

# Early Blight

## THE PROBLEM

Early Blight is a fungal disease primarily caused by *Alternaria solani*. It has become a significant and growing threat to New Zealand potato crops, causing notable yield losses, premature defoliation, and driving increased fungicide use.



### Polycyclic Disease

Multiple infection cycles per season allow rapid epidemic development under favourable conditions

### Weather Patterns

Warm, dry intervals alternating with humid or wet periods promote spore production and infection

### Crop Stress

Low nitrogen, drought, and damage increase susceptibility as *A. solani* targets weakened foliage

### Fungicide Resistance

Reduced use of multi-site protectants and heavy reliance on single-site fungicides is driving resistance

### Limited Control Options

Non-chemical alternatives poorly understood and not integrated into practice

### PNZ Response

- ✓ Literature review of the disease with a focus on control measures
- ✓ Field trial to evaluate the efficacy of various fungicide combinations

# Alternatives for Alternaria Project

## OBJECTIVE

### 1. Evaluate Alternatives

Identify and evaluate alternative crop protection products that are effective against Early blight

### 2. Assess Programmes

Assess the effectiveness of crop protection programmes that utilise these alternative options

### 3. Support Development

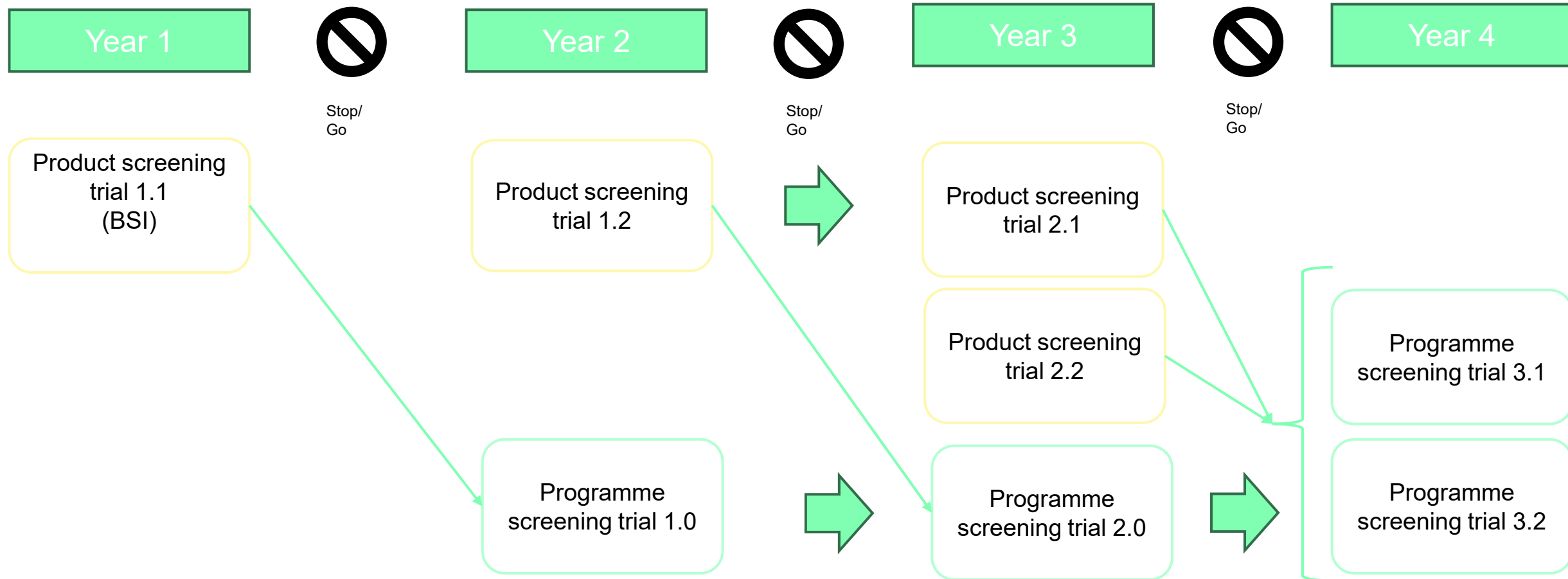
Support product development to increase grower availability of control options

### 4. Drive Adoption

Encourage grower uptake of new control options through demonstration events, extension activities



