SILVER SCURF AND BLACK DOT

potatoes aartappels SA

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THE SILVER SCURF-BLACK DOT DISEASE COMPLEX

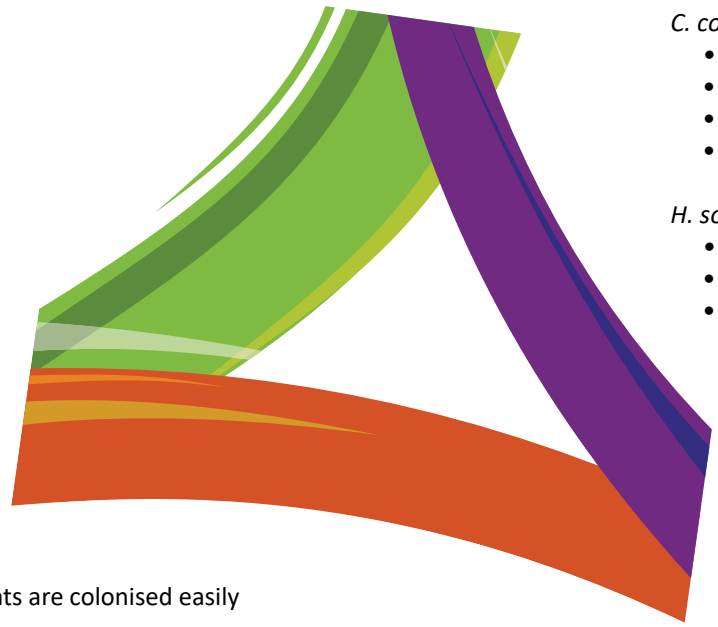
Silver scurf and **black dot** are currently regarded as the two most important post-harvest diseases of seed potatoes in South Africa. Silver scurf is caused by the fungal pathogen *Helminthosporium solani*, while black dot is caused by the fungal pathogen *Colletotrichum coccodes.* Since the conditions for disease development are similar for both diseases, they can occur simultaneously on tubers in the form of a significant disease complex known as silver scurf-black dot

Black dot was previously known as anthracnose.

The mycelium of both *H. solani* and *C. coccodes* grows in the cell layers just beneath the skin, causing the skin to separate from the underlying tissue, giving it a silvery appearance. The skin also tends to slough-off in sections, leaving an unattractive appearance resulting in increased skin permeability, which can lead to water loss and shrivelling of the tubers. The sprouting ability of severely affected seed tubers can be poor.

Although the disease is particularly problematic for seed producers, it also has a negative effect on consignments destined for the fresh produce market, since the appearance and quality of potatoes are affected. Tubers infected with silver scurf and black dot may also be more susceptible to other organisms such as soft rot (*Pectobacterium* spp.) and dry rot (*Fusarium* spp.).

DISEASE DEVELOPMENT



Pathogens

C. coccodes
- Is a weak pathogen
- Soil and tuber-borne
- Has numerous host plants
- Forms microsclerotia and spores

H. solani
- Is tuber-borne
- Limited to the potato
- Forms spores

Plant

- Weak/stressed plants are colonised easily under stress
- *H. solani* infects tubers only
- *C. coccodes* infects tubers, stems and roots
- Most cultivars are susceptible
- Tubers can be infected in the soil, as well as during harvesting and storage

Environment

- Disease complex develops at 20–30^{o}C and under humid conditions (RH>90%)
- Favourable conditions during the growing season in soil, as well as during storage

