The Potential for Bacteriophage to Control Soft Rot Development in Store

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WHAT ARE BACTERIOPHAGE?

- The most abundant organisms in the world ($10^{31}$ on Earth)
- Naturally abundant in soil, water, sewage, animals
- Act as natural antimicrobial agents, with different bacteriophage being specific to different hosts
- Completely harmless to the surrounding environment
- Key benefits: their **specificity**, **safety**, **biodegradability** and **rapid** mode of action
BACTERIOPHAGE LYTIC LIFECYCLE
HOW DO WE ISOLATE BACTERIOPHAGE?

1. Bacterial Isolation
2. Enrichment
3. Isolate Lytic bacteriophage
   - Screened for broad range activity and accepted or rejected
4. Scale up
ADVANTAGES OF BACTERIOPHAGE

- Safe: naturally-occurring (food, water, soil etc)
- Highly specific: will not infect beneficial bacteria or other organisms
- Zero non-target risks and environmental residues
- Applicable to both mainstream & organic agriculture
- The right mix of bacteriophage is highly effective, continuing to work long after chemicals have lost their potency
The challenge: developing an innovative, sustainable and environmentally-sound bactericide treatment that is applicable across the potato industry.
A first bacteriophage-based processing aid for fresh produce, targeting only the harmful, rot-causing *Pectobacterium* & *Dickeya* bacteria & and providing significantly greater control than existing chemical products.

- A bacteriophage mixture covering up to 90% of rot-causing bacteria isolated, with regular monitoring of the mix efficacy.
BIOLYSE® DEVELOPMENT: POTATO SOFT ROTS

Washer barrel tubers

Biolyse® treated tubers

Washer barrel tubers

Biolyse® treated tubers

Washer barrel

Biolyse® mist pre-packing (5 nozzle spray bar each @ 0.065 L/min)

Water spray post washer barrel
BIOLYSE® DEVELOPMENT: POTATO SOFT ROTS

Untreated | Water rinsed

Reduced shelf-life failures, depot rejections & customer complaints
INDUSTRY SHELF-LIFE DATA

Logan Estima
(Phage+7 days)
Crombie Desiree
(Phage +2 days)
Site A: four-year shelf-life failure data, comparing untreated & Biolyse®-treated tubers at day 6 after packing

Customer complaints due to “off”/”rotten”/”mouldy” have halved since the introduction of Biolyse®
OPTIONS FOR BACTERIOPHAGE APPLICATION
TREATMENT AT PLANTING: PILOT DATA

- **Method:**
  - Desiree seed (low natural inoculum) was damaged & inoculated with water or Pba (10^7 cfu/ml) & left to dry
  - Treated with phage (10^6, 10^7 & 10^8 pfu/ml) or water spray
  - Planted as normal

- **Assessment:**
  - Emergence (no diff.)
  - Blackleg levels (12% to 3%, 1%, 0%)
  - Stem number (no diff.)
  - Yield (no diff.)
  - Rots (no diff.)

This work is ongoing as part of an Innovate UK Agri-Tech Catalyst project.
Variety: Lanorma, with much of the stock rotting in store (4 x 10^8 cfu/ml Pectobacterium spp.)

Pba from rotting tubers showed 70% susceptibility to a phage mix

Following grading, 'cleaner' tuber samples were phage treated, bagged in groups of 50-70 & placed in cold store (n = 20 per treatment).

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Bacteriophage have significant potential for the specific control of spoilage pathogens of fresh produce.

The variability of plant pathogens complicates issues and requires a mixture of bacteriophage to provide sufficient pathogen control.

For soft rots in potatoes, a bacteriophage mix (Biolyse®) is in routine use by the packing industry and microbiological evidence of lower bacterial counts following Biolyse® treatment is backed up by both industry and retail customer data.

Soft rot control at other points in the growing cycle are actively being investigated, including treatments aimed at reducing the overall pathogen loading of seed.

Storage applications are potentially very interesting; work is required on application method/timing.
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