e-GRO Edible Alert

Jean Williams-Woodward
jwoodwar@uga.edu

Volume 7 Number 6 March 2022

Root disease management in hydroponic systems

While visiting a deep-water hydroponic producer of lettuce and other leafy greens, I was asked a lot of questions concerning Pythium root disease management within their pond system.

The grower was not having any *Pythium* problems at that time, but they wanted to keep it this way (Figures 1 and 2). Root disease is always a concern within any hydroponic system. The problem with providing a specific program to manage root disease for all hydroponic growers is that almost every grower and system is different. There is deep water raft production, nutrient film (NFT) in channels and coir-based grow bag culture. There are also differences in range size and recirculating water interdependence. Some deep-water ponds range are independent on their own system whereas others are connected, and water is circulated among multiple ponds over an entire greenhouse range. The bottom line is that I can give general recommendations in managing root diseases, but what is a viable option for some may not be practical for others.

Figure 1. Beautiful crop of lettuce produced in a deep-water pond system. (image by J. Williams-Woodward)

The primary root pathogens that I have encountered are *Pythium* spp. and *Berkeleyomyces basicola* (formerly called *Thielaviopsis basicola*) (Figure 3). I am going to concentrate on *Pythium* in this alert. *Pythium* is a “water mold” (an Oomycete) that

Figure 2: Healthy, white lettuce roots grown in deep-water pond production. (Image by J. Williams-Woodward)

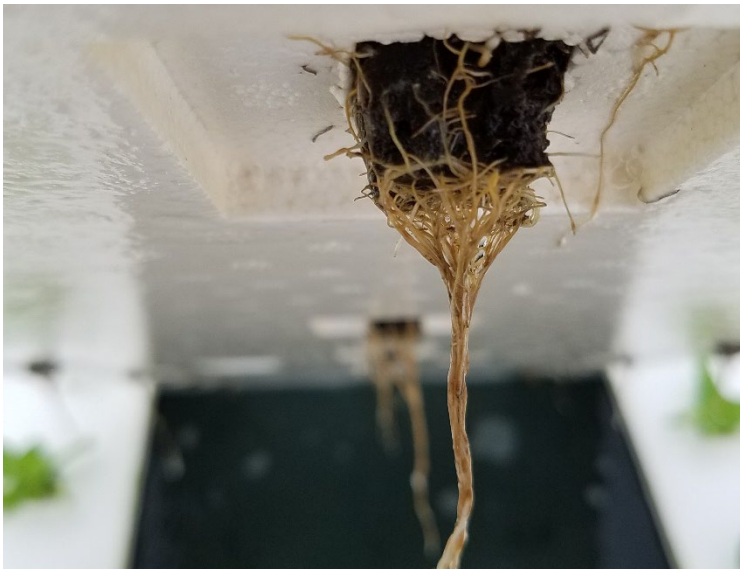

Figure 3. Darkly discolored lettuce roots due to black root rot infection caused by the fungus, *Berkeleyomcyes basicola* (formerly *Thielaviopsis basicola*). *Pythium* infection also causes darkly discolored, soft roots. (Image by J. Williams-Woodward)

thrives in wet conditions. It infects root tips, especially those damaged by low oxygen and/or high EC levels and progresses upward killing the roots. Infected roots are soft and discolored a honey-brown color (Figure 3). What makes *Pythium* of concern within hydroponic systems is that it produces a spore called a zoospore that can swim in water. Zoospores have two flagella that serve to propel and steer the spore along chemical gradients toward damaged root tips.

The number one question I am asked is, "Where does *Pythium* come from?" The answer is that *Pythium* is everywhere. *Pythium* is a soil-inhabiting organism. There are also many species of *Pythium*. Most are saprobic and do not cause disease. Others are highly pathogenic such as *P. aphanidermatum*, *P. ultimum*, and *P. irregulare*. Anywhere water can contact soil such as in outdoor retention ponds and streams or where soil is introduced into a hydroponic facility intentionally or unintentionally on contaminated shoes, tools, or equipment can introduce *Pythium*. It is for this reason that the water source for hydroponics should be clean and preferably well water, which is unlikely to contain *Pythium* propagules. Keeping surfaces clean, free of plant and soil residue, and following good sanitation practices can reduce *Pythium* survival and introduction as well. For information on surface disinfectants see the recent e-GRO alert "Don't treat all surfaces the same" (http://e-gro.org/pdf/E703.pdf).

