as a food source. *Pythium* forms oospores and chlamydospores on decaying plant roots which can survive prolonged adverse conditions in soil, greenhouse growing media and water, leading to subsequent infections.

Symptoms

'Pre-emergence' damping-off causes seeds and young seedlings to rot before they emerge from the growing medium, while 'post-emergence' damping off kills newly emerged seedlings. In 'postemergence' damping-off, the pathogen causes a water-soaked, soft brown lesion at the stem base, near the soil line, that pinches off the stem causing the seedling to topple over and die. In mature plants, *Pythium* causes crown and root rot, where plants suddenly wilt when weather turns warm and sunny and when plants have their first heavy fruit load. Often, upper leaves of infected plants wilt in the day and recover overnight but plants eventually die. In the root system, initial symptoms appear as brown to dark-brown lesions on root tips and feeder roots and, as the disease progresses, symptoms of soft, brown stubby roots, lacking feeder roots, become visible (Figure 2). In larger roots, the outer root tissue or cortex peels away leaving the string-like vascular bundles underneath. Pythium rot also occurs in the crown tissue at the stem base. In cucumber, diseased crown turns orange-brown in colour, often with a soft rot at the base; brownish lesions extending 10 cm up the stem base may be seen.

Figure 2. Pythium crown and root rot in greenhouse cucumber showing orange discolouration of the crown area and rotted roots and root tips

Monitoring & Identification

Routinely monitor your crop for slightly wilted plants and check wet areas in the greenhouse where *Pythium* is more likely to be present. *Pythium* occurs mostly in spring, at early fruit set and later in the season on mature plants. In cucumber, *Pythium* can also occur in the summer on young plants brought in for the fall crop. Monitor plants for wilting, and in cucumber, check the stem bases for discoloration. Always confirm *Pythium* diseases by sending representative plant samples with roots, crowns and foliage to a plant diagnostic laboratory or the Ministry of Agriculture's Plant Health Laboratory.

Integrated Disease Management

Disease management consists of a combination of cultural, biological and chemical tools to control and/or manage crop diseases effectively. Cultural controls keep *Pythium* from reaching the roots while biological and chemical controls inhibit or suppress *Pythium* in the root zone.

Cultural Controls

Sanitation: Field soil, debris, irrigation water from pond and stream water, and roots, and plant refuse and growing medium of previous crops can contain *Pythium*. Follow a strict greenhouse sanitation program throughout the year and a thorough year-end clean up. Clean and disinfest all interior greenhouse surfaces and equipment including tools, hoses, walkways, carts, totes, troughs, tanks and water supply lines. Use sterile propagating media. Remove dying plants by placing them directly into plastic bags for disposal away from the greenhouse.

Irrigation water: Untreated water from rivers, or streams or ponds poses great risk for *Pythium* introduction, while treated, municipal water is considered safe from *Pythium*. Water storage and nutrient tanks need to be disinfected periodically and covered to prevent *Pythium* contamination.

Nutrient Solution: Generally, greenhouse vegetables are raised on rockwool in plastic sleeves or bags containing rooting medium (i.e. rockwool slabs, sawdust or coconut fibre) through which water and nutrient solution are circulated. Since *Pythium* and other pathogens can build up in nutrient solution, periodically disinfest recirculating nutrient solution using physical, biological or chemical methods (Marchuk, 2006).

Filtration methods:
Physical - slow sand filtration, ultrafiltration (membrane filters), micro-pore filtration (high pressure, rapid flow membrane or sediment filters), heat pasteurization (95-97°C for 30 seconds or 85°C for 3 minutes), UV radiation, sonic energy, magnetism, aeration (i.e. oxygenation), ozonation, etc.

Biological - biofiltration (slow sand or lava rock), water retention ponds.

Chemical: chlorine, chlorine dioxide, copper, hydrogen peroxide, electrochemical, soaps (wetting agents), iodine, etc.

Resistant varieties: Although there are no resistant vegetable varieties, some vigorous varieties may have some tolerance to *Pythium*. Contact your local seed/transplant agent for further information on *Pythium* tolerant varieties.

Seedlings & Transplants: Carryout transplanting in the morning or late afternoon/evening to avoid stress from high day time temperatures. Allow for good air circulation around seedlings by

proper plant spacing and good aeration of irrigation water and re-circulating nutrient solution. Use healthy transplants and handle them carefully to avoid wounding plants and roots and practice good sanitation when transplanting; do not let them dry when setting out. Water seedlings in the morning so that plants are not wet overnight.

Plant growing conditions: Ensure that transplants have the proper root zone temperature and adequate moisture when moved into the greenhouse. The growing media must be well drained as saturated bags with low oxygen levels can predispose transplants to *Pythium* diseases.

