College of Agriculture, Food and Environment
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# Sclerotinia Diseases of Vegetable Crops

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## Importance

Sclerotinia diseases on vegetable crops are commonly referred to as white mold but may also be known as timber rot (tomato), drop (lettuce), and head rot (cabbage). Vegetable crops grown in commercial fields, high tunnels, and home gardens are at risk for Sclerotinia diseases. Severe infections may result in plant death, leading to significant economic losses for growers.

## Host Range

Sclerotinia diseases have a host range of more than 150 plant species, including fruits, ornamentals, agronomic crops, and weed species, as well as vegetables. The most commonly affected vegetable crops in Kentucky include:

- Solanaceous crops (e.g. tomato and peppers)
- Greens (e.g. lettuce)
- Legumes (e.g. green beans and peas)
- Root crops (e.g. carrots)
- Cole crops (e.g. cabbage, cauliflower, Brussels sprouts)

A list of vegetables, herbs, and cover crops susceptible to Sclerotinia diseases is provided in Table 3.

## Symptoms & Signs

For a majority of vegetable crops, symptoms are first observed at or near the soil line. While symptoms can vary depending upon the crop, presence of a white, cottony fungal growth (mycelia) is common to most hosts (Figure 1). Over time, small, black, irregularly shaped overwintering structures (sclerotia) develop, a diagnostic feature of this disease (Figure 2).

### Tomatoes

Early symptoms begin as water-soaked spots, usually near the soil line at axils or branch unions. Lesions elongate over time and some lesions may have a zonate pattern (bulls-eye like appearance). As lesions expand, stems become tan or light brown (Figure 3) and girdled. Sudden wilt, and eventually complete plant collapse and death, follow. Plants may break or lodge at stem lesions. The typical mycelial growth and sclerotia may only be visible when affected stems are split open (Figure 2). Tomato fruit in the lower canopy may also become infected, resulting in a soft rot.

**Figure 1.** Sclerotinia is often characterized by the presence of white, cotton-like fungal growth (mycelia).
**Figure 2.** Small, black, overwintering structures (sclerotia) allow the pathogen to survive for several years in soil even in the absence of a host.





**Figure 3.** Infected tomato stems develop lesions that are light-brown in color. This disease on tomato is often called timber rot.
**Figure 4.** Stems and leaves of infected greens develop a soft, wet rot. On lettuce, the disease is often called drop.
**Figure 5.** In root vegetables, such as carrot, infected aboveground plant parts can become covered in white, cottony mycelial growth.
**Figure 6**. Lesions on legumes may appear water-soaked. On bean, the disease is referred to as white mold.

### Leafy Greens & Cole Crops

Stems may develop a soft, wet rot with a light brown color (Figure 4). Over time, the disease progresses toward the top/head of the plant, degrading tissues as it moves upward. Eventually, the advancing decay results in complete plant collapse. Seedlings and transplants are extremely susceptible and decline rapidly once infected.

### Root Vegetables

Above and belowground portions of root vegetables may become infected. Leaves and stems become covered with mycelia (Figure 5). Stems begin to rot and collapse. Below ground, roots may develop a soft rot.

### Legume Crops

Flowers (if present) are the first tissue to become infected, followed by leaves, pods, and stems. Small spots develop, and infected tissues become slimy or water-soaked (Figure 6). Eventually, spots lighten in color and may appear "bleached." Mycelia and sclerotia develop in diseased tissues.

## Cause & Disease Development

In Kentucky, Sclerotinia diseases are primarily caused by the fungal pathogen *Sclerotinia sclerotiorum*, but *S. minor* may also be present. Sclerotia (overwintering fungal structures) accumulate in soils and may remain viable for up to 5 years.

Disease development commonly occurs during late spring following periods of cool, wet weather. Sclerotia break dormancy when soils are 50°F to 60°F and moist. Cloudy, cool days commonly initiate a germination event in which apothecia (mushroom-like structures) develop from the sclerotia (Figure 7) within a few days of breaking dormancy. Apothecia eject infective spores (ascospores), which can be dispersed and distributed via water splash from irrigation or rain (short range dispersal) and air currents (long range dispersal). Once spores are ejected from apothecia, infection typically occurs when temperatures are between 55°F and 75°F. Further spread of the disease can be the result of sclerotia or infested soil being moved by tools, equipment, and people.

**Figure 7.** Apothecia (mushroom-like fruiting structures) develop from overwintering sclerotia (arrow).

Once plants become infected, symptoms become visible within 1 to 2 weeks. *Sclerotinia* is suppressed when temperatures reach 80°F, thereby making the disease more prevalent in April and May in Kentucky. Fruit and produce infected in the field can develop symptoms in storage and shorten shelf life.

