PINK ROT – PROJECT UPDATE

Pink rot, mainly caused by *Phytophthora erythroseptica*, is a true potato specialist. At first glance this should make it easier to manage. However, the pathogen's long-lived oospores, which can survive in soil for up to 7 years, reduce the effectiveness of crop rotations. Dr Jenny Ekman reports.

THE IMPORTANCE OF PINK ROT

Pink rot loves a wet year. The disease is likely to thrive under the current La Niña conditions, being most active in wet soils between 15 and 25°C.

There are also reports pink rot may be developing tolerance to common fungicides (e.g. metalaxyl). Moreover, the key processing variety Russet Burbank has a long maturation time, making it particularly susceptible to this disease.

These factors may explain why pink rot has risen in importance, especially over the last 3-5 years, and particularly in northeast Tasmania. In this area losses can be up to 30%, despite regular fungicide application. Even if disease rates are low, rotten tubers must be detected and eliminated before storage and processing, adding cost.

For some growers, pink rot is now their most challenging disease. Heavily infected paddocks may yield only 25 t/ha; with 45-56 t/ha required just to break-even, this effectively takes entire paddocks out of potato production.

Unfortunately, symptoms often only appear as the crop approaches maturity. Rotting at the crown area can cause infected plants to wilt and collapse. The tubers develop blackened areas, rubbery feel and a distinctive, highly unpleasant smell. When cut open, the rotten area oxidises, producing the key diagnostic pinkish colour (Figure 1).

MANAGING PINK ROT

Dr Robert Tegg from the University of Tasmania, together with Professor Calum Wilson from TIA, SARDI researcher Michael Rettke, and soil scientist Dr Bill Cotching, have been trying to find ways to manage this devastating disease.

In 2009, American research at the University of Utah (Benson *et al.*, 2009a and 2009b) suggested that a pH of 7.0 or higher, together with high levels of available calcium, could significantly inhibit infection of root and stolon tissue by *P. erythroseptica.* However, this research was conducted using a hydroponic system. It also did not follow infection through to mature plants and tubers. IThis made it unclear whether similar effects would be observed under field conditions.

The Hort Innovation project "Investigating soil pH and nutrition as possible factors influencing pink rot of potatoes – a pilot study" was initiated to investigate this research.

Key project aims were to:

1. Examine the impact of soil pH and calcium formulations in field (and pots) on pink rot development
2. Investigate the impact of landform and soil structure
3. Identify knowledge gaps and opportunities from reviewing literature and discussions with industry

The project was timely, as there had been little Australian research on pink rot disease control since SARDI research back in the 1990s.

Figure 1. Pink rot in tubers. Source: R. Tegg

ROT RECONNAISSANCE

The project started with a series of field surveys. Paddocks with a known history of pink rot were surveyed around Sisters Beach, Sassafras, Scottsdale and the Midlands in Tasmania.

Assessments included:

- Pathogen detection using PREDICTA Pt
- Soil chemistry, with a focus on calcium and pH, but also other nutrients
- Soil structure and depth, including variation across paddocks
- Incidence of disease

Analysis of 19 field sites over two years found pH ranging between 5.2 to 6.6 at planting. This sits within the range of pH 4.8 to 6.5 which is normally recommended for potato production. pH tended to decrease slightly during cropping, falling by 0.1 to 0.6 points by harvest.

In season 1, soil calcium treatments such as nanocal (liquid calcium supplement) and calciprill (ultra-fine calcium carbonate) were tested for effects on disease incidence.

"Calcium treatments tended to maintain or slightly raise pH of the soil," commented Dr Tegg." However, they didn't really reduce pink rot disease. Despite this, there were minor yield increases in some cases and, in Season 1, application of nanocal tended to reduce the incidence of hollow heart."

Tasmanian soils used to grow potatoes are primarily ferrosols. These are highly buffered, making it extremely difficult to alter pH. An enormous volume of lime, or other alkaliser, would therefore be needed to increase pH to above 7.0.

"I think we can say that raising pH or adding calcium are definitely not silver bullets for pink rot," concluded Dr Tegg "but there may be other benefits from regular applications of calcium to the soil".

PINK ROT AND SOIL QUALITY

While this result may have been disappointing, the research team identified a number of other soil factors that do influence occurrence of pink rot. This involved using Dr Bill Cotching's expertise in scoring soil quality, assessing its interconnected chemical, physical and biological properties.