# PROJECT METHODOLOGY



Potatoes New Zealand Inc.  
*Growing together*

# Evaluating Biocontrol on Potato Early Blight

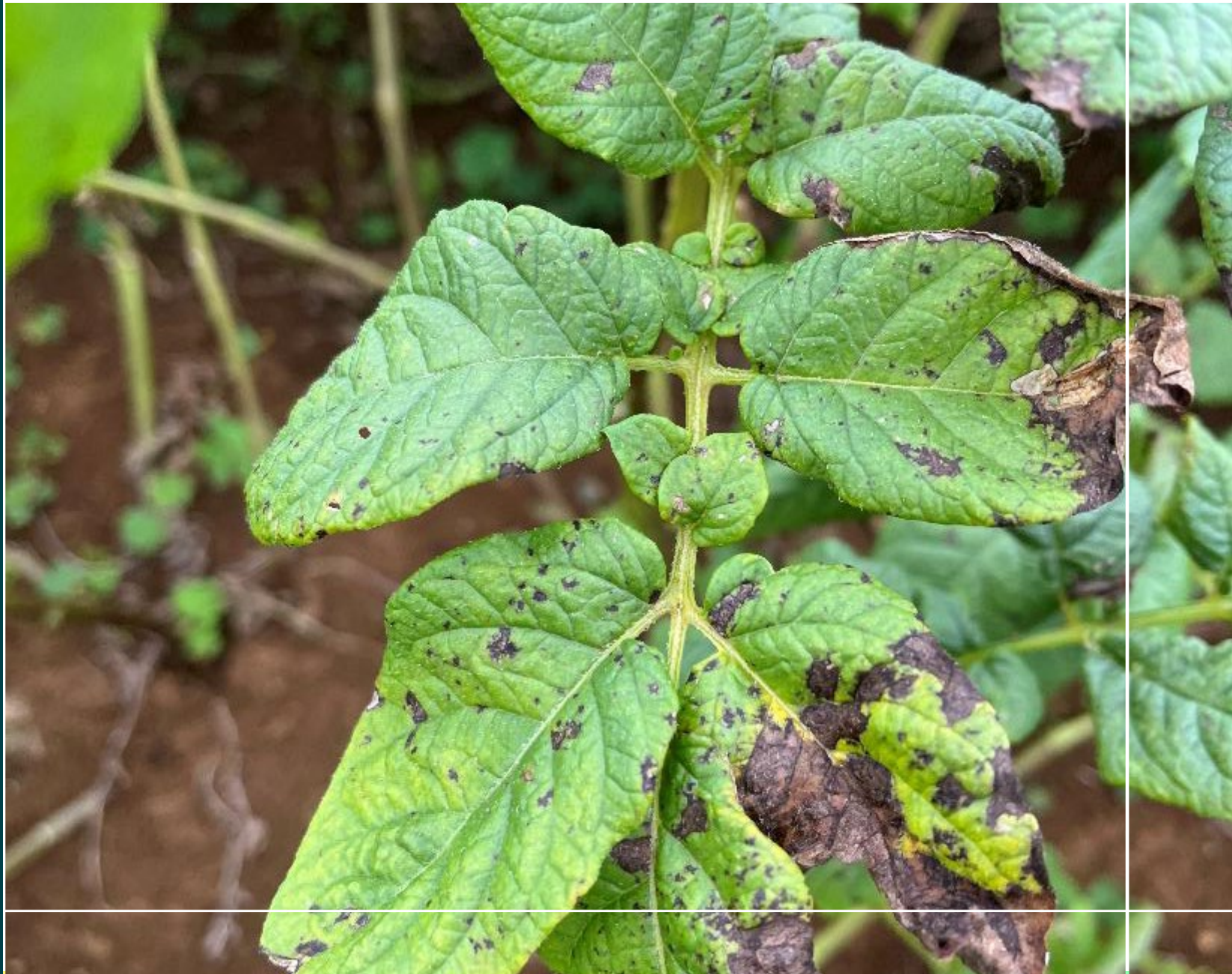
Peter Wright

Bioeconomy Research Institute

Pukekohe

Potatoes New Zealand Agronomy Summit

6 August 2026



# Why Biocontrols to Manage Diseases and Pests?



- Biological control agents (BCAs) offer a promising, eco-friendly alternative to synthetic pesticides.
- BCAs are target-specific, biodegradable, and pose minimal risk to humans and non-target organisms.
- As a cornerstone of Integrated Disease Management (IPM), BCAs not only help suppress pathogens but also reduce the risk of fungicide resistance.

