TECHNICAL NOTE TN630 (Revised) / March 2025

Potato tuber diseases

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Summary

- **Serious losses can occur during potato storage if disease risk is not managed**
- **An integrated management approach is required, the disease triangle (host, pathogen, environment) is a useful framework**
- **Warm temperatures and free moisture promote many potato disease**
- **Most potato disease originate in the field, so management must begin there. However, some spread in store**
- **Regular monitoring and risk assessments should be carried out**
- **Fungicide treatments are available for control or reduction of some diseases**

Introduction

Many potato diseases are capable of degrading stocks during storage and losses to marketability can be substantial. Appropriate store management and proper storage conditions can dramatically reduce the risk of losses, and modern potato storage is much improved in terms of wastage compared with historical levels.

Nevertheless, many diseases may still cause significant economic harm and appropriate management should take place within an integrated pest management (IPM) framework. Integrated management involves selecting and coordination of prevention and control measures in a way that is specific to each crop.

In the context of potato tuber diseases during storage the disease triangle should be kept in mind:

Pathogen: Pathogen inoculum can be removed or reduced by strict hygiene and by assessing stocks that pose an infection risk which may be isolated or deemed too risky to store. For example, regular vacuuming reduces the number of fungal spores within a store. In some circumstances fungicides can be used as a control measure.

Host: Potato varieties differ in their resistance to diseases, and if possible, growers should select varieties that minimise risk. Consider the intended market of a given variety carefully; for example, resistance to blemish diseases will be of greatest relevance for crops destined for packing.

Environment: Next to hygiene, this is the factor over which the grower has the most control. Many (but not all) diseases are inhibited by dry and cold conditions. A well-managed store where condensation is avoided should reduce disease risk.

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Risk management practices

1. Practice good store hygiene
2. Assess the disease risk
3. Consider variety choice
4. Avoid damage
5. Avoid condensation
6. Ventilation judiciously, where appropriate
7. Use storage temperatures appropriate to the situation
8. Monitor stocks throughout the storage period

Some potato tuber diseases originate in the field, others can spread in store, and in some cases both routes of transmission are possible. There are several diseases that do not spread in store but can worsen in severity during storage depending on management. It is also common for secondary opportunistic infections, particularly by bacteria, to take hold and further degrade stocks.

Agronomic decisions in the field can have a large influence on disease risk and development, but these are not the main focus of this note. We will primarily discuss risk and management during the storage phase of potato production only.

	Cultural Control Measure								
Disease	Varietal Resistance	Minimise Damage	Harvest Early	Dry Curing	Low Holding Temp.	Rapid Temp. Pulldown	Store Hygiene	Chitting	Long Rotation
Blemish diseases									
Black Dot	✔	-	✔	✔	✔	✔	-	-	✔
Silver Scurf	-	-	✔	✔	✔	-	✔	-	-
Black Scurf		-	✔	-	-	-	-	✔	✔
Skin Spot	✔	-	✔	✔	-	-	✔	-	-
Tuber rots									
Bacterial Soft Rot	✔	-	-	✔	✔	✔	✔	-	-
Watery Wound Rot	✔	✔	-	✔	✔	-	-	-	✔
Dry Rot	✔	✔	-	✔	✔	-	✔	-	-
Gangrene	✔	✔	-	✔	-	-	✔	-	-
Tuber Blight	✔	-	-	-	-	-	✔	-	-

Risk Assessment

Each disease within this guide has risk factors associated to it. If a stock is judged to have one or more of these factors, there is an increased risk of disease development. The presence of symptoms within a stock is a very important (an obvious) risk factor for all the diseases listed – note that even in the case of diseases that do not spread in store, diseased seed tubers may present a risk to daughter crops.

There are no firm thresholds for disease risk to potato stocks. It is generally recommended that samples are taken from stocks, washed, and examined for presence and severity of disease. Larger samples increase confidence in disease detection, but 100 – 200 tubers for every 20 tonne of stock is a rough guideline.

Not all diseases are visible during such inspections – latent infections by some pathogens (*Polyscytalum pustulans* which causes skin spot for example) may be present. Samples should be hot-boxed to assess risk of progressive disease development. Diagnostic methods are available from plant clinics such as microscopic inspection of potato eyes or the use of molecular methods such as qPCR which can help in assessing the risk of latent infections.

Correct diagnosis

Correctly diagnosing which disease is present is important as it allows appropriate management options to be taken. Some diseases with similar symptoms may require different management strategies. If in doubt, seek advice from a BASIS qualified agronomist or submit samples to a plant clinic for assessment.