According to Dr Cotching, soils that score 4 or less – as shown on the scorecard in Figure 2 – are less suitable for horticultural production than soils with a score of 9 or 10, which have high organic matter and good structure.

Dr Cotching also examined topsoil depth, soil profile changes and topography.

The data confirmed that pink rot can flourish in damp areas of the paddock. In the example shown in Figure 3, 400 tubers from 20 plots on the sloping or low areas of the paddock were assessed for incidence of pink rot. Five plots from the low area had high incidences of disease, whereas the team found only one diseased tuber in one plot on the sloping area.

"This effect of topography is what we expect from pink rot," commented Dr Tegg. "Another site that we sampled had a very boggy area that we assumed would not be planted to potatoes. However, when we returned 4 weeks later, it had been planted. The result was early dieback, significant pink rot, and essentially downgrading of that paddock with much of the crop thrown out."

While topography is important, topsoil depth and quality may be an even better guide to the likelihood of pink rot in some circumstances. This may

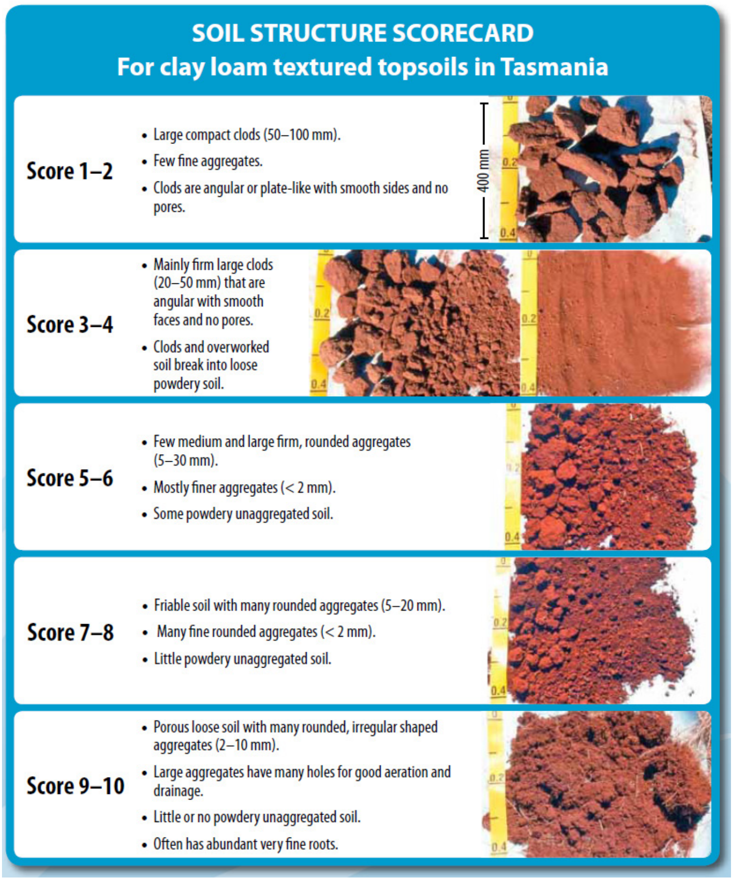

Figure 2. Dr Bill Cotching's soil quality scorecard (Source: soilquality.org.au/factsheets/soil-structure)

Figure 3. Low areas of the paddock (shown pre-planting at left, and at crop maturity at right) were more likely to stay damp, increasing development of pink rot. Source: R. Tegg.

mean that a flat area with good quality soil is likely to be less susceptible to pink rot than a well-drained, but eroded slope.

For example, the flat area of one paddock sampled at Sisters Creek had 40cm deep topsoil and a soil structure score of 8. In contrast, the headland area was eroded and compacted, the topsoil being only 25cm deep with a soil structure score of 3-4. The lower soil quality score correlated with increased pink rot, early dieback occurring on the headland area (Figure 4).

The team even drilled down to the level of individual rows. Where twin rows are inconsistent height, the smaller mounds have less soil depth and will tend to stay wet for longer in between irrigation events (Figure 5). "Unfortunately, in the smaller mounds, we saw a greater likelihood of pink rot. That was one finding from the work that was obvious across many different paddocks that we surveyed," stated Dr Tegg.