MANAGING THE RISK OF SILVER SCURF AND BLACK DOT

	RISK	MANAGEMENT
FIELD SELECTION	Soil contaminated with *C. coccodes*	As microsclerotia of *C. coccodes* have the ability to survive in the soil for up to eight years, it is important to limit the contamination of virgin soil. - Maintain a rotation programme of at least five years. - Ensure that rotation crops are not hosts to black dot. Non-hosts include maize, barley, rye and wheat. - Volunteer plants and weeds must be controlled in order to maintain the effectiveness of the rotation programme and to limit soil inoculum. - Plough potato debris post-harvest deep into the soil. It displaces inoculum away from the infection zone and promotes the decay of organic matter.
CULTIVAR CHOICE	Susceptible cultivars	- It is currently not known whether any of the popular cultivars are tolerant to silver scurf. and black dot.
SEED POTATOES	Contaminated seed potatoes	- Where possible, plant early-generation seed potatoes (G3 or G4). Keep in mind that Elite Class seed potatoes have a lower incidence of soil-borne diseases than Class 1 or Standard Grade. - Be sure to plant seed that was harvested immediately after foliage die-off and treated with a registered fungicide at low-volume. - The treatment of seed with a fungicide prior to planting is recommended.
PLANT-ING	Seed tuber rot prior to emergence	- It is important to avoid conditions that would delay emergence as rotting of seed infected with *C. coccodes* and *H. solani* could be promoted.
CROP MAIN-TENANCE	Weakened plants	- Every effort should be made to avoid conditions of stress, as plants weakened by a stress factor are more susceptible to *C. coccodes*. - Limit the incidence of diseases and nematodes by maintaining a balanced fertilizer programme and avoiding over irrigation.
HARVESTING	Conditions conducive to disease develop-ment	- Where there is a high risk of silver scurf and black dot, it is advisable to harvest the crop two weeks earlier than normal, as a means of limiting disease development in the soil. - In order to limit disease development do not leave tubers in the soil after the skin has set. - Dry tubers as soon as possible after harvesting to avoid humid conditions. - Seed potatoes should be treated with a low volume (2-3 litres /ton) registered fungicide as soon as possible after harvesting.
WASHING	Infection of tubers by soft rot pathogens	- Silver scurf and black dot cause the skin to separate from the underlying tuber tissue, hence the importance of tubers and the pack house sanitation. - Use a registered sanitizer on tubers and be sure to thoroughly dry all washed tubers before packing.
STORAGE	Spread of the disease complex in seed potatoes	- Disinfect the pack house and all equipment before harvesting commences. - Maintain good ventilation to reduce humidity. A uniform airflow within the stack, constant temperature control and the removal of excess moisture are essential. - Continuous monitoring of the stack for signs of decay is vital and immediate action must be taken in the event of decay being detected.

COMPARISON BETWEEN SILVER SCURF AND BLACK DOT

	SILVER SCURF (*Helminthosporium solani*)	BLACK DOT (*Colletotrichum coccodes*)
HOST RANGE	**Potato** - Potato is the **only** known host.	**Potato** - Potato is the most important host. **Alternative hosts** - Wide range of hosts, e.g. beetroot, eggplant, cabbage, canola, chrysanthemums, common blackjack, cotton, lettuce, lucerne, oats, pepper, soybean, sunflower, tobacco, tomato, and yellow and white mustard plants.
SYMPTOMS	**Tubers** - Light brown lesions with a shiny, silvery appearance. - On young lesions, the edges are usually darker due to spore development. - Contaminated tubers can be symptomless when harvested, with symptoms only developing at a later stage during storage.	**Tubers** - Tuber symptoms appear as a brownish-grey discoloration over a large portion of the tuber, or as a circular or irregularly shaped area. - Black dot may develop a silvery sheen colour during storage, which can easily be confused with silver scurf. - Inspection with a hand lens (10x) will quickly differentiate the regularly spaced black dots from the bunched threads of silver scurf. The small black dots in the lesions are microsclerotia and are visible to the naked eye. - Contaminated tubers can be symptomless when harvested, with symptoms only developing at a later stage during storage. **Stems, stolons and roots** - Microsclerotia are not restricted to tubers and can also be found on the stolons, roots and stems, both above and below the ground, late in the growing season and after senescence.
SURVIVAL	**Spores** - Research studies have shown that infected seed tubers are the main source of inoculum, particularly in fields with less than three years' rotation between potato crops. - Spore inoculum is unlikely to survive a rotation period of more than three years. - After harvesting, spores (conidiophores) are easily dislodged from infected tubers, where they can then move through the storage unit's air conditioning system to infect uninfected tubers. - Spores are also able to survive for short periods on contaminated wood, concrete and organic material. - Prevalent where sanitation is lacking or not up to standard. - Can be chemically controlled.	**Spores** - Prevalent where sanitation is lacking or not up to standard. - Spores can even survive for short periods of time on contaminated wood, concrete and organic material. - Can be chemically controlled. **Microsclerotia** - Serve as persistent survival structures. - Can survive under favourable conditions in the soil for up to eight years. - Can be chemically controlled, although with more difficulty than spores.