Types of disease

Bacteria, viruses, fungi, and fungal-like organisms (oomycetes) are all important disease-causing agents in potato plants. However, diseases can also be classified pragmatically based on their relevance to store managers. This note groups diseases into three categories – **blemish diseases, dry rots,** and **soft rots**.

Along with disease, there are also physiological defects and mechanical injuries that can cause reductions in marketability. Damage is often a precursor to some diseases, so taking care with handling is very important.

Blemish diseases – these are diseases that cause degradation of a tubers visual quality and are usually restricted to the tuber periderm (skin or surface layers).

Black Dot

Black dot is caused by the fungus *Colletotrichum coccodes* and appears as silver lesions on potato skins. This is a very important disease for pre-pack ware potatoes as the lesions reduce marketability. The disease is very easily confused with silver scurf. Black dot lesions tend to be darker and have a less regular shape than silver scurf lesions. The two diseases can be differentiated by examining lesions with a hand lens. For black dot, distinctive small back microsclerotia (after which the disease is named) can be observed.

Black dot is predominantly a soil borne disease favoured by wet and humid conditions. Infection occurs in the field, and plant parts other than tubers can be infected. Microsclerotia can sometimes be observed on the residual stems of potato plants following haulm destruction.

The disease probably does not spread from tuber-to-tuber in storage, but symptoms can develop and worsen significantly depending on storage conditions. The black dot fungus can survive on plant debris and as microsclerotia in the soil. Many agricultural soils in potato production regions are infested. Cropping history can be a good guide for risk, and there are some soil tests available to quantify inoculum levels.

Exposure to infested soil is a key risk factor; black dot is more of an issue in long-season crops or in fields that have had a close rotation. Reducing crop stress by ensuring adequate water and nutrient provision makes plants less susceptible to many diseases including black dot. Soil applications of azoxystrobin (applied in-furrow) have proven effective in field trials. Some trials have demonstrated a reduction in black dot from seed treatment with fluxapyroxad and fludioxonil. The tuber treatment products Honesty and Maxim 100FS have label claims for reduction in black dot.

The most important factor limiting disease development in store is temperature – black dot lesion expansion is slower at cooler temperatures. Where a stock is judged to be at risk of black dot it may be sensible to pull down to holding temperatures rapidly following loading (by circa 0.5°C per day).

Silver Scurf

Silver scurf is a fungal disease caused by the pathogen *Helminthosporium solani*. It causes silvery lesions that superficially resemble and are very frequently confused with black dot. Silver scurf lesions are frequently lighter and shiner in appearance when compared with black dot and generally appear to be more circular. Reliable differentiation between the two disease requires a hand lens.

Under magnification conidiophores of *H. solani* are usually visible on silver scurf lesions; these present as thread or fern-like structures. Sporulation is promoted by humid conditions, and silver scurf lesions can sometimes appear to be covered in fine black soot.

As well as the potential for rejection by end markets, silver scurf can lead to desiccation of tubers as the lesions damage potato tuber periderm. This is a particular problem in stores with high ventilation rates.

Field trials suggest that *H. solani* does not survive for extended periods in the soil in the absence of a host, so extending crop rotations is an important control measure. The disease is thus predominately seed borne; planting infected tubers is a risk to the daughter crop, so a seed treatment may be appropriate.

The best approach to management is selection of resistant varieties, high health input seed, and seed treatment. If using a seed treatment the most appropriate treatment time is shortly following harvest of the seed tuber crop. Low storage temperatures will slow, but not prevent, spread and development.

It is important to remember that silver scurf spreads in store. Warm and moist conditions will enhance spread, so efficient drying and judicious hygiene are key control measures. Stores where heavily infected stocks have been stored may merit disinfection following unloading.

Black Scurf

The soil inhabiting fungus *Rhizoctonia solani* causes several diseases and defects in potato – the pathogen infects plants pre-emergence and can cause both stem and stolon pruning and stem canker. Daughter tubers can suffer from growth distortions. *R. solani* is thought to be one of the causal agents of a rough-russeted skin condition termed elephant hide. All these conditions can affect yield and marketability. *Rhizoctonia* infection is more likely in cold wet soils where emergence is slow.

Stem cankers can be visible during the growing season, and in severe cases can cause stunting and wilting of plants.

The most economically damaging issue associated with *R. solani* is black scurf; black or brown structures called sclerotia that adhere to the tuber surface. Marketability for both ware and seed potatoes is affected. There are several different strains of *R. solani* which are known, for technical reasons, as anastomosis groups (AG). Not all AGs cause black scurf; most cases in potato will be AG-3.

