



Pythium Diseases of Greenhouse Vegetables

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Pythium species are protists (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 aeration and improper temperatures in the root zone, and root injury can weaken the crop and, thus, trigger *Pythium* outbreaks. Water 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.

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 spread *Pythium*. *Pythium* spreads by forming sporangia, sack-like structures, each releasing hundreds of swimming zoospores. 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 degrade the root tissues 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 'post-emergence' 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 young 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 1). 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.

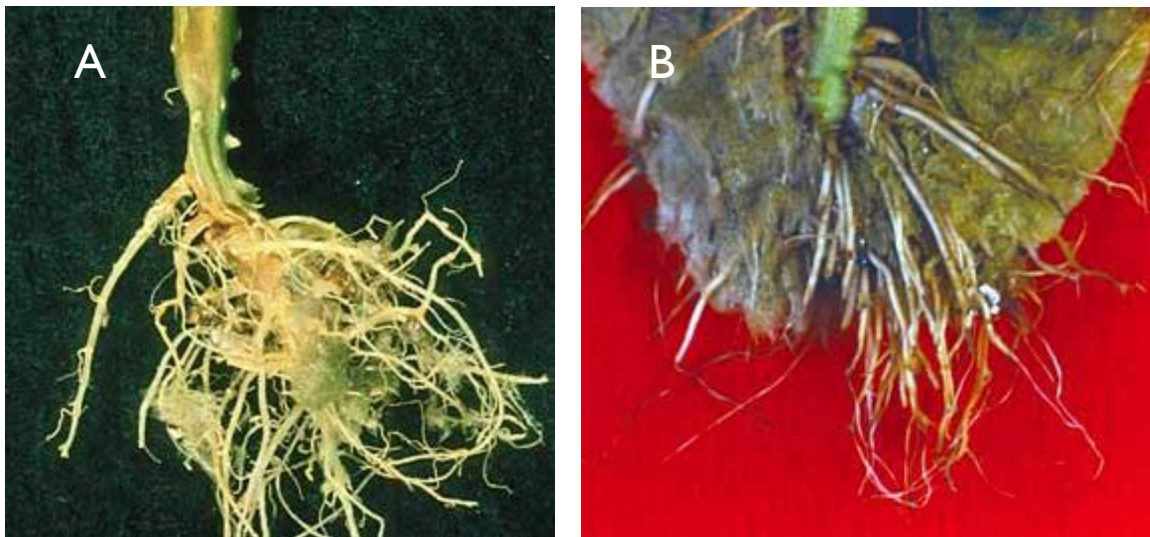


Figure 1. *Pythium* crown and root rot in greenhouse cucumber showing orange discolouration of the crown area (A) and rotted roots and root tips (B).

Monitoring & Identification

Routinely monitor the 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 reliable plant diagnostic laboratory or the [Ministry of Agriculture, Food and Fisheries - Plant Health Laboratory](#).

Disease Management

Cultural Controls

Sanitation: Filled soil, debris, irrigation water from pond or stream, 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 diseased 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 and nutrient storage tanks need to be disinfested periodically and covered to prevent contamination by *Pythium*.

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).

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. Plant 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*. For greenhouse cucumbers, 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).

Maintain 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 signs of *Pythium* diseases throughout the cropping cycle. Remove and destroy severely infected plants, including growing medium, and replant in new growing medium. Infected plant materials and growing medium 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, biological and chemical controls. Use chemicals as a last resort at the onset of disease. Rotate the use of chemicals belonging to different chemical groups and strictly follow label directions to avoid resistance development in *Pythium*. Routinely monitor plants and stop chemical treatment if they fail to provide acceptable disease control; get professional advice.

Table I. A summary of registered chemicals and biological agents and label information. Please refer to Health Canada's [Pest Management Regulatory Agency](#) website on product for labels and information.

Product name	Active ingredient	Chemical or biological group	Mode of Action	REI ¹ hrs	PHI ² days	Application guidelines
Greenhouse cucumber, pepper & tomato						
Torrent	cyazofamid	21	protectant & curative (locally systemic)	12	60	For transplant production, apply at seeding stage.
Previcur	propamocarb	28	protectant & curative (locally	12	2 for cucumber;	Apply preventatively after transplanting, at 7

