MP-117

Silver Scurf of POTATO

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Quick Facts

Silver scurf is caused by the fungus *Helminthosporium solani*. Silver scurf is a cosmetic disease of the tuber skin that greatly affects tuber appearance and consumer acceptance.

Silver scurf is primarily seed-borne, although soil-borne inoculum also may contribute to disease development.

Crop rotation and fungicide applied to seed will decrease infection of daughter tubers prior to harvest. Infected tubers carry the silver scurf fungus into the storage facility.

Fungus spread occurs in the storage facility during tuber handling operations resulting in major economic loss from silver scurf.

Storage sanitation and precise humidity control during tuber storage are critical for limiting secondary spread of silver scurf.

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Introduction

Silver scurf is caused by the fungus *Helminthosporium solani*. This disease is present in all major potato production areas in the United States and is most important in production areas where tubers are stored for extended periods. Silver scurf has become much more prevalent and noticed since the mid- to late- 1980s because of several factors, including resistance to thiabendazole, improved storage facilities that routinely provide conditions favoring disease development, and increasingly restrictive tolerances for tuber surface defects. Silver scurf primarily is a cosmetic disease that greatly affects consumer acceptance, and it is more noticeable on red- and light-skinned cultivars. Although silver scurf does not affect total tuber yield, increased water loss from infected tubers during storage results in economic loss due to excess tuber shrinkage. Potatoes become more difficult to peel as tissue below the diseased periderm becomes increasingly dehydrated.

Symptoms and Signs

Only tubers appear to be infected by the silver scurf fungus, and tan to gray, circular lesions form on the tuber periderm (**Figure 1**). The depth of the lesion is confined to the periderm and does not extend into the tuber flesh, although there may be a slight discoloration of internal tissue immediately below the lesion. Primary lesions of tubers infected before harvest are usually clustered near the stolon end of the tuber. Lesions eventually assume a silvery appearance when moist due to the formation of air pockets in the periderm. Lesions have definite margins and individual lesions may expand and coalesce during disease progression. Sporulation occurs only along the margins of lesions, and the margins of young (more active) lesions often develop a sooty appearance due to abundant sporulation of the fungus (**Figure 2**). Sporulation is not always present and becomes evident for active lesions only under conditions of high humidity.

Figure 1: *Silver scurf lesions are circular, are tan to gray when young and later develop a silver appearance.*

In storage, the surface of infected tubers eventually appears shriveled and wrinkled due to excessive water evaporation through the compromised periderm. The appearance of lesions may eventually become brown and portions of the tuber periderm may slough off. Tubers that appear to be disease-free at harvest may develop symptoms in storage, and the disease readily spreads among tubers held in storage. Silver scurf symptoms can be confused with black dot, and both pathogens can occur on the same tuber and even in the same lesion. Black dot lesions are dotted with tiny black structures and they lack sporulation along lesion margins that occurs in association with silver scurf.

Causal Organism

Silver scurf is caused by the fungus *Helminthosporium solani* Durieu & Mont. This fungus produces hyaline mycelia that is both septate and branched. Conidiophores are unbranched and septate, with conidia borne in whorls from the distal ends of the cells and are sometimes described to appear as miniature Christmas trees (**Figure 3**). Spores (conidia) range in size from 7 to 8 microns wide by 18 to 64 microns long. Spores have up to eight septa and are dark brown, rounded at the base, and pointed at the end. The fungus produces spores (sporulates) within several days to several weeks on the periderm of infected tubers held at high humidity. Individual spores can be placed on V8 juice agar or most any general growth medium to obtain cultures.

Disease Cycle

H. solani is commonly present on seed tubers. After planting, sporulation on infected seed pieces occurs within one week, and spores can be recovered from soil surrounding the seed piece within two weeks after planting. It is not well understood how new tubers become infected because the spores are not motile, and movement of the fungus to new tubers via the stolon has not been demonstrated; however, it is believed that spores produced by seed tuber

Figure 2: *The surface of active lesions may appear sooty due to abundant spore production by the fungus. Spores produced on the tuber surface are dislodged during tuber handling and become airborne. Spores are spread throughout storage via air movement through the ventilation system.*

lesions are washed through the soil by rain or irrigation water and eventually come into contact with daughter tubers. Daughter tuber infection takes place through lenticels and directly through the periderm, and infection processes may continue throughout the growing season. Most new lesions appear on the stolon end of daughter tubers, presumably because this portion of the tuber is nearest to the initial inoculum source.

