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Managing Silver Scurf in Potatoes

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Introduction

Silver scurf is caused by a fungus, *Helminthosporium solani*, a relatively new problem related to potato production in North America. It wasn't until the early 90's that this fungus was identified as being a serious issue, particularly in storage. This fungus causes a surface blemish issue, resulting in the tubers looking "dirty". It attacks all potato cultivars but causes the most economic damage on those that are fresh marketed. Smooth skin types are more susceptible than russet types. While the silver scurf pathogen infects potatoes in the field, the greatest damage occurs in storage, particularly with increasing time in storage and is especially visible on smooth skin cultivars.

Symptoms and Damage

Symptoms consist of tan to silvery gray, circular to irregular lesions formed on the tuber periderm. Lesions generally have a definite margin, vary from pinhead size to patches that cover most of the tuber surface. As the disease progresses, individual lesions coalesce. The silvery appearance of older lesions is most evident when the tuber is wet. Lesions usually remain superficial, causing no damage to underlying tissues, but internal tissue immediately below the lesion may infrequently be slightly discolored. After some time in storage, the surface of infected tubers may become shriveled and wrinkled due to excessive moisture loss.

Margins of young lesions may have a sooty appearance after tubers have been stored at high humidity due to the presence of spores. Close up evaluations with a hand lens or microscope of infected tubers reveals either "Christmas tree" like structures which are conidiophores (the structure where conidia or spores are produced) with branches that are the actual spores of the fungus, or the short black "string" like conidiophore, once the spores have dislodged. The spores are easily dislodged, moved in the air system of a storage unit, and infect additional tubers. Given high enough humidity and time a large proportion of tubers can become infected in storage.

Similar blemishes on tuber surfaces are produced by *Colletotrichum coccodes*, the cause of black dot. Black dot lesions are frequently darker than those of silver scurf, and contain microsclerotia, which are small, round, black structures embedded in the tuber surface. Silver scurf does not produce microsclerotia. Black dot lesions generally have a poorly defined margin. In contrast, silver scurf lesions usually have a clearly defined margin. Confirmation of these two diseases requires examining tubers with a hand lens or microscope to observe the characteristic black sclerotia of black dot, or conidia (spores) and conidiophores of *H. solani*. While both fungi can appear on the same potato tubers, they are usually associated with different lesions. Latent infections on tubers of both fungi are moved from the field into storage.

Damage often does not show up until the tubers have been stored for a month or more. With time in storage, cracking of the epidermis results which increases water loss and shrinkage of tubers. Losses also occur due to increased inspection and sorting time required in lots with damage. While the greatest problems occur in storage, primarily a result of spores spreading from diseased tubers infected in the field to healthy ones, smooth skinned cultivars can have significant infection and damage present at harvest.

Source of Inoculum and Disease Cycle

Silver scurf develops on tubers in the field and in storage. In the field, inoculum of *H. solani* most often originates from seed tubers, particularly where three or four years between potato crops is practiced. The fungus forms spores on the surface of diseased seed pieces in the soil which are washed off during rain and irrigation or potentially grows down the roots or stolons, infecting the developing tubers. The pathogen gains entry into developing tubers through lenticels and directly through the periderm. Field soil may be a source of spores when potatoes are grown immediately after potatoes. Seed lots can be highly infected, and these infected seed tubers have been recently demonstrated to be the main source of inoculum. Planting highly infected seed pieces resulted in high infection rates of daughter tubers. Lesions initiated from infection in the field are generally irregular in shape and associated with the stolon end whereas infections that occurred in storage are found anywhere on the surface of the potato.

There does not appear to be a relationship between infected seed and regional origin of the seed. All seed states potentially produce some seed lots with silver scurf infection. All seed in some seed lots has been found to have infection over most or all of the surface area. Perhaps the most important consideration in silver scurf management is how effectively the seed grower managed the disease. Soil can be a source of daughter tuber infection but not a likely source. Spores of the silver scurf fungus do not survive long in soil, probably not beyond two years. Therefore, wherever three or more years separate potato crops, soil borne spores infecting daughter tubers is of little importance.

Disease severity and damage increases the longer tubers are left in the ground after vine death and skin set. This is because tubers are most susceptible after the periderm has begun to mature.

Time in the field after skin set and time in storage is cumulative for disease development.

In storage, inoculum arises from infected tubers and contaminated soil brought into the storage. Contaminated wood and many organic materials may also be a source of spores. Spores of *H. solani* are formed on the surface of diseased tubers at relative humidity above 90% (and especially >95%) and temperatures above 38 F. Spores are carried by air currents in the storage and through the ventilation system and are deposited onto tubers. When free moisture is present on tuber surfaces, a result of fluctuating temperatures and high relative humidity in storage, the spores germinate and tuber infection occurs. Generally, secondary lesions (infections occurring after storage begins) first become apparent after three - four months of storage. Lesions initiated from infections in storage are circular and not concentrated at the stolon end but produce a "measles" look over the surface of the potato.

