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Silver Scurf Management in Potatoes

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The silver scurf fungus, *Helminthosporium solani*, was first identified as a serious problem in the Pacific Northwest in the early 1990s. It is a problem in potato production throughout North America.

Silver scurf produces a surface blemish on tubers, causing them to look "dirty." Potatoes with silver scurf are safe to eat but shoppers are less likely to purchase them. Some tubers initially become infected in the field, but the greatest damage occurs in storage. The longer tubers spend in storage, the greater the damage. *H. solani* does not cause yield reduction, but culling of tubers with unsightly surface infections and increased inspection and sorting requirements for damaged potato lots can cause substantial economic losses.

The fungus likely attacks all potato cultivars, but it causes the most economic damage on those sold fresh for market. Russet-skin cultivars are less susceptible to infection, but smooth-skin cultivars, particularly yellow and red, readily exhibit symptoms.

Symptoms and damage

Symptoms consist of circular or irregular, tan to silvery gray and sometimes blackish lesions on the tuber periderm. Lesions generally have a definite margin and vary in size from pinhead to patches that cover most of the tuber. As the disease progresses, individual lesions coalesce. The silvery appearance of older lesions is most evident when the tuber is wet.

Infection and symptom development begin in the field. Though most economic damage usually occurs after tubers have been stored for 3 months or more, damage to smooth-skin cultivars can be severe enough at harvest to render tubers unmarketable.

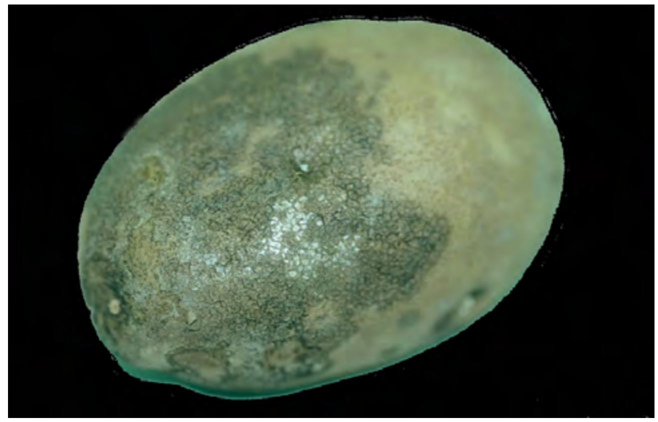

Figure 1. Silver scurf infection originating from the field.

Figure 2. Silver scurf on red potatoes.

Lesions caused by infection in the field generally are irregular in shape and associated with the stolon end (Figure 1). Lesion appearance is somewhat different on smooth-skin cultivars compared to "russet types" (Figure 2). Lesions caused by infection

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Figure 3. Silver scurf on Russet Burbank following secondary infection in storage.

in storage are circular and produce a random "measles" appearance over the surface of the potato (Figure 3).

Silver scurf lesions usually remain superficial, causing no damage to underlying tissues. But in some cases, tissue immediately beneath the lesion becomes slightly discolored. After some time in storage, the infected epidermis cracks, and excessive moisture loss from infected areas may cause tubers to wrinkle and shrivel. Moisture loss can be substantial during long-term storage.

After tubers have been stored at high humidity, the margins of young lesions may appear sooty due to the presence of fungal spores. Close evaluation with a hand lens or microscope may reveal "Christmas tree"-shaped structures. These are spore-producing conidiophores (Figure 4). The "branches" are spores; if the spores are dislodged, the conidiophores look like short, black strings.

Figure 4. Close-up view of silver scurf on tuber. The "branches" are conidia (spores); if the spores are dislodged, the conidiophores look like short, black strings.

Figure 5. The tuber on the left shows a primary infection by silver scurf, the tuber in the center shows a primary infection by black dot, and the tuber on the right shows secondary infections by silver scurf. Notice the more defined margin associated with silver scurf.

Distinguishing silver scurf from black dot

Similar surface blemishes are produced by the fungus *Colletotrichum coccodes*, the cause of black dot. However, black dot lesions frequently are darker than those of silver scurf. Black dot lesions are sometimes slightly raised, whereas silver scurf lesions are not. Unlike silver scurf lesions, black dot lesions generally have a poorly defined margin (Figure 5). They also contain microsclerotia—small, round, black structures embedded in the tuber surface (Figure 6)—but no conidiophores. The silver scurf pathogen does not produce microsclerotia.

Figure 6. Close-up view of black dot on a tuber. There are no conidiophores (contrast with Figure 4).

