



Cora S. McGehee
cora.mcgehee@uconn.edu



Rosa E. Raudales
rosa@uconn.edu

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Stop the drop in greenhouse lettuce production

Follow these guidelines to identify and prevent Lettuce Drop caused by *Sclerotinia sclerotiorum* in soilless systems.

Lettuce drop –caused by *Sclerotinia sclerotiorum*– is a plant disease that leads to a rapid collapse of the leaves. *Sclerotinia sclerotiorum* is a fungus that also causes crown and stem rot on a variety of crops. The disease has been reported in greenhouse and field production worldwide since the late 1800’s. The first official report was from a greenhouse in Massachusetts in 1890. We have seen Lettuce Drop in greenhouses and indoor production facilities growing in hydroponics or aquaponics systems. Lettuce in greenhouses may be commonly affected due to high humidity and density of the plants.

In this Edible Alert, we discuss alternatives to manage Lettuce drop in controlled environment agriculture.

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Symptoms

The first visual symptoms of lettuce drop are wilting of leaves, light brown water-soaked lesions, and eventually white, cottony thread-like hyphae (mycelium). Symptoms usually appear on the lower stems or crown of the plant. However, symptoms may be detected on the top portion of the lettuce head in between the new shoots (Figure 1 and 2). This may be caused by overcrowding and bolting of the lettuce which can create a humid microclimate right above and/or within the lettuce heads.

Life Cycle of the Pathogen

Once this organism is introduced into an operation it can be difficult to manage because of its resilient structures called sclerotia. Sclerotia are tough, long-lived masses of mycelia that produce air-borne spores. These spores can infect the upper leaves and stems of neighboring and distant plants. Spore germination can occur within 48 hours in the presence of free moisture on leaves (Subbarao et al., 2017).

Spores usually infect damaged or aging tissue during cool and moist weather. In wetter conditions they can persist for about 3-4 years in the absence of a host. *Sclerotinia sclerotiorum* has a pathogenic cousin named *Sclerotinia minor* which usually only infects the stems and leaves. A good trick to tell the two species apart is the size of the sclerotia. *S. sclerotiorum* forms sclerotia that are larger (0.25-0.50 inch) than those of *S. minor* (Subbarao et al., 2017). If you come across little pebble-like structures that resemble mustard seeds or tiny charcoal pieces you are probably encountering *S. sclerotiorum* (Figure 3).



Figure 1 and 2. Watery rot and white cottony mycelial growth on the infected leaf tissue of a lettuce head.



Figure 3. Sclerotia belonging to *S. sclerotiorum* are black, lumpy structures that resemble mustard seeds or tiny charcoal.

Get the most out of your host

If *Sclerotinia sclerotiorum* has been an issue in your operation seek out new lettuce varieties and conduct internal trials to determine which genetics are less susceptible. Breeding efforts are underway by USDA geneticists, but truly resistant varieties are not yet available. Choosing upright-growth varieties will allow for less crowding and increased air circulation which may reduce lettuce drop disease (Mersha, 2016).

Disease Management

Scout regularly and discard infected plants.

Inspect all plant material before it enters the greenhouse. Scout frequently to identify infected plants before they form sclerotia. Discard all infected plants and debris from previous crops. Sanitize the production area to remove the long-living sclerotia.

Sclerotia can survive on plant debris for up to five years. Soil from outdoors can come in on workers shoes or carts. Shoe covers or foot baths can be implemented for workers or visitors before entering the greenhouse to minimize outdoor contamination.

