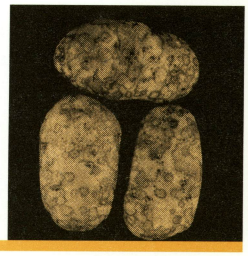

# SILVER SCURF OF POTATOES

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## INTRODUCTION

Silver scurf is a disease of potatoes caused by the fungus *Helminthosporium solani.* The damage caused by the fungus is limited to blemishes and lesions on the skin of the tuber. The lesions will reduce tuber quality and marketability. A 1993 University of Idaho economic assessment estimated a loss of 7 to 8.5 million dollars to Idaho's fresh pack potato industry as a result of this disease. Packing houses in Idaho report increased sorting costs, increased inspection time and rejected lots at destinations. Processors have difficulty peeling the skin off tubers when symptoms on the exterior of the potato become excessive.

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## CHARACTERISTICS

Silver scurf was first reported in the United States during 1914 but there are earlier reports of this disease in Europe. Many of the disease characteristics reported during 1914 are still relevant. It was then reported that the fungus that causes silver scurf (formerly known as *Spondylocladium atrovirens*) can produce spores or conidia, which readily serve as a source of inoculum for the spread of the disease. The disease may be introduced into potato production from infected seed. The fungus can also survive in soil on dead and decaying organic matter and, as a result, will overwinter, potentially subjecting a subsequent potato crop to a new cycle of infection. This fungus can penetrate through the periderm of the potato or through natural openings on the surface of the tuber and therefore does not need a wound to start the infection process. The maximum infection and spread of this disease to new potatoes from any of these sources takes place during handling and the initial 2 to 3 weeks (curing period) of storage. Infection is also increased when pulp temperatures remain warm with relative humidity above 90 percent, along with the re-circulation of the internal air. Subsequently, the infection spread may be slowed but not completely eliminated as storage temperatures are cooled to 45°F or below. At these temperatures the fungus will live and develop slowly. This is why symptoms from a new infection site on a tuber do not appear until after 4 to 5 months.

## SYMPTOMS

The symptoms of the silver scurf disease can be broadly classified as primary and secondary infection. The primary infection is referred to the infection that takes place in the field when the tubers remain attached to the stolon. Primary infection is usually seen on the skin (periderm) at the stem end of the tuber as a smooth, gray and silvery sheen (figure 1). The fungus can infect white skinned, red skinned, and russet skinned potatoes. The advanced primary infection on white and russet skinned potatoes shows a characteristic silvery, thick lesion which may be patchy or extend irregularly, covering a major portion of the tuber surface. The tissue underlying the lesions remains unaffected. Infection of red skinned potatoes can partially or completely discolor the skin. In severe cases primary lesions may shrivel and enhance shrinkage of the potatoes.

Secondary infection may not significantly affect the skin structure but may severely impair the appearance of the potato. Secondary infections may cover a major portion of the tuber surface and usually appear in storage and starts as black circular lesions on several areas of the tuber (figure 2). Eventually these lesions will increase in size, coalesce and disfigure the appearance of the potato. Secondary lesions may produce spores or conidia that allow spread of the disease in storage. In contrast, primary lesions are usually made up of dead and thickened tuber skin cells that do not produce spores.

## THE SILVER SCURF DISEASE IN POTATO PRODUCTION

### *Seed*

The primary way the fungus enters into potato production operations is through infected seed potatoes. The evidence that this disease is seed borne comes from the fact that infected progeny tubers at harvest show the characteristic silver lesions on the stem end of the tubers, the ends that were in closest proximity to the infected seed piece. In addition, fields that have not been in potato production have had crops with serious silver scurf, which is another indication that the initial source of infection is from seed. This infection can take place soon after tuber initiation. However, there is no data showing direct movement of spores from the seed potato to the growing progeny tubers

### *Soil*

Recent reports have shown that the fungus can live in dead and decaying material in the soil for at least one year, indicating that soil can be a source of inoculum.

### *Harvest*

Delayed harvest, particularly after vine kill, appears to increase the severity of the disease. Wet and warm soil conditions help spore production by the fungus, thereby increasing the chances of healthy potatoes becoming infected. Harvesting and handling operations is likely to mix infected potatoes with healthy potatoes which will als initiate several new infections on the tubers.

