e-GRO Edible Alert

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What is swimming around your roots?

Root rot diseases can cause major problems for hydroponic growers, especially in recirculating systems. Symptoms can easily "explode" and quickly result in major crop loss. Preventative action and early diagnosis are critical to disease management, but proper identification of infection before it is too late can sometimes be difficult. The following example highlights a common production scenario.

A hydroponic grower noticed that several of their cucumber plants were wilting on a warm and sunny day. The grower increased the frequency of the drip irrigation to water more often, and the next day the plants looked better. One week later, the crop turned for the worse, and many more plants were wilting even with more water. A close look at the substrate revealed that roots were brown and stunted, and a pathology report indicated infection of *Pythium* root rot.

This e-GRO Alert covers how to diagnose *Pythium* in your crop and why symptoms have potential to "explode" in recirculating hydroponic systems. We also discuss actions you can take to reduce root rot problems in your operation.

***Pythium* thrives in greenhouse hydroponics**

Pythium is a fungal disease belonging to a class of pathogens called Oomycetes or "water molds." These pathogens live mostly in water and spread by spores called zoospores, which swim in water and are attracted towards roots. Surfaces such as equipment, benches, tools, walkways, and especially potting areas, can be a source of contamination when not cleaned thoroughly.

Pythium inoculum is introduced to the greenhouse from outside, from infected transplants, or in contaminated irrigation water. Insects that feed on plant roots, such as fungus gnats and shore flies, also help spread the disease.

Root rot diseases such as *Pythium* can thrive in greenhouses. The same environmental conditions (for example, temperature, moisture, and humidity) required for crop growth also promote disease, and outbreaks tend to occur when conditions are favorable for both. In recirculating hydroponic systems, all plants essentially share the same nutrient solution. So just as one bad apple can spoil the batch, one infected plant can spread root rot pathogens to the rest of the crop through the shared water. In addition, pathogens tend to be opportunistic, and often infect damaged or stressed plants.

Risk of *Pythium* infection varies between types of hydroponic production systems. For example, problems are less likely to occur in bag culture compared to nutrient film technique (NFT) systems because plants are more isolated.

Diagnosing plants with *Pythium*

Pythium infects through the root tip, and forms brown lesions that damage the root system and progress upwards (Figure 1). Other common symptoms include wilting and stunted growth, as shown in Figures 2 and 3, as well as leaf chlorosis, damping-off, stem cankers, and crown rot. Symptoms often lead to death, especially if left untreated.

Figure 1. Pythium root rot. Examples of healthy (blue arrow) and infected (red arrow) roots. Photo credit Anissa Poleatewich, Univ. of New Hampshire.

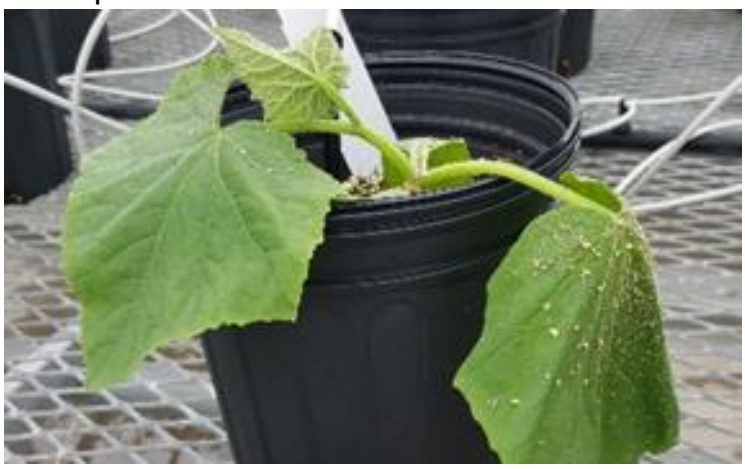

Figure 2. Cucumber wilting as a result of *Pythium* root rot. Photo credit Anissa Poleatewich, Univ. of New Hampshire.

Figure 3. Stunting om tomato seedlings caused by *Pythium* root rot. Right plant is healthy and the left plant is infected (photo credit to Cora McGee, Univ. of Connecticut).

Figure 4. “Sloughing” of a root infected with *Pythium* (red circle). The outer root cortex strips off, leaving the thinner vascular tissue. Photo credit Anissa Poleatewich, Univ. of New Hampshire.

In some cases the visual differences between healthy and infected plants are subtle, especially early on, and detecting a problem takes careful scouting.