R. solani can be carried by seed tubers and can also infect from the soil. For tuber borne inoculum, the presence of black scurf, even at small amounts is enough to justify an appropriate seed treatment. Black scurf is sometimes hard to detect on unwashed tubers, so a thorough inspection is always required. Fungal hyphae can survive on tubers even where there are no black scurf sclerotia – laboratory tests are available to aid detection.

In the field, agronomic practices that accelerate emergence (planting date, chitting, good soil structure, etc.) reduce *Rhizoctonia* risk. Distribution of the fungus is uneven and aggregated within fields – soil testing is technically possible, but rarely carried out. Cropping history is a reasonable indicator of risk, but the pathogen has a wide host range which can complicate planning.

Black surf on tubers develops following haulm destruction, so if crops can be harvested early or a method that produces rapid stolon detachment such as haulm pulling is used then the risk is reduced. Most pre-planting potato seed treatments have *R. solani* as their main target. In-furrow fungicides can be used if soil borne risk is high. The disease does not spread in store.

Skin Spot

Skin spot is a fungal blemish disease caused by the pathogen *Polyscytalum pustulans*. Skin spot presents as clusters of small, raised spots on the tuber surface, often dark in appearance and gathered in groups. If spots occur within tuber eyes then buds can be killed, leading to patchy emergence if tubers are used for seed.

Better hygiene, storage practices, and use of seed treatments have reduced the incidence of this disease, but some varieties such as Rooster and Kind Edward are susceptible and outbreaks occur in a few stocks each season. The disease is favoured by cold and wet conditions, or situations where harvest has been delayed. Heavier clay soils are higher risk than sandy soils.

Crops that are lifted wet and then stored in cool conditions are at a higher risk. The disease has a very long latent period, and infected tubers appear symptomless at harvest. Symptoms usually appear after circa two to three months of storage and worsen over time. Early lifting, ventilation, and dry curing are effective countermeasures in such circumstances.

The disease is mainly seed borne, but *P. pustulans* can survive in plant debris or as long-lasting sclerotia in the soil, so long crop rotation is an important management tactic.

Several seed treatments have activity against the pathogen. Treatment at store loading rather than pre-planting has generally been more effective, but either should

should reduce transmission.

P. pustulans produces small spores that can be present in store dust. Spread during storage is an issue for this disease. High levels of store hygiene are required, particularly if a store has held an infected stock recently.

Other blemish diseases

Common scab (caused by bacteria of the genus *Streptomyces*) and powdery scab (caused by the pathogen *Spongospora subterranea*) are both very important disease of potato that cause serious loss in marketability for both seed and ware potatoes. Neither spreads in store, although sporeballs of *S. subterranea* can cross-contaminate between stocks and cause infections in the field, so good hygiene and disinfection of grading lines are recommended. These diseases infect in the field, and storage conditions have little impact on them. Both common and powdery scab require specific management strategies in the field beyond the scope of this technical note.

There are several other rarer blemish diseases such as charcoal rot (*Macrophomina phaseolina*) and Violet Root Rot (*Helicobasidium purpureum*), but these are not commonly encountered. Long rotations and field history are useful indicators of risk.

Dry rots – these are progressive rots of potato tubers that usually cause damage to internal tissues. These rots tend to be firm, although secondary infections, particular bacteria, can cause further breakdown.

Tuber Blight (Late Blight)

Tuber blight is caused by the oomycete (fungus-like) pathogen *Phytophthorainfestans*. Tuber blight and foliar late blight are both caused by the same pathogen, and late blight within the growing crop is a risk factor for tuber blight, although the disease can occur even if little foliar blight was observed in the field.

There are no approved seed treatments that are effective against tuber blight. If found, the disease has very serious implications as whole stocks can be lost.

Tubers that are blighted have irregularly shaped orange-brown or purplish lesions visible on their surface. The lesions extend into the underlying tissue which has a grainy light brown appearance. Bacterial soft rotting frequently follows tuber blight.

Proactive crop protection measures in-field, including resistant varieties, and a robust fungicide programme (for conventional crops) are required to reduce the risk of tuber blight.

The disease develops rapidly in store, so prompt action is required. Affected stocks should be isolated and ventilated. Blighted stocks should be moved on as soon as possible – regular inspections should be performed to assess disease progress.

Fusarium dry rot

Several species of the soil inhabiting fungi *Fusarium* can cause dry rot in potato. Dry rot causes large irregularly shaped lesions that are frequently accompanied by wrinkled skin around the lesion edge and white pustules on the lesion surface. The disease is frequently confused with gangrene.

When tubers are cut internal lesions can be observed which are usually brown, without a well-defined edge between healthy and diseased tissue. It is very common to see cavities lined with mycelium. However, symptoms can be quite diverse, and it is very common for soft rotting bacteria to overrun the initial infection.