The pathogen also persists in soil, and it has been demonstrated that daughter tubers can become infected by soil-borne inoculum. The fungus likely survives between growing seasons in soil as a saprophyte, because it is able to utilize cellulose and can grow on various kinds of senescent plant tissue. Volunteer potatoes that survive between seasons also can be a source of inoculum for silver scurf and many other diseases. The incidence of daughter tuber infection can be very high at locations where crops are not rotated, although it is not clear which rotational crops are most important for inoculum reduction. The fungus can infect both immature and mature tubers that develop in infested soil. When mature tubers remain in infested soil, the number of lesions and disease severity increases.

Although primary infection takes place before tubers are harvested, the pathogen continues to spread via secondary infections that occur in storages in which

Figure 3: *Characteristic spore-producing structures of the silver scurf fungus, as seen here under the microscope, are sometimes described as miniature Christmas trees.*

temperature and humidity are favorable for spore production, spore dispersal, spore germination, and tuber infection. Spores that remain in the storage facility from one season to the next also threaten the new crop when ventilation fans are activated. Unfortunately, the environmental parameters optimal for tuber storage also prove ideal for silver scurf development and spread. Fungus sporulation and spore germination occurs when the relative humidity exceeds 90 percent and temperatures exceed 38 degrees Fahrenheit. Spores are released into the storage atmosphere when tubers are disturbed by any handling process, and these spores will passively move throughout the potato pile(s) via the air stream and the air handling system. Spores distributed by air land on tubers, and, in the presence of free moisture (condensation), germination and infection will result. Repeated handling of tubers, coupled with temperature fluctuations and cold spots that allow condensation to form or water to drip on tubers, serve to promote disease spread in storage. Relative disease spread is slow when temperatures are 38 degrees Fahrenheit and below and will increase with rising temperatures.

Management Approaches

Silver scurf management will require multiple strategies to obtain even limited success.

Practice crop rotation, as soil-borne inoculum is likely to decrease in the absence of potato tubers. Although crop rotation reduces problems with silver scurf, little is known about the effect of specific rotational crops. Alternate hosts for the fungus have not been reported, and little is known about overwintering conditions that favor survival of the fungus. Control volunteer potato plants, since the pathogen can overwinter in the periderm of the potato tubers that survive between seasons.

Red-skinned cultivars are categorized as susceptible to *H. solani* merely because lesions are readily noticed, while russet-skinned cultivars are considered resistant because symptoms are less obvious.

Although there is no apparent genetic resistance to silver scurf in commercial North American and European cultivars, wild potato species possessing good resistance to silver scurf have been identified. The use of genetic material from wild germplasm may eventually lead to development of commercially acceptable genetically resistant cultivars.

Avoid planting infected seed lots. Unfortunately, the use of silver scurf-free seed may not be practical in many situations because virtually all seed in some production areas is infected, and early generations of seed are quickly contaminated when exposed to spores released from infected tubers held in the same storage. Recent infections are difficult to detect, especially on unwashed seed tubers, and it is difficult to grade and remove seed tubers affected by silver scurf. Although the silver scurf fungus is carried on seed, seed tubers stored at cold temperatures may appear healthy even when infected; therefore, chemical tools are needed at the time of planting to suppress seed-borne inoculum.

Fungicide applied to seed will suppress seed-borne inoculum and reduce the amount of silver scurf present on daughter tubers at harvest. Recommendations for seed treatment typically include formulations that contain mancozeb and fludioxonil. Although most seed treatments are applied during cutting, fungicide application to seed potatoes as they are removed from storage also may effectively prevent widespread infection of seed prior to planting. Most *H. solani* isolates collected from North America are resistant to thiabendazole (Mertect), thiophanate-methyl (TOPS), and other fungicides in the benzimidazole class; therefore, use of these fungicides without simultaneous use of an appropriate fungicide partner is not recommended for silver scurf suppression. It is especially critical to handle seed carefully because infection can occur through bruise injury sites, and bypass the protection otherwise afforded by fungicide. Dithane ST is registered for silver scurf suppression on tubers being placed in storage, but its use is strictly limited to **seed potatoes**.