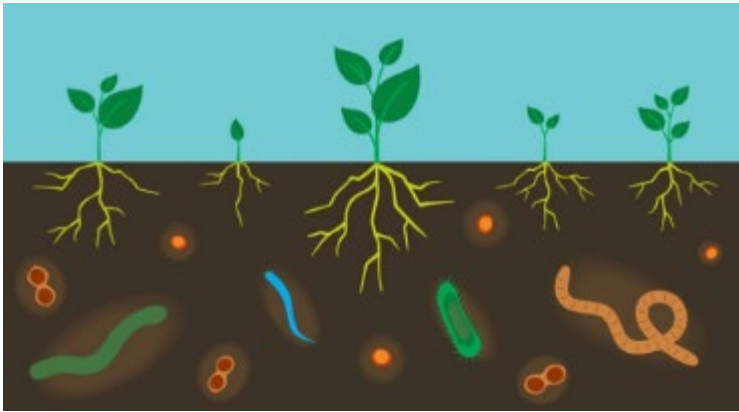
The **objective of this research** was to study the effects of:

- Chitin
- Chitosan
- *Trichoderma* spp.
- *Bacillus subtilis*

Individually, and in combination, on early blight incidence and severity, potato growth and tuber quality characteristics.

# Chitin

- Derived from crustacean shells.
- Successfully used to help manage several horticultural diseases.
- Chitin is a food source for chitinase-producing bacteria and fungi (such as *Streptomyces*, *Bacillus*, *Serratia*, and *Aeromonas*).
- Once the applied chitin is consumed, this massive army of chitinase-producing microbes look for other chitin sources in the soil.



21% Chitin and Humic and Fulvic Acids

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- They aggressively break down the cell walls of pathogenic, root-rotting fungi and the protective shells of pest insects and nematode eggs.
- Chitin can also stimulate plant defence responses, enhance root development, and promote overall plant growth.
- This naturally suppresses soil-borne diseases without chemical pesticides - and result in healthier crops and increased yields.



21% Chitin and Humic and Fulvic Acids

# Chitosan

- A natural sugar polymer made by removing acetyl groups from chitin.
- Used as a foliar treatment to control the growth, spread and development of many plant diseases.
- Including: Early blight (*Alternaria solani*), brown leaf spot (*Alternaria alternata*), late blight (*Phytophthora infestans*).
- Chitosan has multiple effects including
  - Triggering plants' natural defence mechanisms against pests and diseases.
  - Enhancing plant growth.
  - Boosting stress tolerance.
  - Influencing plant nutrition by improving soil fertility and microbial diversity.



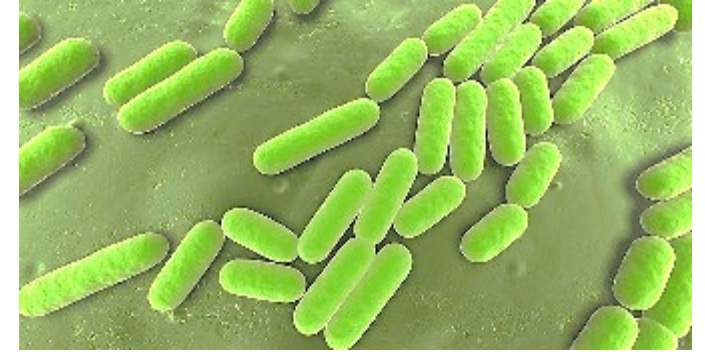
# Trichoderma

- *Trichoderma* soil application suppresses diseases and increases crop yield through multiple mechanisms.
- Directly attacks pathogens via cell-wall degrading enzymes (mycoparasitism).
- *Trichoderma* competes with pathogens for nutrients (competition).
- Directly attacks pathogens via enzymes and antibiotics (antibiosis).
- Induces systemic resistance (ISR) by priming the plant's own immune system (induced resistance).
- Overseas research demonstrated that *Trichoderma viride* reduced early blight incidence and increased potato yields.



# *Bacillus subtilis*

- *Bacillus subtilis* is a well-known plant growth-promoting rhizobacterium (PGPR).
- Produces plant growth hormones like auxins and gibberellins to stimulate root and shoot development.
- Colonizes root surfaces and forms protective biofilms that block harmful microbes from finding space or food.
- Secretes antimicrobial compounds that disrupt the cell membranes of harmful fungi and bacteria (antibiosis).
- Primes the plant's natural immune system to respond faster and stronger against future infections (induced resistance).
- *B. subtilis* is labelled on several products for managing potato early blight in the Northeastern U.S.



# Trial Details

- Conducted in summer/autumn of 2026 at the Te Ahikawariki Vegetable Industry Centre of Excellence (VICE).

