



Jean Williams-Woodward
jwoodwar@uga.edu

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Disease management in edible greenhouse crops

The occurrence and severity of plant diseases within greenhouse and hydroponically produced crops is dependent on the choices growers make.

I am asked all the time for recommendations on how to control plant diseases in production facilities. Currently in greenhouse and hydroponic facilities, I am seeing a lot of powdery mildew, *Botrytis* (gray mold), and *Pythium root rot*. These three diseases probably cause the most damage in edible crops followed by damping-off and stem rot from *Rhizoctonia*, downy mildews, viruses (most often tomato spotted wilt [TSWV] and tobacco mosaic [TMV]) and crop-specific fungal and/or bacterial leaf spots. So basically, everything!



Figure 1. *Botrytis* causing stem rot and leaf blighting in a flat of basil. (Image by J. Williams-Woodward)

All crops have the potential to become diseased. It is the choices made by producers that often determines the amount of crop loss from plant diseases.

Choice #1: Cleanliness.

It is said repeatedly: Sanitation, sanitation, sanitation! Sanitation involves keeping everything as clean as possible. Surfaces like floors, benches, containers, and flats need to be kept clean. Sweeping and removing dirt from floors should be done daily, particularly where flats may be filled and seeded. Most rooting substrates have been

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pasteurized or heat-treated and are free of pathogens. Do not sweep floors or benches and add this substrate back into “clean” rooting medium.

I worked with a producer of microgreens who filled and seeded flats of rooting medium that consisted of mostly steam-pasteurized, composted, old rooting medium. The addition of composted medium was done to reduce costs. Microgreens are harvested weekly. Once the foliage is removed and packaged, the flats containing the roots remain. To constantly discard this material and use fresh medium each week was expensive. The grower decided to compost the used material and then steam pasteurize it before using it as an additive in fresh substrate to grow the next crop (Figure 2). I thought for sure this was the problem of why *Rhizoctonia* pre- and post-emergence damping off was occurring in their flats (Figure 3). However, the introduction of *Rhizoctonia* was not from the re-used medium. The grower filled flats twice per week on Monday and Thursday. No disease problems developed on the flats filled and seeded on Mondays. Only the Thursday seeded flats had issues. After a lot of questions, it was discovered that after finishing filling flats on Mondays that the room was swept and cleaned, and that the substrate swept from benches was added back into the medium. That was it! They were contaminating their medium with *Rhizoctonia* surviving in soil on floors and benches. Pathogens never go away if they have a place to survive. Once they stopped adding this waste medium back into their clean medium, they greatly reduced seeing damping off in their flats.

Disinfecting surfaces, used containers, and tools is also important. Quaternary ammonium products (KleenGrow, Physan,



Figure 2. An ingenious method that a small microgreen producer built to steam pasteurize used, composted rooting medium to add as a component to fresh media to reduce costs and waste. Rooting medium from flats where disease was known to be present were discarded and not composted and re-used. The bed of an older pickup truck was converted to a steam sterilizer by running pipes a modified truck bed. Composted material was added and covered with a heavy tarp for sterilization. When the process was complete, the truck was driven to the seeding room for use in filling flats. This system worked for this grower. The point is to never re-use rooting medium where disease was known to be present, and never use it unless it has been treated to kill potential pathogens. (Image by J. Williams-Woodward)



Figure 3. Pre- and post-emergence damping-off due to *Rhizoctonia* infection. Circular patches of dead plants often are a symptom of *Rhizoctonia*. These flats need to be discarded. *Rhizoctonia* hyphae extends under the canopy for inches beyond the area of dead plants. (Images by J. Williams-Woodward)

GreenShield), hydrogen dioxide/hydrogen peroxide (ZeroTol, SaniDate, Oxidate), and sodium hypochlorite (10% bleach) are often used. Products will work if surfaces are cleaned of organic material prior to disinfecting. If organic material is present, then the products bind with it and are inactivated.

Choice #2: Organic or non-organic production (and when to use fungicides and/or biofungicides).

Often following good sanitation practices can reduce disease problems to a minimum. However, there are times when pathogens become established and spread through production facilities. When this occurs, the question is always whether anything can be done to stop disease spread. The first consideration goes back to sanitation with the removal and discarding of infected plants and infested rooting substrates. You cannot cure a plant of a plant disease. Effective control relies on preventing infection and disease development. The second consideration is whether fungicides or biorational or biological control products can be applied. Most growers of edible crops use primarily OMRI-listed products regardless of whether they are certified as an organic grower or not. The included table provides a list of OMRI-listed products labeled for use on leafy greens, herbs (basil, parsley, thyme, cilantro, etc.), cucurbits, and fruiting vegetables like tomatoes.

Preventive applications of chemical or biological/biorational control products can help when disease is known to reoccur within the facility. If you had a problem last year or on the previous crop, you are likely to see it again. Timing is important when using biological control products. These products must be applied at seeding or transplanting and be present prior to

pathogen infection. They do not have curative activity. Biorational products, such as potassium bicarbonate products, can reduce disease spread after infection, but they should be applied when symptoms are first seen - not when disease is present throughout the crop. This requires scouting and early detection of issues.