The disease tends to develop about a month into storage. Some varieties are prone to infection, but because there are several different species of *Fusarium* that can cause the disease variety selection can be difficult. The different species can also differ in how aggressive they are (i.e. how rapidly disease develops).

Damage to the tuber periderm is a prerequisite for infection. The disease is often encountered in stocks that have been lifted before skin set is complete, or where damage has occurred during harvest or grading.

As damage is so important to infection, proper wound healing via dry curing will reduce the level of disease ingress. Care in handling tubers and delaying harvest until skins have completely set also reduce potential disease levels. Disease development is slowed by cold storage.

Planting seed tubers with dry rot infection increases the risk of blackleg; emergence is also likely to be poor and uneven.

Varieties differ in their susceptibility to dry rot, but because there are several species that cause the disease it is not always straight forward to select a resistant variety.

Seed treatments are an option for dry rot control provided application is timely, but the situation is complicated due to the unknown resistance status of local pathogen populations.

Gangrene

Gangrene is a fungal disease caused by the pathogen *Boeremia foveata* (previously known as *Phoma foveata*) and related pathogens. Gangrene presents as a progressive firm rot which is commonly confused with dry rot.

Symptoms of gangrene can be diverse, but it generally presents as dark sunken “thumb print”-like external lesions – these often have an wavelike margin. Internally the extent of lesions can vary greatly, but they are usually very dark or grey with a distinctive margin between diseased and healthy tissue. Cavities are also sometimes present.

The pathogen produces small spores called pycnidia that contaminate soil, store dust, and seed tubers. Infected or contaminated tubers give rise to latently infected stems. Rotting mother tubers also contribute to inoculum that threatens daughter tubers.

Most infection with gangrene occurs following wounding, so harvest is a critical period for control and reduction. Low temperatures favour the disease, both at harvest and during storage. As with dry rot, waiting until tuber skins have fully set, wound healing, and careful handing are important cultural control measures.

When plant stems are latently infected, senescence triggers the production of spores, so reducing crop stress and early haulm destruction should reduce diseases pressure on daughter tubers. Varieties differ in susceptibility, but there is limited information on rankings.

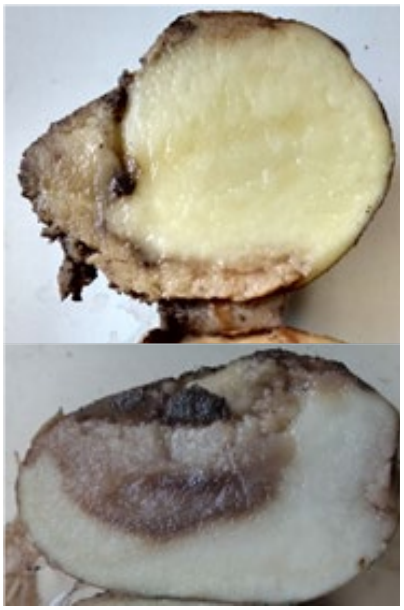
Seed treatments post-harvest many reduce disease development in store.

Other firm rots

Several weak pathogens can cause rots in potato tubers given conducive circumstances. A grouping of defects called pit rot are sometimes seen where there is poor ventilation or from crop harvested from wet areas of fields.

Soft Rots – soft rots are progressive rots where tubers lose their integrity, and are often associated with ooze that can spread infection (particularly in the case of bacteria). Such rots are difficult to manage, but stocks can sometimes be salvaged if action is rapid. For these diseases, ventilation to mummify rotting tubers is a prudent course of action.

Bacterial Soft Rotting



Usually caused by the bacteria *Pectobacterium atrosepticum* or *Pectobacterium carotovorum* in Great Britain and Ireland, bacterial soft rotting is one of the most important factors causing post-harvest losses for potato production. The bacteria that cause this disease produce enzymes that liquefy tuber tissues. If the rot becomes extensive enough, tubers collapse and can contaminate neighbouring tubers.

Soft rotting tubers have a wet cream or tan coloured appearance. Affected lesions are soft and sometimes with a granular appearance. The edge of the rotten area is very sharply defined, and infected tissue can easily be removed by washing.

Bacterial soft rotting is also a very common secondary infection following late blight or dry rot. Bacteria can be present latently on tubers and infect opportunistically. Pectobacterium atrosepticum is the main causal agent of blackleg in the growing crop, so contaminated tubers are a risk. Tests to assess levels of bacteria contaminating seed tubers are available.