## Tested BCA products

- Chitin - Flamingro™; 21% chitin; Bay Nutrients Limited.
- Chitosan hydrochloride PB3; derived from *Aspergillus niger*; BSI.
- Chito-oligosaccharide PB4; derived from *Aspergillus niger*; BSI.
- *Trichoderma* spp. – Agrimm Technologies Ltd.
- *Bacillus subtilis* - Serenade® Prime & Serenade Optimum®; Bayer NZ.



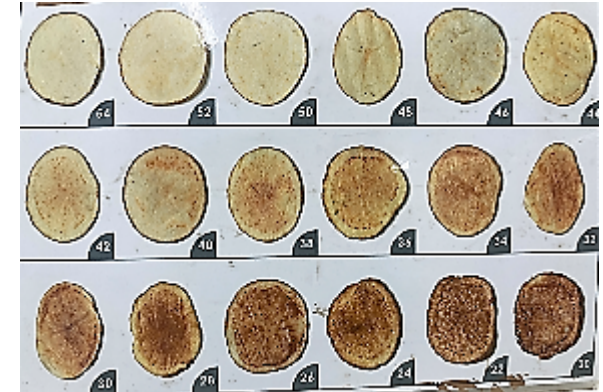
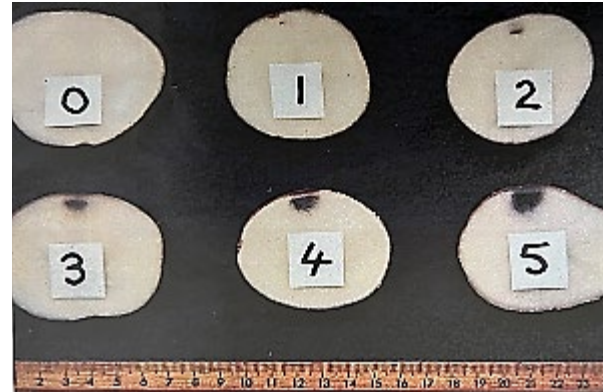
# Treatments



1. **Control** - no BCAs
2. **Chitin** - Flamingo at 50 kg/ha 'in-furrow' at planting.
3. **Chitosan hydrochloride**, as 0.5% aqueous solution, applied to foliage on 5 occasions: 3 weeks after emergence, 7 days after that, then three more applications at 14-day intervals.
4. **Chito-oligosaccharide**, as 0.5% aqueous solution, applied to foliage on 5 occasions: 3 weeks after emergence, 7 days after that, then three more applications at 14-day intervals.
5. **Trichoderma** spp.: Agrimm product at 500 g/Ha in-furrow at planting and to plants at emergence and at tuber initiation.
6. **Bacillus subtilis**: Serenade Prime applied at 7 L/Ha in-furrow at planting.  
Serenade Optimum applied at 2 kg/ha in 400 L water/ha at row closure.
7. **Chitin + Trichoderma** (at rates and times as above)
8. **Chitin + Bacillus subtilis** (at rates and times as above)
9. **Chitin + Trichoderma + Bacillus subtilis** (at rates and times as above)

# Assessments

- Early Blight (0-5 disease severity score)
- Tuber Yield
- Specific Gravity
- Bruising
- Fry Colour
- Zebra Chip
- Skin Finish & Blemishes (Corky skin)
- Cosmetic Diseases (Black scurf, Powdery scab, Common scab)