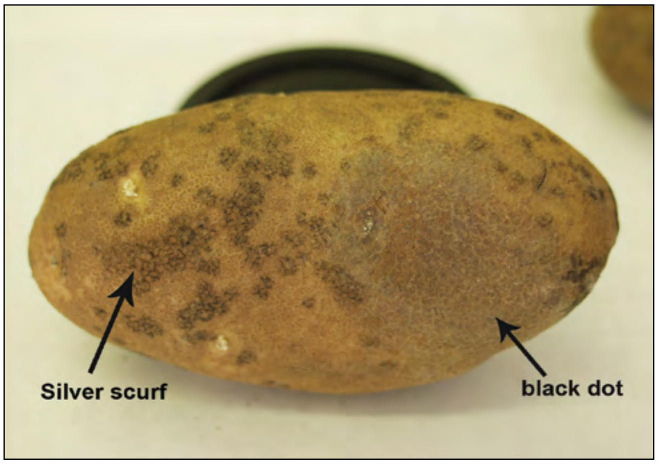

Figure 7. Silver scurf and black dot infection on the same tuber.

Distinguishing the characteristic black sclerotia of black dot from the conidia and conidiophores of silver scurf usually requires examination with a hand lens or microscope. To complicate things even further, both fungi can infect the same tuber (Figure 7).

Source of inoculum and disease cycle

Research studies have shown that infected seed tubers are the main source of inoculum, particularly in fields where there is more than 3 years' rotation between potato crops (because the soil-borne inoculum is unlikely to survive that rotation period; see "Field infection" section, this page). Also, as a general rule, silver scurf incidence increases with an increasing seed generation number. Therefore, planting highly infected seed pieces can result in high infection rates for daughter tubers. Figure 8 shows the life cycle of *H. solani*.

Field infection

The fungus forms spores on the surface of diseased seed pieces in the soil. Spores can be moved in the soil by rain or irrigation water, or the pathogen can grow down the roots or stolons and infect developing tubers.

The pathogen gains entry into developing tubers through lenticels or directly through the periderm. Field infection of developing tubers is called "primary" infection.

Soil is occasionally a source of daughter tuber infection, but spores of the silver scurf fungus typically do not survive in the soil more than 2 years. Therefore, if 3 or more years separate potato crops, it is unlikely that soil-borne spores will survive to infect daughter tubers.

Tubers are most susceptible to infection after the periderm has begun to mature. Disease severity and damage increase the longer tubers are left in the ground after vine death and skin set.

Although the greatest problems often occur in storage, a significant amount of infection and damage can already be present on smooth-skinned cultivars at harvest. Time in the field after skin set and time in storage are cumulative for disease development.

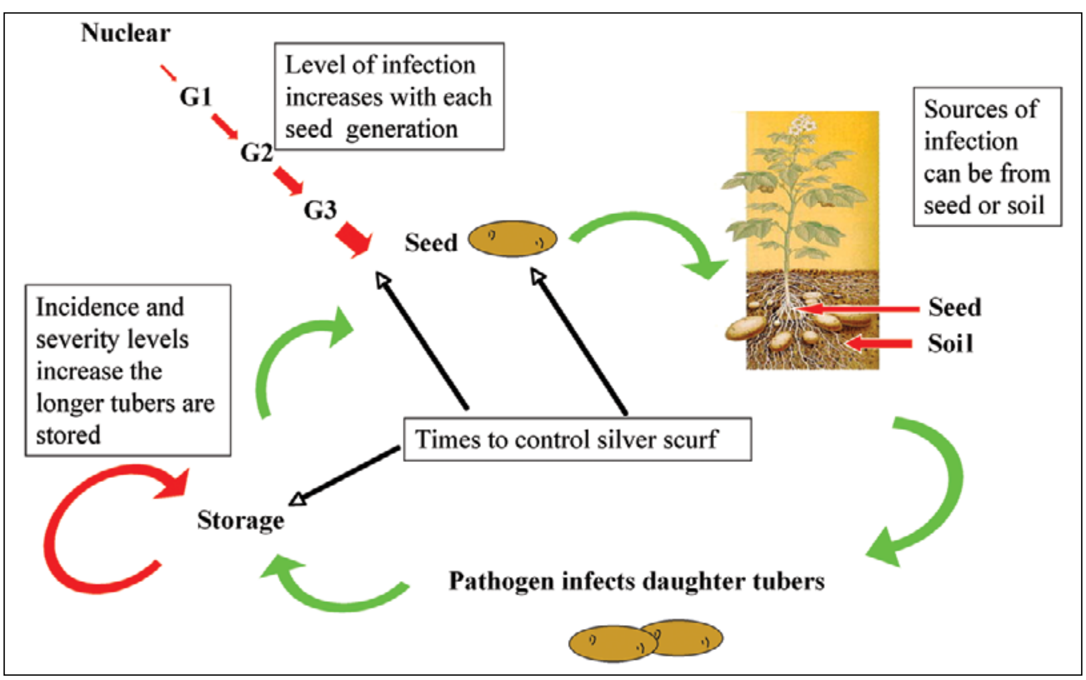

Figure 8. The silver scurf disease cycle (modified from Brad Geary, Brigham Young University).