*Figure 1. Primary silver scurf lesion on russet skin potato showing the silvery sheen on the skin.*

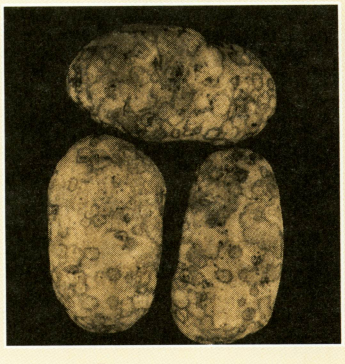

*Figure 2. Secondary infection of silver scurf showing the circular black active lesions.*

### *Storage*

As indicated the tuber infection that takes place prior to harvest can be categorized as primary infection. However, the spread of the disease in storage is usually secondary infection, which can be equally serious. One distinguishing characteristic of the secondary infection is that lesions are generally seen about 4 to 5 months after storage begins, and unlike primary infection, the lesions are not restricted to the stem end of the tuber (figure 2). It has been observed that the fungus does not sporulate and secondary spread will not take place via the air system under seed storage conditions (38 to 39°F). However, a limited amount of secondary spread could take place through physical contact and mixing of infected seed potatoes with healthy seed potatoes. In storages at 45 to 50°F the fungus may remain latent (stays hidden) for 4 to 5 months before symptoms begin to appear on the skin of the potato. Free moisture, resulting from condensation and lack of air movement in the pile, can increase sporulation and secondary spread of the disease.

The fungal spores can remain viable for extended periods on structural materials such as wood and polyurethane. There is also evidence that the fungus can live for over 9 months in the soil of the storage floor, particularly when the soil contains decaying tubers or other organic matter. If conditions remain favorable for the fungus during the off season, then the fungal inoculum can build-up inside the storage and potentially serve as a source of infection for new potatoes put in storage. Therefore, the two ways the silver scurf fungus can initiate a new cycle of infection in storage is from new infected potatoes put into storage or an existing contamination in the storage from the previous season. Potatoes can also be infected from contaminated potato handling equipment.

The fungus thrives well in areas of the potato storage where free moisture forms. Free moisture forms inside storages when condensation occurs on ceiling and walls due to poor insulation or to improper management of humidity and ventilation systems. It has also been noted that potato storages with poor ventilation have unequal distribution of temperatures in the pile, aiding the spread of the disease in warm areas of the pile. Generally, in a storage that has bottom-up forced ventilation, the warmest area of the pile is the sub-surface region of the potato pile to a depth of about 1 to 2 feet below the surface. This high risk area is where infection can develop rapidly. The other likely area where spread can be anticipated is at the bottom of the pile, particularly the area subjected to frequent free moisture formation. Free moisture can form at the bottom of the pile under high humidity conditions if the Δ T (the difference in temperature between the top and bottom of the pile) remains more than 5°F. Ideal Δ T should not exceed 1 or 2°F.

## SILVER SCURF DISEASE MANAGEMENT:

### *Seed treatment*

The fungus *Helminthosporium solani* can be seed borne but, in most cases, seed potatoes do not show the characteristic silvery lesion on the skin because seed storage temperatures of 38 to 39°F are not conducive for growth of the fungus. However, at these temperatures the fungus will survive in the skin of the potato and remain latent until conditions become favorable for sporulation and spread. Therefore, the use of an effective seed treatment is important in the management of silver scurf on potatoes. The fungus exists as different isolates or strains, capable of showing varying degrees of sensitivity or tolerance to some of the common seed treatment fungicides that are currently in use. Therefore, the best approach to controlling such a fungus is with seed treatment fungicides that are capable of inhibiting more than one bio-chemical reaction site in the metabolism of the fungus. Several seed treatment fungicides are currently being tested and have shown significant control of the fungus. In addition to the use of an effective seed treatment, potato seed should be handled carefully, because there is evidence that the efficacy of seed treatment is lost if the seed is bruised. Figure 3 shows the ability of the fungus to penetrate bruised areas of the tuber.

### *Storage disinfection*

Silver scurf spores can survive in dead and organic materials inside a storage. Before harvest, thoroughly clean and disinfect storages with labeled disinfectants. When disinfecting, keep surfaces wet for at least ten minutes. Close the storage for a day or two and then open to allow for complete drying before refilling with potatoes.

### *Harvest*

Avoid delaying harvest. Delaying harvest after vine-kill could increase the amount of infection in the field.