Use warm, aerated irrigation water (18-22°C). Avoid low light levels, low pH, high salts and warm growing conditions (above 28°C) which favour *Pythium*. In greenhouse cucumbers, the nutrient solution should be delivered at pH 5.0 for approximately 5 weeks followed by adjusting the pH to a 5.8-6.2 regime for one week. (Tu, 2004).

Target rockwool block wetness at 70-75% between watering.

Use white/colourless drip lines instead of black or place drip lines on the shaded side of the grow bags.

Disease monitoring: Plants must be monitored for any signs of *Pythium* diseases throughout the cropping cycle. Remove and destroy severely infected plants and replant in new growing bags medium. Infected plant materials, including grow bags, must be safely disposed away from the greenhouse by deep-burying, incinerating or composting.

Control fungus gnats (*Bradysia impatiens*) and shore flies (*Scatella stagnalis*) which spread *Pythium*.

Biological and Chemical Control

Prevent *Pythium* diseases by practicing integrated disease management strategies based on cultural and biological controls. Use fungicides as a last resort at the onset of disease.

Rotate registered fungicides with different chemical groups and strictly follow label directions to avoid resistance development in *Pythium*.

Routinely monitor plants and evaluate the level of disease control if fungicides are used. Stop fungicide treatment and get professional advice if fungicides fail.

Table 1. . A summary of registered fungicides and label information (Please adhere to Product label instructions when using each chemical) For more information refer to Health Canada's Pest Management Regulatory Agency website for fungicide label information.

Product Name	Chemical or Biological Ingredient	Chemical Group	Mode of action	REI[1]	PHI[2]	Application
Greenhouse cucumber, pepper & tomato						
Previcur	propamocarb	28	preventative, locally-systemic	12 hrs	2 days for cucumber; 1 day for tomato & pepper	use preventatively; maximum 2 applications per crop cycle after transplanting, thereafter 7-10 days interval
Torrent	cyazofamid	21	preventative, locally systemic	12 hrs	60 days	for greenhouse transplant production only; apply at seeding to prevent transplant damping-off and root rot
Mycostop	*Streptomyces* Strain K61	biological	suppressive, non- systemic	NA	0 days	use preventatively; apply to growing medium soon after transplanting, thereafter every 3-6 weeks interval; store unopened product in a cool (≤8°C), dry place.
Prestop	*Gliocladium catenulatum*	biological	suppressive	4 hrs	0 days	use preventatively; apply to growing medium soon after transplanting, thereafter every 3-6 weeks interval; store unopened product in a cool (≤4°C), dry place

Table 1. (cont.)

Product Name	Chemical or Biological Ingredient	Chemical group	Mode of action	REI[1]	PHI[2]	Application
RootShield WP	*Trichoderma harzianum* Rifai, strain KRL-AG2	biological	suppressive	4 hrs	0 days	use preventatively; apply to plant growing medium soon after transplanting, repeat thereafter; store unopened product in a cool (2-5°C), dry place
Greenhouse cucumber						
Ridomil Gold 480EC	metalaxyl-M, S isomers	4	preventative, systemic	12 hrs	21 days	use preventatively; one application per crop cycle; apply as drench immediately after transplanting
Lettuce						
Torrent	cyazofamid	21	preventative, locally systemic	12 hrs	40 days	for greenhouse transplant production only; apply at seeding to prevent transplant damping-off and root rot
Prestop	*Gliocladium catenulatum*	biological	suppressive	4 hrs	0 days	use preventatively; apply to growing medium soon after transplanting, thereafter every 3-6 weeks interval; store unopened product in a cool (≤4°C), dry place

Table 1. (cont.)						
Product Name	**Chemical or Biological Ingredient**	**Chemical group**	**Mode of action**	**REI[1]**	**PHI[2]**	**Application**
Eggplant						
Previcur	propamocarb	28	preventative, locally- systemic	12 hrs	2 days for cucumber; 1 day for tomato & pepper	use preventatively; maximum 2 applications per crop cycle after transplanting, thereafter 7-10 days interval
Prestop	*Gliocladium catenulatum*	biological	suppressive	4 hrs	0 days	use preventatively; apply to growing medium soon after transplanting, thereafter every 3-6 weeks interval; store unopened product in a cool (≤4°C), dry place
RootShield WP	*Trichoderma harzianum* Rifai, strain KRL-AG2	biological	suppressive	4 hrs	0 days	use preventatively; apply to plant growing medium soon after transplanting, repeat thereafter; store unopened product in a cool (2-5°C), dry place

1REI - re-entry interval
2PHI - pre-harvest interval
NA –information is not available

For further information

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