Storage infection

In storage, spores arise primarily from infected tubers, but they also can originate from contaminated soil brought into storage. Contaminated wood, concrete, and organic material can also be sources of spores.

Spores of *H. solani* form on the surface of diseased tubers at relative humidity greater than 90% (especially above 95%) and temperatures above 38°F. Spores are easily dislodged from the conidiophore, and they move through the storage unit's air system to infect other tubers. Storage infection is called "secondary" infection.

When there is free moisture on tuber surfaces (as a result of fluctuating temperatures and high relative humidity in storage), spores germinate and tuber infection occurs. Given adequate humidity and time, a large proportion of tubers in storage can become infected. Generally, secondary infection (small, randomly found lesions) first become apparent in russet cultivars after 3 to 4 months in storage (Figure 3, page 2).

Management

Managing silver scurf requires an integrated approach through each step of seed and commercial production. All of the following management tactics must be used to provide the best control of silver scurf.

Seed

Silver scurf problems start with infected seed. Use seed that is free or relatively free of the disease. There seems to be no relationship between infected seed and its regional origin. All seed-producing U.S. states and Canadian provinces may produce seed lots infected with silver scurf. A recent study showed that in some seed lots, all of the seed tubers were infected over most or all of the surface area; other lots were free or nearly free of infection.

Before purchasing seed to be grown for the fresh market, test for silver scurf infection.

Place a representative sample of washed tubers (25 to 50 tubers per sample) in a plastic bag containing moist paper towels. Seal the bag, punch a few holes (about 1⁄16 inch in diameter) in the bag, and store the bag in the dark at 60°F to 75°F for 2 to 3 weeks. Do not allow the tubers to dry out. Then, use a hand lens to detect the pathogen. The fruiting structures and spores are dark brown to black and look like tiny Christmas trees (Figure 4, page 2). Some laboratories will do this test for a nominal fee.

Perhaps the most important consideration in silver scurf management is how effectively the seed grower manages the disease. Seed growers can manage silver scurf by separating different seed generations in storage. Silver scurf has been found to increase with each seed generation. The fungus can infect tubers of an early generation seed lot when the early generation seed is stored in the same facility as a later-generation infected lot. To avoid this, the storage space must be smaller, more specialized, and compartmented. Isolating clean lots is the only way to ensure they do not become contaminated.

Be sure to clean and disinfect equipment and storage spaces between different seed crops each year as well as between crop years.

Seed treatment

Fungicide seed treatments can reduce silver scurf infections in most cases. However, do not plant highly infected seed even when using an effective seed treatment. Though the seed treatments are effective at reducing silver scurf, they will not prevent infection of daughter tubers, particularly if the seed infection is severe.

There are a number of effective products available. Consult your local Extension personnel for current information.

Manage early dying

Tubers become more susceptible to infection as the periderm matures after vine death. So, tubers under vines that die early are more likely to become infected than tubers under green plants. Use cultural and chemical practices to keep vines healthy until frost or vine kill. If widespread early dying occurs, consider modifying the original harvest date to minimize the time that tubers remain in the soil under dead vines.

Harvest

Harvest potatoes as soon as skins are adequately set. Fields unharvested beyond skin set encourage higher levels of infection.

Reduce the amount of soil going into storage with tubers. Soil can be a source of inoculum. It can also restrict air movement around tubers, possibly increasing humidity at the tuber surface.

Crop rotation

Research has shown that *H. solani* does not survive long in soil. Crop rotation—with at least 3 years between potato crops—greatly reduces the chance that fungal spores will survive in the soil and infect tubers.

Sanitation

Clean and disinfect seed cutting and handling equipment between lots. Clean storage facilities well before storing the crop. All plant material, debris, straw (a favorite substrate for the silver scurf fungus), and soil must be removed from the storage space. Thoroughly clean the entire facility with a detergent and steam wash, and then apply a disinfectant to all surfaces. After the storage facility is clean, avoid bringing in field soil on equipment.

Storage

Considerable silver scurf infection can occur in storage, sometimes affecting all tubers in a storage unit. How much disease develops depends on environmental conditions in storage, how long tubers are stored, and the amount of infection on tubers when they are placed in storage.

CONDITIONS IN STORAGE

The three basic tools of storage management are temperature, relative humidity, and air flow. As a general rule, cooler temperatures, lower humidity, and adequate ventilation help reduce development of silver scurf in storage.

