Bacterial Ring Rot of Potato

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Foliage Symptoms

- wilting, starting at lower leaves and at first recovering at night.
- rolling of leaf margins.
- interveinal leaf chlorosis and necrosis.
- milky exudate expressed when lower stem is cut and squeezed.
- dwarf rosette characterized by short internodes (some cultivars only).



Tuber Symptoms





External

- dark blotches under skin
- sharp, jagged surface cracks exposing decayed tissue





- rot in vascular ring at stem end, initially cream coloured but later light to dark brown
- cheesy cream-colored exudate expressed from vascular tissue when pressure applied
- corky tissue formed around hollows in decayed vascular ring

What causes ring rot?

It is caused by a bacterium, *Clavibacter* sepedonicus

- they are small
- they achieve high densities
- they are robust
- each cell is an infectious unit



How does BRR develop?



Drawing from Potato Health Management. R.C. Rowe, ed. APS Press

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The Disease Cycle



Two possible ways to get ring rot

Possibility 1

From latently infected seed tubers

VERTICAL SPREAD

Possibility 2

From external contamination

HORIZONTAL SPREAD

Vertical spread – Latent infection

- Occurs as a result of infection during a previous season.
- Detect by visual inspection of the growing crop and harvested tubers. Complement visual inspection by lab test.
- Prevent by making sure that seed is free from BRR.

Horizontal spread – from external source

- Seed tubers come in contact with a BRR inoculum source.
- BRR survives a long time when dried on surfaces.
- Prevent by sanitation: cleaning and disinfecting (or replacing) all possible contaminated surfaces.

Possible sources of BRR infection (Means of Horizontal Spread)

Biological sources and vectors

- Seed tubers
- Cull piles
- Field
 - Volunteer plants
 - Potato debris
- Insects
- Animals
- People
 - Boots
 - Gloves
 - Pocket knives

Equipment and other surfaces

- Seed cutter
- Planter
- Conveyer
- Bin piler
- Storage bins
- Trucks
 - Wheels
 - Trailer compartment

Where did the inoculum come from in the first place?

Either : It came from an off-farm source,

Or: It persists at a low level on the farm site.

BRR spread among production units

Horizontal spread

 sharing of equipment
 contaminated trucks

Vertical spread

 purchase of infected seed

BRR spread among farms



Off-farm sources of ring rot

- Infected seed potatoes bought from another farm.
- Infected culls brought on-site as cattle feed.
- Un-cleaned commercial trucks or other contaminated equipment brought on farm.
- By man or animals from neighbouring, infected tablestock or processing crops.

Persistence on farm site

 Insufficient clean-up after ring rot occurrence - gradually builds up again spread by equipment.

 Maintenance of a low level of infection (latent) on farm - short generation time flush through but back infection - spread by equipment.

Finding ring rot on a farm

 Visual inspection - limited sensitivity due to latent infections, success varies with variety and growing conditions.

 Lab tests - better sensitivity than visual, but still limited sensitivity due to sample size and test factors.



Laboratory test detection

Undetected

Purpose of lab testing

 Lab testing is done to detect infected BRR plants or tubers that do not show symptoms of the disease (ie. Latent infections).

2. Lab testing can NOT be used to detect contamination from an external inoculum source.

Sampling of stem or tuber tissue

Diagram 1: How to collect a stem section.



Note: The stem section appearing here is drawn to scale: the real sample should look approximately the same (adjust length depending on the diameter to get a sample of 0.5 - 1.0 g.)

m Stem section

Diagram 2: How to take a core from a tuber.



Note: The core in this diagram is drawn to scale.

The ELISA Test

- Detects the soluble slime produced by the BRR bacteria.
- Most useful as a screening test.
- Positives need to be confirmed by a second test.



The IMF Test

- Detects individual BRR bacterial cells.
- A tedious procedure useful for limited number of samples.
- Permits visualization of the actual BRR pathogen.



The PCR test

- Detects a fragment of the BRR bacterial DNA.
- Has a high level of sensitivity.
- Must avoid crosscontamination and false negatives due to inhibitors.

Conventional PCR



Real time PCR



Accuracy of lab tests

Depends on:

- 1. Precision of test
 - Screening test
 - Confirmatory test
- 2. Quality of the sample

What to expect from lab tests

Greatest limitation is sample size:

Sample size Disease incidence Probability of detection

400	0.1%	33%
1000	0.1%	63%
2000	0.1%	86%
5000	0.1%	99%

Randomness of ring rot is assumed. Disease incidence of 0.1% is 1 plant or tuber in 1000, or about 30 plants/hectare, or about 8 tubers/tonne.

Sample size required for a 99% probability of detection			
Incidence detected	Sample size		
5.0%	100		
2.0%	300		
1.5%	400		
1.0%	500		
0.5%	1000		
0.2%	2400		
0.1%	5000		

Sampling Criteria

- Sample must be representative
 - assumes unclustered distribution of disease
 - samples to be taken randomly

• Sample size

- depends on level of infection to be detected
- determines probability of detection
- probability of detection is independent of population size

Random distribution of diseased plants at 1% level (red) and 5% level (yellow)

Non-Random distribution of diseased plants at 1% level (red) and 5% level (yellow)

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 Ring rot is randomly distributed in a lot; each plant is equally likely to be infected.

 Is the assumption more true for small lots than it is for big lots ?????

What can testing do?

- Testing CANNOT prove that a potato lot is free from ring rot.
- Testing is an extension of visual inspection.
- Testing sensitivity is limited by sample size and the laboratory test.
- Positive test result indicates, with a high level of certainty, that ring rot is present.
- Negative test result indicates that there is no infection OR that the level of infection is below detection level.

Components of successful ring rot control

Thank you

Any questions