COMPARISON BETWEEN SILVER SCURF AND BLACK DOT

	SILVER SCURF (*Helminthosporium solani*)	BLACK DOT (*Colletotrichum coccodes*)
DISPERSAL	**Contaminated tubers** - Silver scurf is tuber-borne. **Plant debris** - Spores can only be dispersed through potato tubers. **Soil** - *H. solani* does not survive in the soil after the potato debris has composted in the soil. **Air** - Spores are dispersed by air currents.	**Contaminated tubers** - Black dot is tuber-borne. **Plant debris** - Spores can be dispersed through tubers, stems and roots. - The pathogen can grow and survive on dead plant material of all host plants **Soil** - *C. coccodes* is a soil-borne disease. - Microsclerotia can **survive in the soil for up to eight years**. **Air** - Spores are dispersed by air currents.

THE PATHOGENS

Helminthosporium solani (causing silver scurf)
Research has proven that *H. solani* spreads more rapidly on slightly diseased tubers than on severely diseased tubers after planting. Sporulation is also more abundant in new lesions than in old lesions. Planting untreated, lightly infected seed does not hold any advantages, as any small lesions would spread rapidly on the surface of the tubers after planting and eventually sporulate abundantly.

H. solani has the ability to sporulate profusely on newly colonised tissue under warm, damp conditions, which facilitates the spread of the disease while tubers are still in the soil, and particularly during storage. Conidia from sporulating lesions also cause new infections on the same tuber.

H. solani also has a secondary disease cycle, occurring during storage under conditions of elevated moisture (relative humidity >90%) and elevated temperature (optimum 21 - 27^{o}C).

Colletotrichum coccodes (causing black dot)
C. coccodes is a weak pathogen that attacks mainly plants that are stressed. When both silver scurf and black dot are present on the same tuber, *C. coccodes* competes unfavourably with *H. solani,* and black dot is therefore important if silver scurf is absent.

Although black dot is a weak pathogen, it has the ability to form microsclerotia, allowing it to survive in the soil for up to eight years in the absence of a suitable host.

The risk of black dot development increases as the level of soil inoculum rises.

Black dot is also found under waterlogged conditions caused by excess moisture, making irrigation scheduling essential where black dot is expected to occur.

The extent of disease development significantly correlates with the length of time tubers spent in the soil. If the soil is contaminated, crop duration should be shortened by harvesting earlier.

During storage, the symptoms will continue to develop, with lesions usually growing darker in colour. Lowering the temperature during storage will limit the development of black dot.

ASPECTS OF INTEGRATED PEST MANAGEMENT

Integrated management

Silver scurf and black dot can only be suppressed by an integrated management strategy combining several actions including long rotation, weed control, sanitation, chemical treatment and cultivation practices. Each grower must develop an individual management strategy, depending on the prevailing environmental conditions.

Being disseminated exclusively by tubers, silver scurf is readily manageable by treatment with fungicides. Black dot, however, is both seed and soil-borne and has a more extensive host range than silver scurf. Control of black dot by conventional chemical tuber treatment is therefore not as straightforward as in the case of silver scurf, and in most instances a comprehensive strategy is required for the production of a healthy crop. It should commence prior to planting and be continued with throughout production and storage. Any such strategy would have to be based on data relevant to the prevailing circumstances.

Seed potatoes

The maximum percentage seed potatoes that may be infected with black dot and silver scurf, permissible under the South African Seed Potato Certification Scheme, is:

Disease	Maximum percentage affected seed potatoes allowed									
	G0	G1-3			G4-6			G7-8		
		Elite	Class1	Std.	Elite	Class1	Std.	Elite	Class1	Std.
Silver scurf	0	0.5	2	30	5	15	30	10	20	30
Black dot	0	0.5	2	30	5	15	30	10	20	30
Max joint %	0	0.5	2	30	5	15	30	10	20	30

Soil management practices

H. solani is mostly restricted to seed and is unable to survive in the soil once potato debris has been removed or thoroughly composted. On the other hand, *C. coccodes* can survive in the soil on host debris or in the form of microsclerotia for a period of up to eight years.

Crop rotation with non-hosts is essential to circumvent black dot development. Crops that are non-hosts, and therefore good rotation options, include wheat, barley, rye and maize. Fields that are mono-cropped with potatoes or rotated with susceptible or host crops should be avoided. A number of these host crops are listed in the table on page 4.