Harvest fields in a timely manner because silver scurf incidence on daughter tubers will increase with delayed harvest. The least amount of silver scurf is found when the interval between vine-kill and harvest is five days. Delaying harvest after vine-kill may increase the amount of tuber infection that occurs in the field and, ultimately, the amount of inoculum carried by daughter tubers into the storage facility.

Storage facilities should be cleaned, pressure-washed, and treated with a disinfectant before newly harvested tubers are stored. Silver scurf spores survive in plant debris and organic materials often present within the potato storage. Storage soil and organic debris appear to be the most important reservoirs of the fungus, and the fungus does not appear to survive on surfaces such as wood and metal that have been thoroughly cleaned; therefore, thoroughly clean all surfaces and remove all soil and visible debris prior to applying disinfectant. Disinfect the storage with labeled compounds, allowing for sufficient contact time (usually at least 10 minutes) to permit the chemical to kill the fungus and other deleterious organisms that commonly contaminate storages. Close the storage for a day or two to permit additional disinfection and, once doors are opened, allow sufficient time for complete drying of all surfaces prior to refilling with potatoes.

Eliminate dirt and debris before loading potatoes into storage. The fungus produces spores that are easily transmitted from infected to healthy potatoes during handling and piling operations. Periodically clean and disinfect handling equipment and trucks, particularly between fields. Some post-harvest chlorine treatments are labeled for use directly on potato tubers, although their efficacy is not well documented. If such products are used, carefully read labels for rates and application procedures. It is important that treated tuber surfaces are quickly dried to reduce the risk of loss from bacterial decay that is often triggered by the presence of free moisture. Avoid storing wet potatoes or potatoes with adhering wet soil. If such storage is unavoidable, run the fans until the tuber surfaces are dry and then resume normal storage ventilation.

Random samples of tubers should be collected from trucks or the pile (preferably about a foot below the surface of the pile) and placed in a ziplock bag containing a slightly moistened paper towel. Place the bag at room temperature in the dark, and periodically re-moisten the paper towel. Silver scurf will develop characteristic miniature black Christmas tree-like structures (**Figure 3**) within several days to several weeks that can be observed under a microscope or with a powerful hand lens. If the tubers show evidence of disease, early marketing of the potatoes should be considered.

The first few days in storage when pile temperatures are warmest is a crucial time for silver scurf management. Tubers may be better protected if temperatures are decreased rapidly to 50 degrees Fahrenheit followed by 2 to 3 weeks curing, and then temperature should be decreased to holding conditions between 42 to 45 degrees Fahrenheit. During this process the relative humidity in the storage must be maintained at 90 to 95 percent without condensation occurring in the storage or in the pile. Reducing the relative humidity to 85 percent will reduce secondary infection processes but also will increase shrinkage losses. For processing potatoes, rapid cooling may not be an option because increased sugars are likely.

Avoid conditions that promote condensation in storage, because silver scurf spread and development is most rapid when free moisture is present on tuber surfaces. Spore germination is reduced from 80 percent to less than 5 percent at conditions of less than 95 percent relative humidity, regardless of temperature. If tubers are held at less than 90 percent relative humidity, spore production and germination are halted, preventing tuber-to-tuber spread. Maintaining a storage environment of 90 percent humidity during the first month following harvest is sometimes recommended to delay silver scurf spread. Although reduced relative humidity will slow silver scurf spread, it will increase losses due to black spot, shrinkage, and pressure bruise.

If silver scurf is present, it is recommended to increase intake of outside air when possible, run continuous low-speed ventilation or frequent 4- to 6-hour ventilation cycles to maintain recommended temperatures evenly in the pile from top to bottom without permitting condensation at the bottom. Efficacy of this recommendation is largely dependent on fan efficiency. Make sure any adjustment in the ventilation system or changing the cycles of fan run times will still maintain the desired temperatures, at the bottom and at the top of the pile. Always use tuber pulp temperature measurements to be certain the pile is at the desired holding temperatures. If silver scurf is seen spreading early in the storage season, any lowering of the set temperature, within limits of the expected use of the potatoes, will slow disease spread in the pile. Store tubers at the lowest temperature possible, given the market requirements.

Additional Information

Loria, R., and G.A. Secor. 2001. "Silver scurf." Pages 40-41 In: *Compendium of Potato Diseases.* W.R. Stevenson, R. Loria, G.D. Franc and D.P. Weingartner. (Eds.). APS Press, St. Paul, MN. (106 pp.).