SoilWealth NURTURING CROPS

Integrated Crop Protection PROTECTING CROPS

AUGUST 2019

Image adapted from Hannukkala, Asko. (2011). *Examples of alien pathogens in Finnish potato production - Their introduction, establishment and consequences.* Agricultural and Food Science. 20. 42-61. 10.2137/145960611795163024 under Creative Commons Licence Attribution 4.0 International

MANAGING THE RISK OF POWDERY SCAB

This guide is based on current available knowledge on the management of Powdery Scab. It highlights the key factors that affect the risk of powdery scab and opportunities minimise the risk factors.

THE PATHOGEN AND THE DISEASE

Powdery scab is caused by the protozoan *Spongospora subterranea*. It is the main vector of Potato mop top virus (PMTV) which is high on the list of biosecurity threats (see the Potato Growers Biosecurity Manual available from the Farm Biosecurity website). The pathogen can survive for long periods in the soil (> 10 years).

Powdery scab is both seed and soil borne. The occurrence and severity of symptoms can vary widely depending in a range of factors, including inoculum level on soil or on seed and weather conditions. The disease can result in major losses of marketable yield of fresh market crops and substantial rejections after peeling for processing.

Tubers with powdery scab lesions are particularly susceptible to various other diseases. The 'scabs' possibly act as an infection point for other pathogens.

Powdery scab has been implicated in increasing the susceptibility to tuber late blight (*Phytophthora infestans*), pink rot (*Phytophthora erythroseptica*), dry rot (*Fusarium caeruleum*) and tuber rot caused by *Colletotrichum atramentarium* (Harrison et al. 1997).

Symptoms

- Early root infection by the pathogen is invisible to the naked eye
- Later, infection may lead to root galling and tuber lesions
- Root galls are small white growths of callous tissue on the plant roots
- Tuber lesions are well-known symptoms which are often confused with common scab
- Plants may develop tuber lesions but not root galls and vice versa
- Depending on temperature and progeny, tuber infections may take 6 to 8 weeks to develop and thus may not be evident in the growing crop.

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FACTORS THAT HELP POWDERY SCAB INFECTION

Potato crops are especially susceptible during the tuber initiation phase and under the below mentioned conditions.

Temperature	Infection can occur at temperatures as low as 9°C. Range 9°C – 17°C. Optimum around 12°C.
Moisture	Soil moisture is the main influencing factor for infection. Free moisture is required for infection; it enables zoospores to swim to potato roots. Alternating saturated (wet) and unsaturated (dry) soil conditions as well as constant saturated conditions support infection.
Soil pH	Infections are only slightly greater in alkaline soils than acid soils.
Soil drainage	The risk of powdery scab is greater in poorly drained soils. Hardpans or general compaction increase the powdery scab risk.
Tillage	Excessive use of tillage to create a fine tilth compacts soil. It then then drains poorly (saturates) which increases the powdery scab risk.
Soil type	Powdery scab has been recorded in all soil types. However, there is insufficient evidence from research to make a judgment on the effect of soil type on disease. Heavier soils might lead to higher levels of diseased plants. This may be due to their commonly poorer drainage.

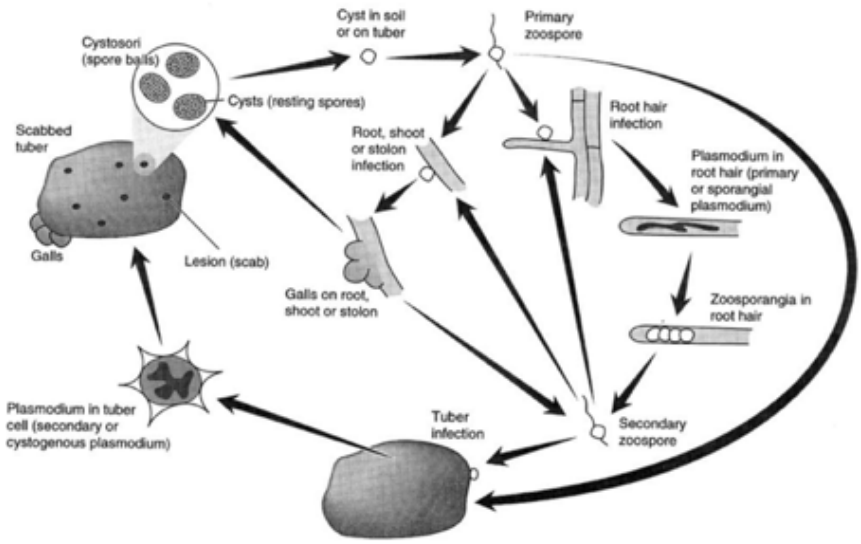

Figure 1: Diagram of lifecycle of powdery scab from Harrison JG, Searle RJ, Williams NA, 1997. Powdery scab disease of potato – a review. Plant Pathology 46, 1–25.