The wound healing or curing period is important for rapid suberization (the production of suberin to seal the wound and reduce water loss) after tubers are placed in storage. To ensure optimal healing, maintain high humidity (95%), optimum temperature (50°F to 55°F), and good ventilation (the highest air flow rate and volume the storage can supply) to avoid condensation. Reduce the temperature immediately once adequate healing has occurred.

During storage, keep temperatures at the lower range of optimum for the type of potato being stored (about 38°F for seed, 42°F for table stock, 45°F for French fry processing, and 50°F for potato chip processing) while still maintaining the quality needed for the particular use.

TIME IN STORAGE

Though the storage environment may reduce silver scurf development, disease progression still continues at a reduced rate. Therefore, the principal management tactic is to know how much infection is in the potato crop and to adapt storage placement and length of storage accordingly.

Test representative tubers going into storage, particularly those likely to be stored for 4 or more months. The best way to perform the test is to dig some tubers from each lot of potatoes just before vine kill and assay for silver scurf. It is important to take a representative sample from each lot because levels of infection may vary among lots.

When placing potatoes in storage, separate lots with high levels of infection from those with little or no infection. (Lots can be assayed following harvest, but then it is too late to make decisions about storage placement.)

AMOUNT OF INFECTION

Knowing the amount of infection of all lots also can help you decide how long tubers might be stored without large-scale secondary infection. Research from the Pacific Northwest has shown that secondary infection does not appear on Russet Norkotah tubers until the end of January, given a normal storage environment. It apparently takes this long for field-infected tubers to produce spores or for spores in contaminated soil to move through the air system and infect new potatoes. Therefore, even heavily infected Russet Norkotah lots likely can be stored until late January without risk of symptom development from new infections.

Low-risk lots (those with little or no infection at the beginning of the storage season) can likely be stored until May or later, given a proper storage environment, but periodic assaying for silver scurf is important. Smooth-skin cultivars seem to be more susceptible, so storing them for the same duration might not be successful.

If long-term storage is the plan, do not open the storage facility to pack and ship a portion of the lot and then close it again. Major losses have occurred in these cases, apparently due to equipment dislodging spores and the air system then spreading the pathogen throughout the pile.

STORAGE PESTICIDES

Thiabendazole (Mertect 340-F) is registered for silver scurf suppression in storage. Due to disease resistance, however, the postharvest application is no longer recommended.

Research has shown that phosphorous acid products used for postharvest, prestorage application are effective for control of silver scurf in storage, particularly when infection levels are low to moderate.

Stadium, a new product registered in early 2013, was found in experimental research trials to be effective against silver scurf in storage. Before using Stadium, make certain it is registered for use in your state. This product will be available only to commercial growers, not seed growers.

Use pesticides safely!

- Wear protective clothing and safety devices as recommended on the label. Bathe or shower after each use.
- Read the pesticide label—even if you've used the pesticide before. Follow closely the instructions on the label (and any other directions you have).
- Be cautious when you apply pesticides. Know your legal responsibility as a pesticide applicator. You may be liable for injury or damage resulting from pesticide use.

Research has shown limited or no efficacy for the following labeled products:

- General biocides such as ozone, hydrogen peroxide/peroxyacetic acid mixtures, and chlorine dioxide
- Biological products such as *Bacillus subtillus* and *Pseudomonas syringae*
- Clove oil

Summary of best management practices

- Practice good crop rotation, waiting at least 3 years between potato crops.
- Use seed that is free of silver scurf. Before purchasing seed, test it for silver scurf.
- When growing seed, it is best not to store different generations in the same facility.
- Use registered seed treatment products to treat seed tubers at planting.
- Keep vines healthy until frost or vine kill.
- Harvest potatoes as soon as skins are adequately set.
- Thoroughly clean and disinfect storage facilities before storing tubers.
- Remove plant material, debris, and straw from the storage space.
- Cure tubers under conditions of high humidity (95%), optimum temperature (50 to 55°F), and good ventilation (highest air flow rate and volume the storage can supply). Reduce temperature immediately to the desired level for storage.
- During storage, keep temperatures at the lower range of optimum based on the potato's end use.
- Test potatoes for silver scurf infection before storage, and adjust storage times accordingly.
- Isolate lots with silver scurf infection from those with little or no infection.
- Apply a postharvest product to control silver scurf in storage.
- If long-term storage is the plan, do not open the storage facility to pack and ship a portion of the lot and then close it again.

Acknowledgments

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Photos
Figures 1, 2, 3, and 6: Philip B. Hamm ©Oregon State University; Figures 4 and 5: Phillip Nolte ©University of Idaho

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