## Management

Following good cultural practices is critical to disease management in all production systems; they are essential to limiting pathogen introduction, reducing disease spread, and disrupting the disease cycle. Monitoring and scouting at regular intervals allow early detection of disease. Failure to manage Sclerotinia diseases results in the accumulation of sclerotia and increased disease incidence, which can result in complete crop losses.

**Table 1.** Non-host cover crops for *Sclerotinia sclerotiorum*.

| Common Name | Scientific Name |
|---|---|
| Austrian winter pea | *Pisum sativum L. subsp, arvense* |
| Black oat | *Avena strigosa* |
| Oat | *Avena sativa* |
| Ryegrass (annual, Italian) | *Lolium multiflorum* |
| Sudan grass | *Sorghum sudanese* |
| Woollypod vetch | *Vicia dasycarpa* |

### Crop Rotation

- **Rotate to a resistant cultivar** (see below) or non-host crop for a minimum of 5 years.
- **Utilize non-host crops** such as corn, sorghum, wheat, barley, oats, and Sudan grass (Table 1) in the rotation to break the disease cycle.

### Resistant Cultivars

- **Select resistant or tolerant vegetable cultivars**, whenever possible. They are most beneficial in field or high tunnel sites with low levels of inoculum. Tolerant cultivars are not completely resistant, so they should be combined with other cultural practices or fungicides for disease management.
- **Refer to Table 2** for commercially available cultivars with resistance to Sclerotinia diseases. Additional cultivars may be available through seed and plant sources.

### Plant Material & Planting

- **Utilize disease-free, certified seed** when available. Avoid saving seed from plantings with known infections.
- **Inspect transplants** prior to planting to ensure they are disease-free.
- **Do not reuse soil or media** for growing vegetable crops in containers.
- **Properly space plants** to allow for improved air flow.
- **Apply a mulch layer** early in the growing season to prevent spore splash.
- **Avoid wounding** plants.

**Table 2.** Commercially available vegetable cultivars resistant to *Sclerotinia* spp.

| Crop | Resistant Cultivars |
|---|---|
| Beans | Black Turtle, Drabo, Fortex, Jacob's Cattle, Nickel, Pincher, Nodak Pinto, Red Noodle, USPT-WM-1, USPT-WM-2 |
| Brussels sprouts | Lunet |
| Cauliflower | Super Snowball |
| Cucumber | Dragon Subyo, Jumbo F1, Mexican Sour Gherkin, Park's Whooper II, Tasty King |
| Lettuce | Black Seeded Simpson, Cimmaron, Galactic, Gildenstern, Hyper Red Rumple Waved, Kweik, Merlot, Merlox Red Oak, Pirat, Plato II, Red Deer Tongue, Rouge D'Hiver |
| Peas | Little Sweetie, Oregon Sugar Pod, Patio Pride |
| Sweet potato | Beauregard |

## Watering & Air Circulation

- **Prune plants** to improve air circulation and allow for rapid drying.
- **Provide adequate ventilation** in greenhouses and high tunnels.
- **Avoid overhead watering**.
- **Avoid excessive soil moisture** (maintain a water holding capacity below 60%).

## Sanitation

- **Promptly remove any infected plants** during the growing season as soon as symptoms are evident.
- **Remove and destroy all crop residues** at the end of the growing season. All infected plant material should be burned, buried, deep-tilled, or destroyed.
- **Deep till** to bury sclerotia 8 to 10 inches, which accelerates decomposition.
- **Work infested growing sites last** to avoid movement of soil on equipment and worker boots into *Sclerotinia*-free areas.
- **Wash and disinfect tools**, equipment, containers, woven fabric, irrigation lines, and shoes/boots that may have become infested with pathogen structures. This should be completed regularly, specifically after harvest and again before planting.
- **Disinfect structures**, such as greenhouses and high tunnels. Refer to *Cleaning & Sanitizing Commercial Greenhouse Surfaces* (PPFS-GH-07) and *Cleaning & Disinfecting Home Garden Tools & Equipment* (PPFS-GEN-17) for more information

## Fungicides

### *Commercial Growers*

Information on fungicides available to commercial growers can be found in the *Vegetable Production Guide for Commercial Growers* (ID-36) and the *Southeast U.S. Vegetable Crop Handbook*. Follow these guidelines when using fungicides:

- Fungicides may be effective in sites with a history of low-level disease. Fungicides are most effective when used before disease develops.
- Always use fungicides in combination with resistant cultivars and multiple cultural practices as outlined above (especially crop rotation). Fungicides should never be used as the primary or only line of defense.
- Protect young plants from infection with stem drenches. Always read and follow all label instructions.
- Note for high tunnels: Many fungicides are only labeled for field use. Only those labeled for greenhouse use may be used in high tunnels.

### *Residential Gardeners*

There are no effective fungicides available for residential use. Cultural practices such as sanitation and rotation should be used for management.