Methyl bromide has proven to be effective against the disease, but the product is no longer available due to its negative impact on the environment. Solarisation and mouldboard ploughing to a depth of 30 cm have also been proven to reduce black dot, but due to the high costs involved, such practices are only feasible in cases where the soil is also infected with *Fusarium, Rhizoctonia* and *Verticillium*.

Harvesting

The time of harvesting is a crucial component of the integrated management of silver scurf and black dot. Symptoms become evident as early as 14 weeks after planting, increasing in severity as the growing season progresses. For this reason, foliage killing is advised as a means to induce maturity and thus enable harvesting as early as possible.

Wet conditions are highly conducive to the development of the disease, making it advisable to dry tubers as soon as possible after harvesting. As shown in the figures 1 and 2, local researchers found that the longer tubers are left in the soil after harvest, the more severe the infection with *C. coccodes* and *H. solani*.

Seed tuber treatment

Disease free or treated tubers are the essential foundation of an effective management programme. The planting of infected, untreated seed will result in infected progeny and in the case of black dot, will introduce the pathogen into the soil.

If conditions are favourable during storage, seed infected with either silver scurf or black dot will continue to develop disease, and for this reason the treatment of seed at harvesting is advised.

There are several fungicides registered for the treatment of seed against silver scurf and black dot. Low volume application of fungicides on the roller table is the recommended method to minimise the risk of infection and to treat large quantities of seed. Water volumes of between two and three litres per ton of tubers are recommended.

Storage management

Contamination of seed by black dot, and especially silver scurf, occurs very rapidly during storage, and pre-treatment with a fungicide is therefore essential (see information on seed health above). A clean, well-designed storage facility is crucial for maintaining tuber health during storage. Appropriate sanitary measures such as the removal of residues and soil have been known to reduce the severity of silver scurf.

Uniform airflow within stacks, temperature control and removal of excess moisture are essential, while positive ventilation to minimise condensation can significantly reduce the severity of silver scurf. Lowering the relative humidity and temperature has been proven to reduce the development of silver scurf and black dot.