Intersects between rows, where they run at 90° to each other, are another area with increased risk. This can occur due to blockage of water running down one set of rows, causing pooling at the intersection (Figure 6).

Figure 4. The high quality soil in the flat area of this paddock (top) produced an excellent crop, whereas plants growing on the degraded area near the headland (bottom) died prematurely due to significant pink rot. Source: R. Tegg.

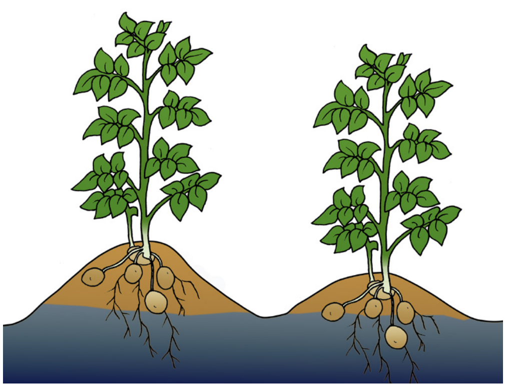

Figure 5. Where pairs of rows are uneven heights, the smaller mounds may have increased risk of pink rot.

Figure 6 (below). There is a greater risk from pink rot where rows intersect at right angles, such as where headland rows cross downward rows. Source: R. Tegg.

USING PREDICTA PT FOR PATHOGEN DETECTION

As well as measurements of soil attributes, regular samples were taken for qPCR detection of the pink rot organism with the PREDICTA Pt service.

PREDICTA Pt provides a reliable indication of risk for a range of pathogens (e.g. powdery scab, black dot) and nematodes.

Unfortunately, pink rot is harder to detect in the soil, and results are not always a good guide to the likelihood of infection.

The pathogen was rarely detected before planting. However, as the soil warmed and irrigation was applied, pink rot was found more frequently. This suggests that pink rot populations in soil fluctuate widely during the growing season, so both sampling strategy and timing are critical for detection.

The other finding is that intensive sampling is needed to be sure of detecting the pink rot pathogen. Current Predicta Pt sampling protocol advises analysing 4 separate samples, each compiled from 30 subsamples taken in a "W" pattern, for a paddock larger than 10ha. However, new modelling by SARDI suggests that at least 10 separate, composite samples are needed to be 90% confident of detecting pink rot within a paddock.

The requirement for a large number of samples, combined with the low probability of detection prior to planting, may make testing uneconomical and impractical in some situations.

QUESTIONS FOR FUTURE RESEARCH

While the research has revealed much, questions remain:

- When is the best time to take soil samples for pink rot detection and risk assessment?
- Is there a way of enriching the soil sample to increase chances of detection?
- While other crops e.g. carrots, cereals, perennial ryegrass are potential hosts for pink rot, do they support the pathogen's full lifecycle?
- To what extent do volunteers during crop rotations contribute to risk of pink rot in temperate areas?
- How does pink rot interact with other pathogens?
    - Potatoes can be infected by powdery scab, *Rhizoctonia* and *Sclerotinia* as well as pink rot – does infection by one of these organisms make the plant more susceptible to the others?
    - What are the potential interactions with bacteria and/ or nematodes?
- Can EM38 mapping identify areas which are more likely to be susceptible to pink rot?
    - These may then be left fallow or planted with an alternative crop such as corn.
- What new or alternative chemistry may become available for management of pink rot?

KEY POINTS

- Calcium amendments and pH modification are very unlikely to offer a practical way to manage pink rot
- Soil characterisation and site analysis can be an effective way to assess risk
- Pink rot is difficult to control, and will require multiple management strategies
- Factors associated with increased risk of pink rot include:
    - Damp conditions in low lying areas
    - Over-irrigation or unseasonal rain, especially late in the season
    - Shallow topsoil and/or poor soil structure
    - Soil compaction, such as in the headlands
    - Short mounds, especially where the neighbouring mound is taller
    - Intersections between rows which prevent water from draining
    - Damage to plants by the irrigator, tractor or windy conditions

PT19000 - Investigating soil pH and nutrition as possible factors influencing Pink Rot in potatoes – a pilot study has been funded by Hort Innovation, using the Potato - Fresh and Potato - Processing research and development levies and contributions from the Australian Government. Hort Innovation is the grower owned, not-for-profit research and development corporation for Australian horticulture.

Hort Innovation Strategic levy investment
POTATO – FRESH FUND

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