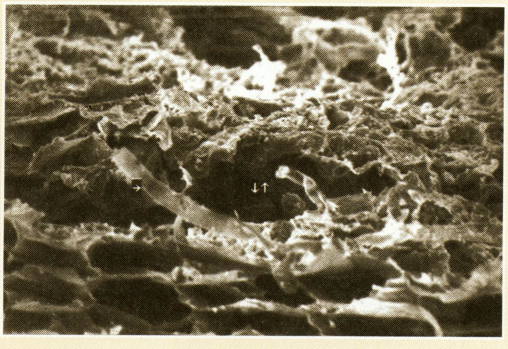

*Figure 3. Arrows indicate the penetration of H. solani mycelia into an wounded area of the potato periderm.*

*Figure 4. A magnified picture of the conidiophore showing the conidia (spores).*

*Handling and postharvest treatments*
The fungus produces many spores that can be easily transmitted from infected to healthy potatoes during handling and piling operations. It is advisable to clean and disinfect handling and conveying equipment (including trucks) periodically, particularly between fields. Some postharvest chlorine treatments are labeled for use on potatoes directly. Use labeled products, rates and application procedures during treatment. It is important that after treatment the potatoes receive continuous ventilation until the surface is dried.

*Storage management*
There are two important factors in storage management.

a) *Storage contamination:*
Recent research work at the University of Idaho, Potato Storage Research Center, Kimberly demonstrated that the fungus can survive in the storage soil and organic debris but did not appear to survive on plywood. This suggests that storage cleaning and decontamination procedures should be an integral part of management procedures to minimize silver scurf on potatoes.

b) *Storage temperature and relative humidity control:*
The first few days in storage when the pile temperatures are usually warm are a crucial time for the potatoes. If storage conditions are not properly controlled, the warm pulp temperatures in combination with increased humidity, can provide a good environment for the silver scurf fungus to spread and infect new areas in the pile. Whether storage managers should reduce pile temperature faster than the recommended rate depends on the market use of the potatoes. Silver scurf is predominantly a problem on potatoes destined for fresh market. These potatoes may be better protected against silver scurf if temperatures can be decreased rapidly to 50°F and then cured for 2 to 3 weeks. Subsequently, the temperature should be decreased to holding conditions between 42 and 45°F. 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 help reduce the secondary infection but it will also increase shrink loss in the potatoes. If the potatoes stored for processing or in an open market situation, then the rapid cooling may not be an option because of the increased likelihood of sugar build-up in the potatoes.

*Dirt and debris*
Eliminate dirt and debris that move with the potatoes before loading potatoes into storage. These materials can carry silver scurf spores. Clean and disinfect the stinger and conveyor belts frequently during harvesting and loading operations to reduce contamination between loads.

Avoid storing wet potatoes or potatoes with excessive wet soil in storage. If this cannot be avoided, eliminate as much soil as possible and continuously run the fans without added humidity until the tuber surfaces are dry, and then resume normal storage ventilation.

*Early detection*
Random samples of potatoes should be drawn out of trucks or from the pile (preferably about a foot below the surface of the pile) and placed in a plastic bag with a wet paper towel. Place the bag at room temperature, out of exposure to light, and periodically wet the paper towel with water. Silver scurf infection will show the characteristic miniature black "Christmas tree" like structures (figure 4) in about 4 weeks. This can be observed under a microscope with 10x magnification. If the potatoes show evidence of infection there may be a potential problem with this disease and therefore early marketing of the potatoes should be considered.

## STORAGE VENTILATION

During the storage season, check daily for condensation in the ducts and on top of the pile. Silver scurf spread and development can be encouraged by free moisture on the tuber surfaces. Avoid as much as possible all conditions that promote condensation in the storage. If samples indicate silver scurf infection, increase fresh intake of outside air when possible. Continuous low speed ventilation or frequent 4 to 6 hour ventilation cycles will help maintain the recommended temperature evenly in the pile from top to bottom without the possibility of condensation at the bottom of the pile. This is a new recommendation and its effectiveness will largely depend on the efficiency of the fans. Make sure that any adjustments in the ventilation system or changing the cycles of fan run times will still maintain the desired pile temperatures, both 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 the disease is seen spreading early in the storage season a slight lowering of the set temperature, within limits of the expected use of the potatoes, will slow the disease spread in the pile.

## ABOUT THE AUTHORS

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