Choice of product is dependent upon crop species grown, restricted entry interval (REI), preharvest interval (PHI), usage location (field, greenhouse, hydroponics), and potentially state restrictions. There are fungicides labeled for use on herbs, leafy greens, and other edible crops (tomatoes, cucumbers, etc.). However, some are only labeled field or seed production while others can be used within greenhouses and hydroponic systems. All have a PHI that can range from 0-day (most biological and OMRI-listed products) to several days. This can be an issue if you are harvesting daily. Always read and follow product labels for rates, application intervals, use guidelines, and whether it can be legally used in your state.



Biological/Biorational Products for Edible Greenhouse Crops (OMRI-listed)

Active Ingredient	Product	REI/PHI	Diseases
<i>Bacillus amyloliquefaciens</i> strain D747	Triathlon BA; Double Nickel 55; Double Nickel LC	4-hrs/ 0 days	Powdery mildew, downy mildew, damping-off diseases (<i>Rhizoctonia</i> , <i>Pythium</i> , <i>Fusarium</i>), fungal and bacterial leaf spots
<i>Bacillus subtilis</i> QST 713 strain	Cease	4-hrs/ 0 days	Powdery mildew, downy mildew, pink rot (<i>Sclerotinia sclerotiorum</i>), Alternaria leaf blight, bacterial blight (<i>Pseudomonas syringae</i>), anthracnose (<i>Colletotrichum</i> sp.)
<i>Bacillus subtilis</i> strain IAB/BS03	Aviv	4-hrs/ 0 days	Downy mildew, powdery mildew, rust, pink rot (<i>Sclerotinia sclerotiorum</i>), Cercospora leaf spot, bacterial blight (<i>Xanthomonas</i> sp.)
Neem Oil	Triact 70, Trilogy	4-hrs/ 0 days	Botrytis, leaf spot, downy mildew, powdery mildew, rusts
Potassium bicarbonate	MilStop	1-hr./ 0 day	Powdery Mildew, downy mildew, <i>Botrytis</i> , Cercospora leaf spot
Potassium bicarbonate	Armicarb Kaligreen	4-hrs./ 0 days	Powdery mildew
<i>Pseudomonas chlororaphis</i> strain AFS009	Howler EVO	4-hrs/ 0 days	Alternaria leaf blight, anthracnose, <i>Botrytis</i> , Fusarium wilt, <i>Phytophthora</i> , Pythium damping off, Rhizoctonia root rot
<i>Reynoutria sachalinensis</i> extract	Regalia GC	4-hrs/ 0 days	Downy mildew, powdery mildew, fungal and bacterial leaf blights.
<i>Streptomyces lydicus</i> WYEC 108	Actinovate AG	4-hrs/ 0 days	Anthracnose, Basil downy mildew, <i>Botrytis</i> , powdery mildew, <i>Pythium</i> , <i>Rhizoctonia</i> , <i>Fusarium</i>
<i>Swinglea glutinosa</i> extract	EcoSwing	4-hrs/ 0 days	Powdery mildew, Basil downy mildew, <i>Botrytis</i>
<i>Trichoderma asperellum</i> ICC 012; <i>T. gamsii</i> ICC 080	Obtego	4-hrs/ 0 days	Root rot prevention (<i>Fusarium</i> , <i>Phytophthora</i> , <i>Pythium</i> , <i>Rhizoctonia</i> , <i>Sclerotinia</i> , <i>Thielaviopsis</i>)
<i>Trichoderma harzianum</i> T-22	RootShield WP	4-hrs/ 0 days	Root diseases: <i>Pythium</i> , <i>Rhizoctonia</i> <i>Fusarium</i> , <i>Cylindrocladium</i> , <i>Thielaviopsis</i>
<i>Trichoderma harzianum</i> T-22 & <i>T. virens</i> G-41	RootShield Plus+ WP; RootShield Plus+ Granules	4-hrs/ 0 days	Root diseases: <i>Pythium</i> , <i>Rhizoctonia</i> <i>Fusarium</i> , <i>Cylindrocladium</i> , <i>Thielaviopsis</i>
<i>Ulocladium oudemansii</i> (U3 Strain)	BotryStop WP	4-hrs/ 0 days	Botrytis, head/leaf drop (<i>Sclerotinia sclerotiorum</i>)

Products mentioned in the table above are labeled for leafy greens (lettuce, spinach, etc.), herbs and spices (basil, thyme, parsley, etc.) produced in greenhouses. The mention of a product or active ingredient does not constitute an endorsement or recommendation of, nor discrimination against similar products not mentioned.

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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

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
Sustainable Greenhouse & Nursery
Systems Extension & Research
The Ohio State University
owen.367@osu.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 - Greenhouse Systems
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

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