The one area that must be kept clean is the seeding area. The health of the seedlings directly affects the finished product. Poor quality seedlings will not give expected yield or finishing time. Never reuse rooting mixes or add floor sweepings back into the mix when filling trays. Surfaces and equipment should be disinfected between runs.

Within deep-water systems, often the source of root pathogens is within the rafts. Rafts are most often polystyrene, which is porous. As plant roots grow through and around the planting openings, the roots can grow into the polystyrene pores. As plant roots grow

through and around the planting openings, the roots can grow into the polystyrene pores. Rafts must be washed to remove organic debris and then should be heat-treated or disinfected before re-use (Figure 5 and 6). However, root pieces and debris can remain embedded within the raft even after treatment. New root growth often follows the channels made into the raft from the previous crop, which can expose the new roots to pathogens remaining in the pores. Plastic rafts can be a solution to this (Figure 4). They are easier to clean and disinfect, but they are more expensive.

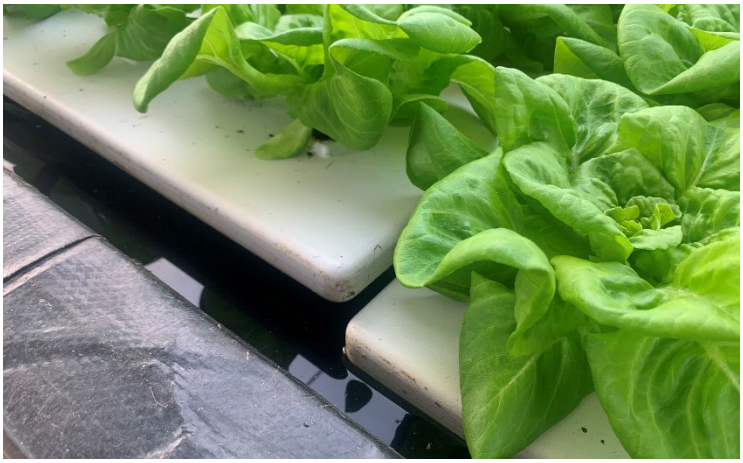

Figure 4. Plastic rafts are non-porous, easier to clean and disinfect; however, they are more expensive than polystyrene rafts. (Image by J. Williams-Woodward)

The water and nutrient solution conditions also affect *Pythium* populations and survival. High oxygen levels can reduce *Pythium* zoospore survival. Ensuring adequate aeration within the nutrient solution to achieve saturated dissolved oxygen (8 ppm O2) in the nutrient solution can reduce *Pythium* survival. Maintaining cooler water temperature (68-72˚F) is optimal for spinach and lettuce production and can also slow *Pythium* survival and infection as well. Low oxygen and warmer root zone temperatures will increase *Pythium* problems.

Figure 5. Used rafts must be washed to remove plant and rooting mix residue and algae and then disinfected by heat or chemical treatment before re-use. (Image by J. Williams-Woodward)

Beneficial microbes build-up within deep-water ponds over time that can help reduce root pathogen survival as well. I have visited growers with ponds that were filled 8+ years ago. Their plant production and root growth is good and healthy. As long as *Pythium* or another root pathogen are not introduced on contaminated tools, rafts, or plants, there is no need to drain the ponds and replace the water. For growers with connected ponds, draining and refilling could mean hundreds of thousands gallons, if not millions, of water which is not feasible. For them, disease prevention is key to maintaining their systems. For them, disease prevention is

Figure 6. Polystyrene boards are porous. Plant roots harboring pathogens can channel into pores and be very difficult to clean and disinfect. Contaminated rafts are often a source for root disease pathogens. (Image by J. Williams-Woodward)

key to maintaining their systems. Microbes can be added to the system by incorporating commercial biocontrol products within the rooting medium or adding products directly to nutrient solutions. A very good summary of these products can be found in the e-GRO alert "Biofungicides for control of root diseases on greenhouse-grown vegetables" (http://e-gro.org/pdf/E207.pdf).

Algae often grows in hydroponic systems that can reduce plant growth. Algae can also harbor shore flies and fungus gnats. These insects are known to spread root pathogen spores. The insects can ingest the spores as they feed on rotting roots. The spores are very resilient and survive within the insect's digestive system. The insects can then spread the spores to new areas when they defecate. Keeping insect populations and algal growth low will reduce root disease spread.