Research has shown that silver scurf may increase with each seed generation with an increase of a particular seed lot. This is due to the disease increasing with each seed generation in the field and in storage. The silver scurf fungus can infect seed of an early generation when the early generation is stored in the same facility of an older, infected seed generation. In other words, placing a generation 2 seed lot with a little silver scurf in the same storage as a nuclear lot allows spores to move from the infected lot to the clean lot. Additionally, equipment and storages contaminated with *H. solani* spores from a previously infected crop may also contribute to the infection of an early seed generation.

Management

Silver scurf management requires an integrated approach through each generation of seed-tuber production to production and storage of fresh marketed or processing potatoes. All management tactics listed below 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 silver scurf. Always test seed to be grown for the fresh market for silver scurf infection before seed purchase.

The incidence of infected seed tubers can be determined using a simple test. Place a representative sample of unwashed tubers (25-30 tubers/sample collected randomly from the field or about two feet below the surface of the pile) in a plastic bag containing moist paper towels. Seal the bag, punch a few holes (about 1/16 inch in diameter) and store the bag at 60-75 F for two to three weeks. Do not allow the tubers in the bag to dry out. The pathogen can be detected with a hand lens. The fruiting structures and spores of the fungus are dark brown to black and look like tiny Christmas trees. Some laboratories do this test for a nominal fee.

Seed lots should be kept separately in storage because different lots may have different levels of silver scurf infection, regardless of generation. While this creates difficulties of needing different storage space than may be currently available, this is the only way to insure that an infected lot does not contaminate a clean lot.

Crop rotation - Research has shown that *H. solani* does not survive long periods in soil. Therefore practicing crop rotation, by not planting potatoes for two years or more in the same field, will greatly reduce the chance of daughter tuber infection originating from fungal spores surviving in the soil.

Manage Early Dying - Tubers under vines that die early are more likely to become infected than tubers under green plants because the periderm on tubers matures after plants die. Therefore use cultural and chemical practices to keep vines healthy until frost or vine kill.

Seed treatments - Specific seed treatments have been found that, in most situations, reduce silver scurf infections. The three most common are thiophanate-methyl plus mancozeb (Tops MZ), fludioxonil (Maxim), and fludioxonil plus mancozeb (Maxim MZ). Tops MZ at the 8oz rate/cwt, Maxim (8 oz/cwt), Maxim MZ (8oz/cwt), or liquid Maxim (0.04 fl oz/cwt) have all been shown to provide good silver scurf control. The added use of mancozeb (MZ) with Maxim is recommended as a means to control spread of late blight on seed tubers/pieces and reduce the likelihood of the development of fungicide resistance. Research continues to investigate other seed treatments that may provide better control. The use of seed treatments does not allow the use of highly infected seed. In other words, while these seed treatments do a great job in reducing silver scurf, they will not prevent all infection of daughter tubers, particularly if the seed was highly infected.

Sanitation - Seed cutting and handling equipment should be cleaned and disinfected between lots to kill spores left behind from the previous lot when increasing seed tuber generations. Clean storage facilities well before the crop is stored. Plant material, debris, straw (straw is a favorite substrate for the silver scurf fungus), and dirt should be removed. Thoroughly clean with a detergent, steam wash, and disinfect the entire storage. Avoid carrying field soil into the storage on equipment after the storage is cleaned.

Harvest - Potatoes should be harvested as soon as skins have been adequately set. Leaving fields unharvested beyond skin set will encourage higher levels of infection in the field. Reduce the amount of soil going into storage with tubers. This can be a source of inoculum and will also restrict air movement around tubers, thus increasing humidity at the surface of the tuber.

Storage - Considerable silver scurf infection (complete storages) can occur in storage. How much disease develops depends on storage conditions, amount of infection on tubers when placed into storage, isolation on seed lots, and how long tubers are stored. The three basic tools of storage management are temperature, relative humidity and air flow. The wound healing or curing period is important for rapid suberization right after tubers are placed into storage. This includes high humidity (95%), optimum temperature (50-55 F) and good ventilation (up to 25 cfm per ton of potatoes) to avoid condensation. As a general rule, cooler temperatures, lower humidity, and adequate ventilation help reduce development of silver scurf in storage. Keep temperature and humidity at the lower range of the optimum conditions for the type of potato being stored (temperatures of about 38 F for seed, 42 F for table stock, 45 F for French fry processing and 50 F for potato chips). Modifying the storage environment does not eliminate sliver scurf development, and the major management tactic is to rely on knowing how much infection is in the potato crop and relate that to the length of time tubers will be stored.