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Factor	Risks	Actions to manage the risk
Market	Markets with zero tolerance for powdery scab, e.g. certain seed export markets or fresh/ ware potato markets.	**Check your customer / intended markets' tolerance to powdery scab levels. Use low risk land for markets with tighter tolerances.** • Powdery scab tolerances are tight for seed and ware markets; some markets dictate zero tolerance for any sign of the disease. Powdery scab is an impediment to opening up new overseas markets or expanding existing ones. • Wash seed samples and inspect as required.
Variety	Highly susceptible varieties.	**Check varietal resistance to powdery scab with your seed supplier.** • Knowing your varieties' resistance ratings for powdery scab along with intended market tolerances can help with paddock selection and agronomy (esp. irrigation). • Variety resistance can be used to reduce both occurrence and severity of powdery scab. However, in seasons conducive to disease development, variety resistance will have a lower impact.
Seed Health	Infected seed particularly when planted in uncontaminated land.	**Use certified seed. Use disease free seed when planting into uncontaminated land.** • Powdery scab is more prevalent in cooler and wetter areas, but that there is little evidence of a consistent relationship between seed tuber inoculum and progeny crop disease. Using powdery scab infected seed risks contaminating disease-free soil.
Farm Hygiene		• Removing infected tubers from seed lines does little to diminish the risk posed by remaining tubers as resting spores will be in soil residues on remaining tubers. • Control weeds and volunteer potatoes • Do not transfer soil from paddock to paddock • Do not allow contractors and visitors with dirty machinery, shoes and vehicles onto paddocks

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Factor	Risks	Actions to manage the risk

Site Selection and Rotation	Previous field history of powdery scab. Volunteers. Solanaceous weeds. Poor drainage. Close rotation.	**Consider paddock disease history when developing a rotation plan. Use PreDicta PT DNA testing to assess risks.**
		Avoid tight rotations (< 5 years) and control volunteers and weeds to minimise disease build up.
		Plant at soil temperatures above the optimum for infection. This results in quicker growth and less chances for infection
		• Field history is a good indicator of the likely risk of daughter crop infection from the soil.
		• Plant high risk crops (based on varieties or market) on uncontaminated and well drained land with uninfected seed.
		• To minimise the build-up of soil inoculum, ensure:
		  • good farm hygiene
		  • using uninfected, certified seed
		  • long rotations
		  • good irrigation and nutrition management

Soil Conditions	Cold wet soils (particularly at tuber initiation). Compaction evident. Poor soil management e.g. excessive cultivation/ tillage.	**Ensure good soil structure to maintain free draining soils, minimise cultivation/tillage to reduce compaction.**
		Ensure a good seed bed to promote rapid even emergence.
		Try biofumigation.
		• Avoid soils that are compacted (>2000 kPa with a penetrometer at field capacity) consider introducing controlled traffic
		• Use of elemental sulphur (S) and keeping zinc Zn at the upper end of its soil range have produced some positive results in the Ballarat region in the Central Victorian uplands.
		  • Results with Zn applications have been highly variable. Routine soil testing will indicate whether Zn fertiliser applications may help. High levels of phosphorus can reduce Zn uptake.
		  • Caution with S use is required as applications may cause nutrient imbalances and significant decrease in soil pH.
		• Biofumigation using mustards have shown positive results when combined with less susceptible cultivars and clean seed.
		• Drain paddocks that have large areas prone to water logging
		• More information on good soil management can be found at www.soilwealth.com.au

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Factor	Risks	Actions to manage the risk
Growth	Protracted tuber initiation period in cold soils with either seed or soil inoculum. Over irrigation / poor drainage during tuber initiation.	**Avoid water stress, especially during tuber initiation.** **Avoid over irrigation, especially of susceptible varieties.** • Good seed and soil management may help reduce crop stress (see other factors). • Schedule your irrigation to minimise risk of water logging • Monitor soil moisture and keep it below field capacity (FC)* during tuber initiation • Be aware that the risk of powdery scab infections will increase after excessive rainfall. • Ensure good drainage, soil structure, general hygiene and biosecurity on farm. • Planting tubers shallower in the ridges may help reduce risk as do other practices that encourage rapid emergence **This is sometimes seen as conflicting with management for common scab where a good soil moisture is recommended. This is not necessarily the case. Soils should be kept moist (between FC and above the wilting point but without excess moisture). If water runs from soil after irrigation or can be squeezed out of a soil sample, or it is like playdough, it is above field capacity.*