			systemic)		1 for tomato & pepper	to 10 days interval. Only 2 applications per crop cycle.
Confine Extra	Phosphorous acid mono- & dipotassium salts	33	protectant (systemic)	4	1	Apply preventatively as foliar or drench treatment at 7 to 14 days intervals after transplanting.
Rampart	Phosphorous acid mono- & dipotassium salts	33	protectant (systemic)	4	0	Apply preventatively as foliar or drench treatment at 2 to 4 weeks intervals after transplanting.
MycoStop	<i>Streptomyces</i> Strain K61	biological	suppression (non- systemic)	NA	0	Apply to growing medium after transplanting, thereafter, every 3 to 6 weeks intervals.
PreStop	<i>Gliocladium</i> <i>catenulatum</i>	biological	suppression	4	0	Apply to growing medium soon after transplanting, thereafter, every 3 to 6 weeks intervals.
RootShield HC & WP	<i>Trichoderma</i> <i>harzianum</i> Rifai, KRL-AG2	biological	suppression	4	0	Apply to plant growing medium soon after transplanting, repeat thereafter.
RootShield Plus	<i>Trichoderma</i> <i>harzianum</i> Rifai, KRL-AG2 & <i>T. virens</i> G-41	biological	suppression	4	0	Apply to plant growing medium soon after transplanting, repeat thereafter.
Greenhouse cucumber						
Ridomil Gold	metalaxyl-M	4	protectant & curative (systemic)	12	21	Apply as drench immediately after transplanting. One application per crop cycle.
Greenhouse Lettuce						
Subdue Maxx	metalaxyl-M	4	protectant & curative (systemic)	24	21	Apply as drench to growing medium a day before transplanting. One application per crop cycle.
Torrent	cyazofamid	21	protectant (locally systemic)	12	40	For transplants, apply at seeding to prevent damping-off and root rot.
Confine	Phosphorous acid mono- & dipotassium salts	33	protectant (systemic)	4	1	Apply preventatively as foliar or drench treatment at 7 to 14 days intervals after transplanting.

Rampart	Phosphorous acid mono- & dipotassium salts	33	protectant (systemic)	4	0	Apply preventatively as foliar or drench treatment at 2 to 4 weeks intervals after transplanting.
PreStop	<i>Gliricium catenulatum</i>	biological	suppression	4	0	Apply to growing medium soon after transplanting, thereafter, every 3 to 6 weeks intervals.
RootShield Plus	<i>Trichoderma harzianum</i> Rifai, KRL-AG2 & <i>T. virens</i> G-4I	biological	suppression	4	0	Apply to plant growing medium soon after transplanting, repeat thereafter.
Greenhouse Eggplant						
Previcur	propamocarb	28	protectant & curative (locally systemic)	?	?	Apply preventatively after transplanting, at 7 to 10 days intervals. Only 2 applications per crop cycle.
Confine	Phosphorous acid mono- & dipotassium salts	33	protectant (systemic)	4	1	Apply preventatively as foliar or drench treatment at 7 to 14 days intervals after transplanting.
Rampart	Phosphorous acid mono- & dipotassium salts	33	protectant (systemic)	4	0	Apply preventatively as foliar or drench treatment at 2 to 4 weeks intervals after transplanting.
PreStop	<i>Gliricium catenulatum</i>	biological	suppression	4	0	Apply to growing medium soon after transplanting, thereafter, every 3 to 6 weeks intervals.
RootShield WP	<i>Trichoderma harzianum</i> Rifai, KRL-AG2	biological	suppression	4	0	Apply to plant growing medium soon after transplanting, repeat thereafter.
RootShield Plus	<i>Trichoderma harzianum</i> Rifai, KRL-AG2 & <i>T. virens</i> G-4I	biological	suppression	4	0	Apply to plant growing medium soon after transplanting, repeat thereafter.
Pepper						
Subdue Maxx	metalaxyl-M	4	protectant & curative (systemic)	24	2	Apply to growing medium prior to transplanting or at first sign of symptoms. One application per crop cycle.

¹REI - re-entry interval

²PHI - pre-harvest interval

NA –information is not available

For Further Information

Cherif, M. et.al. 1994. Defense responses induced by soluble silicon in cucumber roots infected by *Pythium* spp. *Phytopathology* 84: 236-242.

Compendium of pepper diseases. 2003. K. Pernezny, et. al. editors. The American Phytopathological Society. <http://www.apsnet.org/apsstore/shopapspress/Pages/43003.aspx>

Diseases and pests of vegetable crops in Canada. 1994. R. Howard et. al. editors. The Canadian Phytopathological Society and the Entomological Society of Canada.

Growing greenhouse peppers in British Columbia. A production guide for commercial growers. 2005. BC Greenhouse Growers' Association and B.C. Ministry of Agriculture. <http://bcgreenhouse.ca/>

Growing greenhouse vegetables. 2005. Ontario Ministry of Agriculture, Food and Rural Affairs. Publication order #371, Agdex #290. <http://www.omafra.gov.on.ca/english/products/newpubs.html> or products@omaf.gov.on.ca

Jarvis, W.R. 1992. Managing diseases in greenhouse crops. American Phytopathological Society. <http://www.apsnet.org/apsstore/shopapspress/Pages/41221.aspx>

Marchuk, R. 2006. Treatments for greenhouse recirculation water. Proceedings, 48th Annual Horticulture Growers Short Course, 2006. Lower Mainland Horticultural Improvement Association, Pages 3-8.

Pesticide label information for Canada: <http://pr-rp.hc-sc.gc.ca/ls-re/index-eng.php>

Tu, J. C. 2004. An integrated control measure for pythium root rot of hydroponically grown greenhouse cucumbers. *Acta Horticulturae* 644: 571-574.

Zamir, P.K. and R. Yip. 2003. Biological control of damping off and root rot caused by *Pythium aphanidermatum* on greenhouse cucumbers. *Can. J. Plant Pathol.* 25: 411-417.

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