# Results



| Trt. No. | Treatment                                        | Early blight score |        |          |        | Total yield (kg) | Tuber specific gravity | Tuber bruise score | Fry colour score | Zebra chip score | Black scurf | Corky skin | Skin finish |
|----------|--------------------------------------------------|--------------------|--------|----------|--------|------------------|------------------------|--------------------|------------------|------------------|-------------|------------|-------------|
|          |                                                  | 11 Feb             | 25 Feb | 11 Mar   | 25 Mar |                  |                        |                    |                  |                  |             |            |             |
| 1        | Control - no BCAs                                | 0                  | 0.5    | 3.00 a   | 4.00   | 3.484            | 1.053                  | 0.93 abc           | 38.3             | 2.20             | 0.95        | 0.55 abc   | 2.35        |
| 2        | Chitin                                           | 0                  | 0      | 2.00 cd  | 4.00   | 3.274            | 1.056                  | 1.63 a             | 37.1             | 2.08             | 0.48        | 0.40 bc    | 2.33        |
| 3        | Chitosan BP3                                     | 0                  | 0      | 1.50 d   | 3.50   | 2.143            | 1.051                  | 1.70 a             | 32.1             | 3.88             | 0.70        | 0.25 c     | 2.58        |
| 4        | Chitosan BP4                                     | 0                  | 0      | 2.25 b   | 3.75   | 3.255            | 1.055                  | 1.30 abc           | 36.8             | 3.30             | 0.85        | 0.88 a     | 2.35        |
| 5        | <i>Trichoderma</i>                               | 0                  | 0      | 2.50 abc | 4.00   | 3.905            | 1.057                  | 0.65 c             | 40.2             | 1.90             | 0.75        | 0.70 ab    | 2.23        |
| 6        | <i>Bacillus subtilis</i>                         | 0                  | 0      | 2.50 abc | 4.00   | 2.976            | 1.054                  | 1.63 a             | 39.8             | 2.15             | 0.75        | 0.58 abc   | 2.23        |
| 7        | Chitin + <i>Trichoderma</i>                      | 0                  | 0      | 2.50 abc | 3.75   | 3.485            | 1.054                  | 0.68 c             | 35.0             | 2.80             | 0.45        | 0.45 bc    | 2.18        |
| 8        | Chitin + <i>Bacillus subtilis</i>                | 0                  | 0      | 2.75 ab  | 4.00   | 3.184            | 1.054                  | 0.83 bc            | 40.1             | 1.93             | 0.40        | 0.33 bc    | 2.43        |
| 9        | Chitin + <i>Trichoderma</i> + <i>B. subtilis</i> | 0                  | 0      | 2.25 bc  | 4.00   | 3.667            | 1.056                  | 1.63 a             | 41.4             | 1.50             | 0.33        | 0.28 c     | 2.33        |

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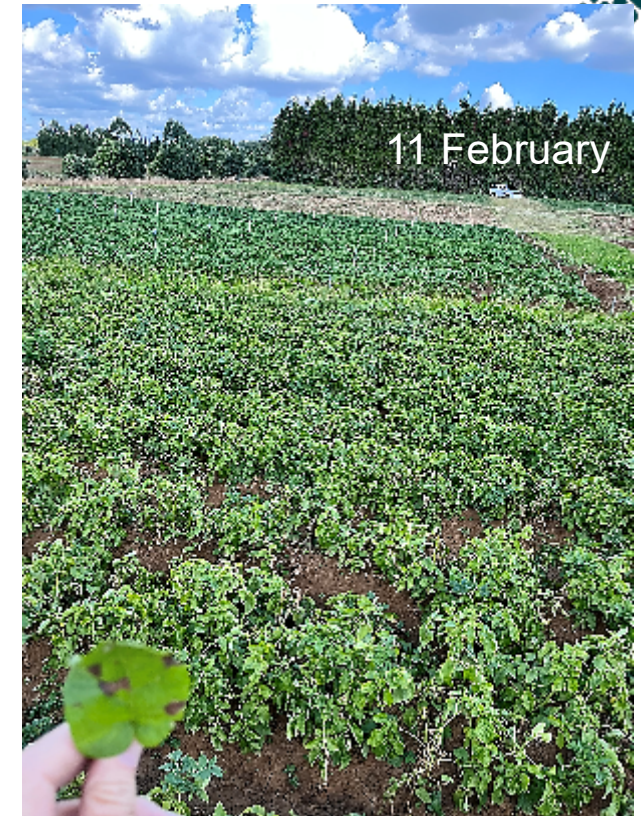
# Trial photos



9 January



11 February



11 February



5 March



25 March

- 11 Feb - No Early Blight (EB) in trial
- 25 Feb - First EB symptoms seen
- 11 Mar – Treatment differences
- 25 Mar – Severe EB throughout trial

# Discussion



- The trial was subjected to very high early blight disease pressure because it was located next to another potato early blight trial.
- Chitosan hydrochloride showed the highest efficacy against early blight when applied to foliage five times as a 0.5% solution.
- However, heavy and continuous *Alternaria* spore pressure ultimately overwhelmed this treatment.
- Chitosan hydrochloride and the Chitin + *Trichoderma* + *B. subtilis* combination performed best in controlling *Rhizoctonia*-induced corky skin.
- The *Trichoderma* treatment and Chitin + *Trichoderma* treatment produced the lowest levels of tuber bruising.
- Expanding this research to evaluate the BCAs for control of powdery scab, common scab, and other major soilborne potato diseases in infested soils in major potato growing regions would provide valuable insights.

# Thank you