Grading	Grading uninfected seed stocks without cleaning and disinfection, after infected ware or seed stocks.	**Wash and evaluate samples of all stocks intended for grading to know whether they are infected.**
		Grade seed stocks before ware stocks.
		Give priority to higher seed grades.
		Wash / disinfect grading lines at appropriate times during grading, between lines/ crops.
		Fully wash down and disinfect grading lines at the end of each season (at least).
		• Spore balls can be carried on grading lines and be transmitted on to subsequent healthy seed stocks which could infect the daughter crop.
		• Possible grading strategies to help reduce the spread of seed-borne powdery scab are:
		  • Ranking all your stocks. Work with the healthiest first. Taking opportunities to clean the grader.
		  • After grading an infected stock, clean and disinfect the grader before returning to healthy stocks

Store Hygiene	Dusty stores. Poorly managed forklift traffic.	**Ensure strict store hygiene is in place with your seed supplier – check it out!** • Dust in potato stores can be contaminated with powdery scab spore balls; they can be transmitted on to clean tubers in poorly cleaned stores (e.g. by forklift traffic).

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CHEMICAL CONTROL

In the US, the active ingredient fluzinam can be used for powdery scab control under a permit. In Australia, this active ingredient is only registered for control of Late Blight and Sclerotinia in potatoes. **Do not use unregistered pesticides or use pesticides for uses not specified on the label. Always follow label instructions.**

ACKNOWLEDGEMENTS

This factsheet has been adapted from:

- the factsheet "Managing the risk of powdery scab" produced by a British Potato Council factsheet (https://potatoes.ahdb.org.uk/sites/default/files/publication_upload/Managing%20the%20risk%20of%20powdery%20scab_0.pdf)
- Horticulture Innovation Australia final report: Clayton-Greene, K. (2015) *A review of knowledge gaps and compilation of R and D outputs from the Australian Potato Research Programs.* PT13013 (https://ausveg.com.au/app/data/technical-insights/docs/pt13.PDF).

REFERENCES AND FURTHER RESOURCES

Potato Growers' Biosecurity Manual (2018): https://www.farmbiosecurity.com.au/wp-content/uploads/2019/06/Potato-Growers-Biosecurity-Manual.pdf
Dr Calum Wilson (TIA, UTAS) discussing powdery and common scab - video - https://youtu.be/ryHPrvWcF8o
Dr Richard Falloon - *Spongospora subterranea* root infection reduces potato plant growth and tuber yields (http://www.appsnet.org/publications/Darwin_Presentations/Wednesday%20Presentations%20_WF2/Richard%20Falloon.pdf)
2013 Potato PreDicta Pt manual (ed. M Rettke, SARDI) [provided as part of PREDICTA Pt Training/Accreditation Course]

A number of final reports can be found on the AUSVEG website (https://ausveg.com.au/infoveg/infoveg-database/) and the Hort Innovation website (https://www.horticulture.com.au/delivery-partners/resources-for-delivery-partners/research-reports-and-more/).

1996 PT303 Epidemiology and control of powdery scab in potatoes
https://ausveg.com.au/app/data/technical-insights/docs/PT303.pdf
2003 PT96032 Influence of rotation and biofumigation on soil-borne diseases of potatoes
https://ausveg.com.au/app/data/technical-insights/docs/PT96032.pdf
2004 PT98018 Cleaning and disinfestation strategies on farms
https://ausveg.com.au/app/data/technical-insights/docs/PT98018.pdf
2008 PT04001 Understanding the implications of pastures on the management of soil-borne diseases of seed potatoes - https://ausveg.com.au/app/data/technical-insights/docs/PT04001_complete.pdf
2014 PT09039 (https://ausveg.com.au/app/data/technical-insights/docs/PT09039.PDF)
which includes the following APRP2 programs: PT09026- Soil health disease mitigation program, PT09026A(i) - Soil amendments and nutrients, PT09026(ii) - Impact of rotations, PT09019 - Comparison between DNA testing and visual methods for assessing seed tuber health
2018 PT14002 *Spongospora* infection of potato roots – ecology, epidemiology and control
https://ausveg.com.au/app/uploads/technical-insights/PT14002v2.pdf

Harrison JG, Searle RJ, Williams NA, 1997. Powdery scab disease of potato – a review. Plant Pathology 46, 1–25.