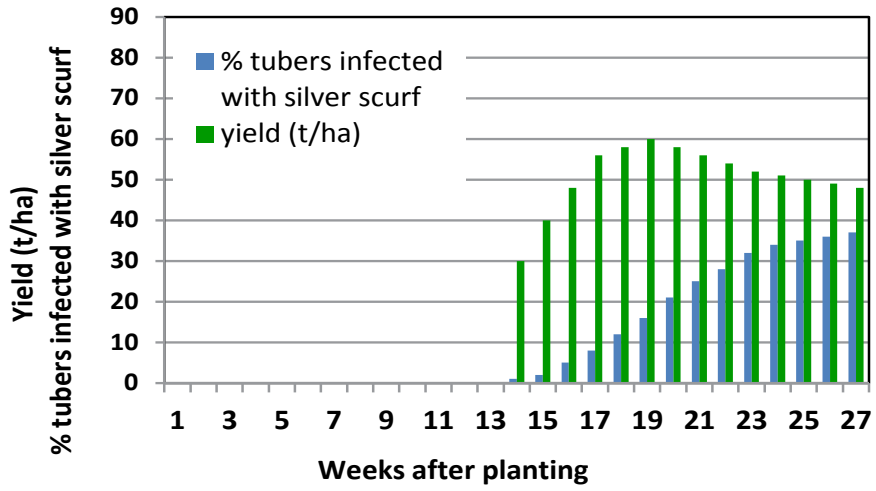


Figure 1: Potato tuber yield and incidence of silver scurf

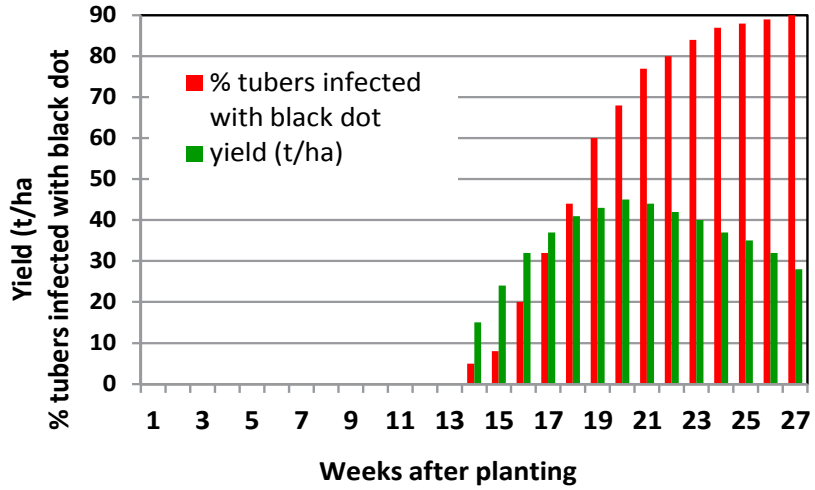


Figure 2: Potato tuber yield and incidence of black dot

SYMPTOMS

The disease complex causes a superficial blackish or silvery discolouration of the tuber skin, producing an unattractive appearance. It also increases skin permeability, which can result in water loss and shrivelling of the tubers. The typical silvery appearance on the surface of tubers when wetted is the result of the cell walls loosening in the periderm, forming many air pockets between the cells. The silvery sheen lesions are associated with mature sporulating lesions.

Black dot can be distinguished from silver scurf by the presence of microsclerotia that are found not only on tubers, but also the stolons, roots and stems (above and below the ground). Minute black dots, characteristic of the disease, are visible inside and on the surface of the stem at the end of the growing season.

REFERENCE

Potatoes South Africa. 2014. Final report: Black dot and silver scurf on potatoes in South Africa. www.potatoes.co.za/research/finalreports

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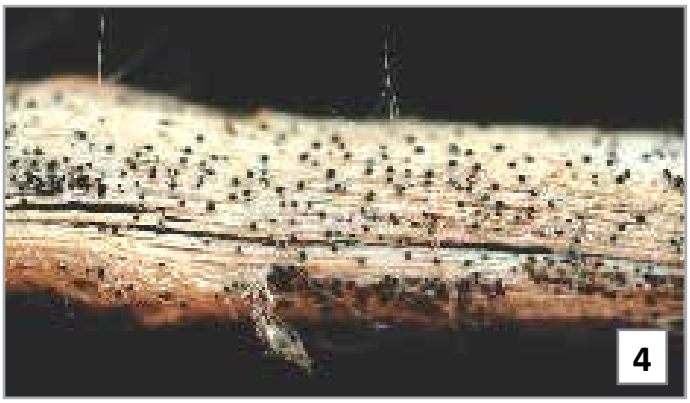
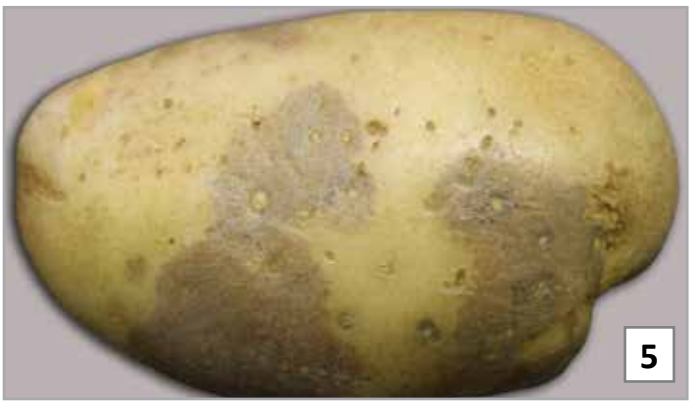
SYMPTOMS OF SILVER SCURF AND BLACK DOT





Black dot (1, 2, and 4)
Tuber symptoms appear as a brownish to grey discoloration over a large portion of the tuber, or as a circular to irregularly shaped area. The edges of the lesions are not clearly defined. The small black dots in the lesions are microsclerotia, visible to the naked eye. Black dot may develop a silvery sheen colour during storage, which can cause confusion with silver scurf. Microsclerotia are not restricted to tubers and can also be found on the stolons, roots and stems.

Silver scurf (5)
Light brown lesions with a shiny, silvery appearance.
On young lesions, the edges are usually darker due to spore development.

Infected seed tubers (3 and 6)
Silver scurf and black dot cause the skin to become permeable, resulting in shrivelled tubers. In severe cases, the skin separates from the underlying tissue during post-harvest handling.

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