Root rot diseases tend to share common symptoms, and diagnosing the exact pathogen can be difficult in the greenhouse. It is critical that growers send root samples to a university or commercial testing laboratory for a proper diagnosis. Proper identification of the type of root rot is necessary, because treatment plans and fungicides are often specific to the pathogen. Growers can perform a quick initial diagnosis specifically for *Pythium* using the “sloughing” technique. For roots infected with *Pythium*, the cortex, or the outer layer of the root, easily pulls off leaving the inner white vascular tissue (Figure 4). This is an easy way to test whether plants might have *Pythium* before root samples are sent to the laboratory.

What about our cucumber crop?

In our grower example, plant wilting was mistaken for water stress. However, *Pythium* had damaged the root system. Poorly functioning roots caused by *Pythium* struggle to take up enough water to meet plant demand, and wilting is a common symptom. In the early stages of Pythium infection, plants can sometimes recover from wilting temporarily, especially at night or in cooler weather. However, wilting returns and is permanent once the pathogen is established. Increasing the irrigation frequency likely exaggerated the problem, since over-watering can reduce oxygen levels in the root zone (creating low oxygen stress) and promote infection. Initial inspection of the root system may have indicated disease and allowed the grower to take corrective action before symptoms got out of control. When diagnosing any plant problem in the greenhouse, even nutrient deficiency, we emphasize the need to check root health for pathogens.

Like most diseases, *Pythium* is difficult to control once established. If diagnosed early on, the grower may have been able to rogue out infected plants to reduce risk of further infection. They may have also been able to dump and replenish the nutrient solution with clean water free of *Pythium*. Once severe infection occurs, the main options are to treat plants with fungicides labeled for edible crops, or discard the crop and start again with a clean system.

Tips for controlling root rot diseases

Prevention is the best strategy when it comes to managing any type of disease. Below are a few main tips for successful disease management.

Maintain a clean and pathogen-free environment. Pathogens survive in organic matter, so remove organic material, trash, and plant debris from floors, benches, irrigation lines, tools and equipment daily. If using chemical disinfectants to clean tools and surfaces, apply them after removing organic matter and always use the label rate. Scrubbing and high-pressure washing helps maximize sanitizer efficacy. Always rinse with clear water to reduce the risk for plant phytotoxicity and worker safety hazards.

Control insect pests. Insects that feed on plants are notorious for spreading disease as they move from infected to healthy plants. Therefore, controlling insects and diseases often go hand-in-hand, and maintaining an integrated pest management program is essential for success.

Maintain optimal growing conditions. Stressed plants are highly susceptible to disease, and common stress factors include high and low temperature extremes, low dissolved oxygen, water-logging, and high salts in the root zone. Providing optimal temperatures for the crop, and taking care not to over-water or over-fertilize go a long way in preventing infection. Low dissolved oxygen in nutrient solutions is a common cause of root damage for crops like lettuce, and we recommend maintaining a dissolved oxygen level at 6ppm or greater to prevent damage and root rot.

Identify key stages of plant development that favor disease. Crops such as tomato and cucumber become more susceptible to disease once they start developing fruit. This is because plants start allocating more resources towards fruit development and less towards vegetative growth and natural plant defenses. Young transplants are also highly susceptible, typically because of transplant shock and potential root damage. Growers should be extra careful during these periods and boost efforts to prevent disease.

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Develop and implement a water treatment program. A water treatment program is critical to successful disease prevention, especially in recirculating hydroponics. A treatment program typically includes filtration of organic matter and plant debris as well as chemical disinfection of water to eliminate pathogens. For information on water treatment technologies and system design, check out resources from CleanWateR3 and Water Education Alliance (http://cleanwater3.org/). It is also a good idea to work with a reputable water-testing laboratory and send irrigation water samples regularly for pathogen testing.

Consider biocontrol technology to promote plant health and suppress disease. Recent advances in biotechnology are enhancing the potential of biological control agents in disease management. Current research at the University of New Hampshire focuses on developing new biocontrol strategies for growers, as well as understanding cultural factors that influence the ability for biocontrols to colonize roots and suppress disease. For additional tips on biocontrols, also check out our e-GRO Biocontrol Webinar series (https://e-gro.org/webinars.php).

In summary, key factors for success focus on prevention, which include maintaining a clean and disease-free environment, maintaining optimal environmental conditions, minimizing plant stress, preventing the spread of disease, and diligently scouting crops for potential problems.

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