Manage environmental conditions. Disease management in the greenhouse focuses on controlling moisture and humidity. Practice harvesting strategies to avoid getting water on other lettuce leaves still in the system. Try to prevent nutrient solution dripping from roots on neighboring plants when pulling plants up during harvest. Rafts should be removed from tanks and harvested away from actively growing plants. Maintain a plant density that allows enough air space between plants. Production with high plant density or poor ventilation result in a suitable environment for lettuce drop. Providing space between plants throughout the rafts or troughs will improve air circulation and significantly reduce the plant-to-plant contact and hence spread of the disease. In deep water culture production, the recommended space should include 9 plants per square foot until day 21, then respaced to 3.5 plants per square foot until day 35 (Mattson, 2016). Avoid cool and damp conditions by using vents to exchange moist greenhouse air with drier air from outdoors coupled with heating which will alleviate humidity levels. For more information to reduce greenhouse humidity please visit: <https://ipm.cahnrc.uconn.edu/reduce-greenhouse-humidity/>.

Biological fungicides can be used as a preventative treatment against lettuce drop. Table 1 contains a list of biological fungicides registered against *Sclerotinia* spp. for leafy greens grown in greenhouse or indoor production.

Table 1. Biological fungicides registered for use against *Sclerotinia* spp. on greenhouse leafy greens, all fungicides are classified under OMRI (Organic Materials Review Institute) certification (NC=not classified).

Active Ingredient	Commercial Product (Manufacturer) Formulation	FRAC Group	REI	Comments
<i>Bacillus amyliquefaciens</i> D747	Triathlon BA (OHP) and Double Nickel LC (Certis), aqueous suspensions	44	4 hours	Apply as a preventative foliar spray or drench.
<i>Bacillus subtilis</i> GB03	Companion (Growth Products, Ltd) aqueous suspension	44	4 hours	Apply as a preventative foliar spray.
<i>Bacillus amyloliquefaciens</i> F727	Stargus (Marrone Bio Innovations) aqueous suspension	NC	4 hours	Apply as a preventative foliar spray.
<i>Bacillus subtilis</i> IAB/BS03	Aviv (SEIPASA S.A.) suspension concentrate	NC	4 hours	Apply as a preventative foliar spray or drench.
<i>Coniothyrium minitans</i> CON/M/91-08	Contans WG (Bayer CropScience Ltd) water dispersible granule	NC	4 hours	Apply as a preventative spray.
<i>Gliocladium catenulatum</i> J1446	PVent (BioSafe Systems) soluble powder	NC	4 hours	Apply as a spray on plant stems or foliar parts.
<i>Streptomyces lydicus</i> WYEC 108	Actinovate SP (Novozymes BioAg Inc) soluble powder	NC	4 hours	Apply as a soil drench, chemigation (including hydroponics), transplants dip, and foliar spray.
<i>Trichoderma asperellum</i> ICC012 and <i>T. gamsii</i> ICC080	Bio-Tam 2.0 (Isagro) soluble powder	NC	4 hours	Apply as a preventative spray or drench in the substrate.
<i>Ulocladium oudemansii</i> (U3 Strain)	BotryStop (BioWorks) soluble powder	NC	4 hours	Apply as a preventative spray when conditions are conducive for disease. Adequate coverage and wetting is required.

Effectiveness of biological fungicides depends on preventative applications (before the disease is present), thoroughness of the coverage, and proper storage. These products contain a living organism as the active ingredient, so its efficacy depends on how the product is stored and applied. Products with a short shelf life should be stored in a cool location. Check with a technical representative or company website for specific information on shelf life and proper storage conditions. Read the product label for more information on application rates and frequency.

Take home messages

An integrated approach involves the use of multiple practices listed above to manage this disease in soilless systems and thereby increase productivity and profitability. *Sclerotinia* diseases can persist in your production system if you don't sanitize properly and avoid outside contamination. Depending on the time of year, location, and level of inoculum, implementing as many of these preventative practices as possible is highly recommended.

Disclaimer: Reference herein to any specific commercial products by trade name does not necessarily constitute or imply its endorsement, recommendation, or favoring by the University of Connecticut. The data presented here shall not be used for advertising or product endorsement purposes.

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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

Thomas Ford
Commercial Horticulture Educator
Penn State Extension
tf2@psu.edu

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

Dr. Joyce Latimer
Floriculture Extension & Research
Virginia Tech
jlatime@vt.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. 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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