Representative tubers from each seed lot going into storage should be assayed for silver scurf, particularly those likely to be stored for 4 to 6 or more months. This can be done by digging tubers just before vine kill from all seed lots planted and assaying for silver scurf. High infection lots can be placed together into the same storage whereas lots with little or no infection could be placed together in a separate storage. It is particularly important to sample in such a way to get a representative sample of the seed lot to provide the best information as to daughter tuber infection.

Knowing the amount of infection of all lots in storage can provide significant information as to how long they might be stored without large scale secondary infection. Research has shown that secondary infection on the tubers is not apparent in Russet Norkotah until the end of January, given a normal storage environment. This time period apparently is what is needed for the silver scurf infected areas on tubers that went into storage to produce spores that move through the pile via the air system, and infect new potatoes. Therefore even heavily infected (Russet Norkotah) lots can likely be stored until about that time. Low risk lots (those with little or no infection at the beginning of the storage season) can be stored as long as May or more, given a proper storage environment, but periodic evaluation of the storage and assaying for silver scurf levels is important.

In storages intended for long term storage, never open the storage and remove some tubers and then close the storage to return sometime later. Major losses have occurred in these situations apparently due to the dislodging of spores present on potatoes by equipment activity and then air currents from the storage air system serving to spread the pathogen throughout the pile.

The use of ozone, hooded ozone, hydrogen peroxide and chlorine dioxide products has not been consistently effective in controlling silver scurf in storage. The biological products, *Bacillus subtillus* (Serenade) and *Pseudomonas syringae* (BioSave 10 LP) are registered for silver scurf suppression and could be a management consideration when storing organically produced potatoes.

Future management possibilities - For the last several years researchers at Oregon State University, Washington State University and University of Idaho have been looking at how to manage silver scurf in storage. At least one product (azoxystrobin) has been shown to be highly effective when very small levels are applied in small amounts of water as the tubers are going into storage. The use of fludioxonil in storage is also being evaluated to provide a mixture of effective materials to reduce the likelihood of developing resistance. An IR-4 program is currently underway to test residue levels and hopefully a new product, will be registered for this use in the near future. This would be for commercial growers only. Currently, post-harvest applications of azoxystrobin and fludioxonil are NOT registered for use on potatoes.

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Time to Clean Up Cull Piles and Spills

In a recent edition of this newsletter (Volume VII No. 2) we discussed the importance of cull piles and spilled potatoes in disease and pest issues for the commercial crop. Cull piles and other waste potatoes pose little or no threat during the winter, but with the growing season underway and the crop starting to emerge, it is past time to clean up cull piles and maintain good sanitation around storages and other places where it might be tempting to pile culls. Some of the problems associated with cull piles, such as late blight, are community problems and must be handled by the whole community working together.

2007 Commercial Seed Lot Trial Information

Mark J. Pavek, WSU Pullman

Commercial potato seed samples are requested for the 2007 Washington Seed Lot Trial. Two to three hundred whole (single drop) seed is an acceptable sample size, or **50 lbs of 4 oz single drop seed**. This seed should not be treated with insecticide or fungicide. Seed tubers need to be uniformly small (not larger than 4 oz) because no seed cutting is done and a cup-type planter is used. A sample that represents the entire seed lot received is most desirable. Sampling the first (or last) 300 seed from the truck is not likely to provide a representative sample of the lot. Sample tags may be obtained by calling the Potato Commission at 509-765-8845.

Your assistance with collection and drop off of seed samples is needed. Seed samples may be taken to the WSU Othello Research Unit (509-488-3191), located on Booker Road ¼ mile south from State Highway 26 and about five miles east of Othello. For South Basin sample pickup and any questions regarding the seed lot trials, please call Mark Pavek at 509-335-6861 or Ed Driskill at 509-335-6859.

In the North Basin, one seed "drop-off" has been established. It is located at Qualls Ag Labs (Mick Qualls, 509-787-4210 ext 16) on the corner of Dodson Road and Road 4; come to front office between 8 am and 5 pm. Please call the numbers below to arrange additional pickup sites. Samples will be picked up at 2:00 pm the day before each planting date (below) to be included. Growers planting in early March should drop their samples off at the Othello Research Center or store the samples and call the numbers below for pickup. For all alternative pickup locations or questions please call Mark Pavek at 509-335-6861 or Ed Driskill at 509-335-6859.

The remaining seed lot planting dates for 2007 are:

3rd	**April 24**
4th (Late)	**May 8**

This year's virus reading of the seed lots will take place on June 12 and 26.

The 2007 Potato Field Day is scheduled for Friday June 29.