The key to keeping root disease low is to reduce inoculum build-up within the system. Discard infected plants as soon as any symptoms are seen. The longer infected plants remain within the system, the more *Pythium* (or any other pathogen) will increase inoculum load and spread to more plants. For *Pythium*, zoospores are released into the water from infected roots continuously and can spread through an entire system quickly. Ponds sharing recirculating water systems are rarely drained unless disease pressure is extremely high. These systems should have a water disinfection system in place. Filtration and UV treatment can be very effective. Filtration to remove organic matter and algae and improve water clarity is important to ensure UV treatment is effective. There are other water treatment options such as chlorination, ozonation, copper ionization, and addition of oxidizers (hydrogen peroxide, peroxyacetic acid). Care should be used in any system as some of the treatments can alter nutrient solution pH, interfere with nutrient availability or be phytotoxic to some crops. A good source of information on water treatment options is available in the Waterborne Solutions Tool from the Clean Water3 program (https://www.cleanwater3.org/gsearch.asp).

Keys points to remember in managing root pathogens:

- Prevent introduction of pathogens
- Disinfect surfaces, tools, equipment especially in raft filling and seeding areas
- Wash and disinfect rafts before re-use
- Discard infected plants as soon as seen
- Incorporate beneficial microbes
- Maintain optimal fertility, dissolved oxygen, pH, and EC levels in the nutrient solution
- Chill water to 68-72F, especially in the summer months
- Keep algae and insect pests to a minimum

American Floral Endowment
Funding Generations of Progress Through Research and Scholarships
eGRO Electronic Grower Resources Online
Project Sponsor

e-GRO Alert

www.e-gro.org

CONTRIBUTORS

Dr. Nora Catlin
Floriculture Specialist
Cornell Cooperative Extension
Suffolk County
nora.catlin@cornell.edu

Dr. Chris Currey
Assistant Professor of Floriculture
Iowa State University
ccurrey@iastate.edu

Dr. Ryan Dickson
Greenhouse Horticulture and
Controlled-Environment Agriculture
University of Arkansas
ryand@uark.edu

Thomas Ford
Commercial Horticulture Educator
Penn State Extension
tgf2@psu.edu

Dan Gilrein
Entomology Specialist
Cornell Cooperative Extension
Suffolk County
dog1@cornell.edu

Dr. Chieri Kubota
Controlled Environments Agriculture
The Ohio State University
kubota.10@osu.edu

Heidi Lindberg
Floriculture Extension Educator
Michigan State University
wolleage@anr.msu.edu

Dr. Roberto Lopez
Floriculture Extension & Research
Michigan State University
rglopez@msu.edu

Dr. Neil Mattson
Greenhouse Research & Extension
Cornell University
neil.mattson@cornell.edu

Dr. W. Garrett Owen
Greenhouse Extension & Research
University of Kentucky
wgowen@uky.edu

Dr. Rosa E. Raudales
Greenhouse Extension Specialist
University of Connecticut
rosa.raudales@uconn.edu

Dr. Alicia Rihn
Agricultural & Resource Economics
University of Tennessee-Knoxville
arihn@utk.edu

Dr. Debalina Saha
Horticulture Weed Science
Michigan State University
sahadeb2@msu.edu

Dr. Beth Scheckelhoff
Extension Educator - GreenhouseSystems
The Ohio State University
scheckelhoff.11@osu.edu

Dr. Ariana Torres-Bravo
Horticulture/ Ag. Economics
Purdue University
torres2@purdue.edu

Dr. Brian Whipker
Floriculture Extension & Research
NC State University
bwhipker@ncsu.edu

Dr. Jean Williams-Woodward
Ornamental Extension Plant Pathologist
University of Georgia
jwoodwar@uga.edu

Cooperating Universities

Cornell CALS College of Agriculture and Life Sciences

Cornell Cooperative Extension Suffolk County

Iowa State University

University of Kentucky

PennState Extension

UTIA Institute of Agriculture, The University of Tennessee

Michigan State University

UConn

Purdue University

College of Agricultural & Environmental Sciences, University of Georgia

NC State University

The Ohio State University

UofA Division of Agriculture, Research & Extension, University of Arkansas System

In cooperation with our local and state greenhouse organizations

Maumee Valley Growers — Choose the Very Best.

Metro Detroit Flower Growers Association

NC Flower Power

Western Michigan Greenhouse Association

Connecticut Greenhouse Growers Association

Indiana Flower Growers Association

LIFGA

Michigan Greenhouse Growers Council

NYSFI — New York State Flower Industries, Inc.

Kentucky Horticulture Council