## Soil Solarization

Soil solarization may be effective in destroying sclerotia if soil temperatures can be raised above 104°F. Research is ongoing to determine solarization recommendations for Kentucky climates.

# Additional Resources

## Disease Management Publications

- Home Vegetable Gardening (ID-128)
https://publications.ca.uky.edu/files/ID128.pdf
- Post-harvest Disease Losses in Fruit & Vegetable Crops
https://plantpathology.ca.uky.edu/files/ppfs-gen-24.pdf
- Southeast U.S. Vegetable Crop Handbook
https://www.aces.edu/wp-content/uploads/2023/02/2024_SEVEG_final_web.pdf
- Vegetable Production Guide for Commercial Growers (ID-36)
https://publications.ca.uky.edu/files/ID36.pdf

## IPM Scouting Guides

- An IPM Scouting Guide for Common Pests of Solanaceous Crops in Kentucky (ID-172)
http://www2.ca.uky.edu/agcomm/pubs/id/id172/id172.pdf
- An IPM Scouting Guide for Common Problems of Cole Crops in Kentucky (ID-216)
http://www2.ca.uky.edu/agcomm/pubs/ID/ID216/ID216.pdf
- An IPM Scouting Guide for Common Problems of Legume Vegetables in Kentucky (ID-227)
http://www2.ca.uky.edu/agcomm/pubs/ID/ID227/ID227.pdf

## Sanitation Information

- Cleaning & Disinfecting Home Garden Tools & Equipment (PPFS-GEN-17)
https://plantpathology.ca.uky.edu/files/PPFS-GEN-17.pdf
- Cleaning & Sanitizing Commercial Greenhouse Surfaces (PPFS-GH-07)
https://plantpathology.ca.uky.edu/files/ppfs-gh-07.pdf

**TABLE 3.** List of vegetables, herbs, and cover crops susceptible to *Sclerotinia* spp.

| Crop | Scientific Name |
|---|---|
| **Vegetables** | |
| Artichoke | *Cynara* spp. |
| Asparagus | *Asparagus* spp. |
| Bean | *Phaseolus vulgaris* |
| Beet | *Beta* spp. |
| Cole Crops: Cabbage, Cauliflower, Broccoli, Kale, Mustard, Brussels sprouts | *Brassica* spp. and other genera of the Brassicaceae Family |
| Lettuce | *Lactuca sativa* |
| Okra | *Abelmoschus esculentus* |
| Onion, Garlic, Chives | *Allium* spp. |
| Parsnip | *Pastinaca sativa* |
| Pea | *Pisum sativum* |
| Pepper | *Capsicum annum* |
| Potato | *Solanum nigrum* |
| Radish | *Raphanus sativa* |
| Spinach | *Spinacia oleracea* |
| Squash, Pumpkin, Gourd | *Cucurbita* spp. |
| Tomato | *Solanum lycopersicon* |
| Watermelon | *Citrullus lanatus* |

| Crop | Scientific Name |
|---|---|
| **Herbs** | |
| Dill | *Anethum* spp. |
| Fennel | *Foeniculum* spp. |
| Mint | *Mentha* spp. |
| **Cover Crops** | |
| Buckwheat | *Fagopyrum esculentum* |
| Chicory | *Cichorium* spp. |
| Cirsium | *Thistle* spp. |
| Common vetch | *Vicia sativa* |
| Corn cockle | *Agrostemma githago* |
| Devil's walking stick | *Aralia* spp. |
| Grass | *Lathyrus sativus* |
| Hemp | *Cannabis sativa.* |
| Lambsquarters | *Chenopodium* spp. |
| Mustard | *Sinapis alba* |
| Niger seed | *Guizotia abyssinica* |
| Oilseed radish | *Raphanus sativus* |
| Phacelia | *Phacelia tanacetifolia* |
| Pigweed | *Amaranthus* spp. |
| Quinoa | *Chenopodium quinoa* |
| Teasel | *Dipsacus* spp. |
| Wild carrot | *Daucus* spp. |

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**Tables** were modified from the following sources: Oregon State University—Pscheidt, J.W., and Ocamb, C.M. 2021. Pacific Northwest Plant Disease Management Handbook [online] (https://pnwhandbooks.org/plantdisease/pathogen-articles/common/fungi/plants-susceptible-sclerotinia-sclerotiorum) (Table 1); Phytopathology. 69:875-880—Purdy, L.H. 1979. Sclerotinia sclerotiorum: history, diseases and symptomatology, host range, geographic distribution, and impact (http://dx.doi.org/10.1094/Phyto-69-875) (Table 2); Cornell University Extension—Disease resistant vegetable varieties. 28 April 2022 (https://www.vegetables.cornell.edu/pest-management/disease-factsheets/disease-resistant-vegetable-varieties/) plus additonal with Information obtained from various seed company online catalogs (Table 3)