Soft rotting bacteria are promoted by free moisture and by warm conditions. Any situation which allows their populations to multiply will increase the risk that soft rotting develops. Wet harvests and poor ventilation are key risk factors. Avoiding condensation in store should also decrease risk.

Creating an environment this is unfavourable for bacterial multiplication is very important, so low holding temperatures and ventilation are both key control factors. There are no approved plant protection products.

Varieties do differ in their susceptibility to soft rots, but information on relative rankings is scarce.

Watery Wound Rot

Also known as Pythium leak, watery wound rot is a disease of increasing importance for potato production, with sporadic, but serious outbreaks occurring most seasons. The disease is soil borne and is caused by the fungus-like pathogen *Pythium ultimum* and closely related species.

Affected tuber tissue is often spongy and wet but does not fully macerate initially as with bacterial soft rot (though bacterial rotting often follow watery wound rot). The affected tuber often has blister-like lesions that leak fluid after a small amount of pressure is applied. Internal tissues have a cheesy texture with a dark boundary line between healthy and diseased tissue.

The fungus is a common inhabitant of agricultural soils, so the disease is a soil borne issue. Note on field records if the problem has been encountered. The disease requires wounds to enter, so damage during harvest and bruising increases risk of infection. Recently, there have been unconfirmed reports of infection pre-harvest, but this has not been well researched.

Warm temperatures at harvest are a key risk factor (circa 20°C) so wait for cooler conditions to lift crops if possible. Differences in varietal susceptibility are not well understood. There are no approved chemical control measures in GB.

Other soft rot diseases

Pink rot (*Phytophthora erythroseptica*) is a soil borne disease that is favoured by similar conditions (hot and dry seasons) to watery wound rot. The soil inhabiting fungus *Geotrichum candidum* can sometimes cause a disease called rubbery rot in waterlogged conditions.

Using a seed treatment

Options and restrictions on seed treatments have changed substantially since the publication of the previous version of this note (Burnett and Oxley, 2010). Most importantly, there are now no approved chemical control measures that can be used to treat ware potatoes. In fact, fungicide treated potatoes cannot be used for either human consumption or as stock feed.

When treating seed tubers there are different restrictions for different products, and it is important that you consult the relevant label before use. For example, Maxim 100FS (fludioxonil) can be used on seed tubers that will be used to plant crops for consumption and seed tubers grown to produce seed for export markets only.

Seed treatments fall broadly into two categories – post-harvest and at grading. Post- or at harvest treatments are generally aimed at preventing disease development during storage. Imazalil and thiabendazole are the two actives approved for this usage in GB. Treatments applied at grading are used to promote health in the follow crop and for some diseases may offer protection to daughter tubers.

Where fungicides are used pre-planting, the best timing is usually close to time of planting but before sprout development. Most products specify on labels that sprouted seed tubers should not be treated.

	Into store		Pre-planting			
Disease	Storite Excel (thiabendazole)	Gavel (imazilil)	RhiNo (flutolinil)	Maxim (fludioxonil)	Serenade (biological)	Honesty (fluxapyroxad)
Blemish diseases						
Black Dot	-	-	-	✔	-	✔
Silver Scurf	✔	✔	-	✔	✔	✔
Rhizoctonia Black Scurf	-	-	✔	✔	-	✔
Skin Spot	✔	✔		(✔)	-	(✔)
Tuber rots						
Bacterial soft rot	-	-	-	-	-	-
Watery wound rot	-	-	-	-	-	-
Dry rot	✔	✔	-	(✔)	-	(✔)
Gangrene	✔	✔	-	(✔)	-	(✔)
Late blight	-	-	-	-	-	-

✔ = Label claim for control or reduction
(✔) = Evidence of a reduction within field trials

Fungicide resistance

There is very limited information on fungicide resistance for the pathogens detailed in this guide (apart from for the field phase of *Phytophthora infestans*).

Historically, some resistance to thiabendazole has been detected in *Helminthosporium solani* (silver scurf), *Polyscytalum pustulans* (skin spot), and some (but not all) of the Fusarium species that cause dry rot. Resistance to other fungicides is found in other regions. The current prevalence of resistance in most potato tuber pathogens is not known for the United Kingdom and the Republic of Ireland.

There are some resistance management steps that should always be taken when using seed treatments. These include:

1. Only using a fungicide where there is a genuine need, following an appropriate risk assessment.
2. An integrated approach is used, where cultural methods such as dry curing, store hygiene, and ventilation are used in conjunction with a fungicide.
3. Minimise the use of the same fungicide actives in consecutive years. This is challenging with seed treatments as the number of available actives is small, again highlighting the importance of an integrated approach.
4. More information can be found at the FRAC and FRAG websites.

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