

Biological Disease Control — Grow Your Own®

John Francis

BioWorks, Inc., 100 Rawson Rd, Suite 205, Victor, New York 14564

Email: jfrancis@bioworksinc.com

INTRODUCTION

“Planting” or applying very small dormant propagules of beneficial microbes to your rooting medium can result in a population of organisms that provide many benefits including protecting your plant roots from disease. While the “crop” doesn’t produce a plant of above-ground beauty or utility, some biological fungicides can result in hairy, disease-free, vigorous roots, which to a grower, are beautiful things!

I will be focusing on biological fungicides for root disease control. When approached with a new product to try, the first level of evaluation is to determine if it is EPA/DPR registered. Registered products have at least been screened for a basic level of efficacy against root diseases. Currently, the more commonly used biological fungicides are either bacterial or fungal organisms (Table 1). These include:

Table 1. List of some microbial pest control agents.

Product/type/REI	Primary source	Organism	Formulation/reapp
Actinovate® (bacterium) [REI-1]	Natural Industries, Inc.	<i>Streptomyces</i> <i>lydicus</i> (WYEC 108)	Powder (season long)
Actino-Iron (bacterium) [REI-4]	Natural Industries, Inc.	<i>Streptomyces</i> <i>lydicus</i> (WYEC 108)	Granular (season long)
CEASE® (bacterium) [REI-4]	BioWorks, Inc.	<i>Bacillus subtilis</i> (QST 713)	Liquid (3–4 weeks)
Companion® (bacterium) [REI-4]	Growth Products, Inc	<i>Bacillus subtilis</i> (GB03)	Liquid (2–4 weeks)
Mycostop® (bacterium) [REI-4]	Verdera Oy	<i>Streptomyces</i> <i>griseoviridis</i> (K61)	Powder (2–6 weeks)
PlantShield® HC (fungus) [REI-0]	BioWorks, Inc.	<i>Trichoderma</i> <i>harzianum</i> strain T-22	Powder (10–12 weeks)
RootShield® (fungus) [REI -0]	BioWorks, Inc.	<i>Trichoderma</i> <i>harzianum</i> strain T-22	Powder or granules (10–12 weeks)
SoilGard 12G (fungus) [REI-0]	Certis USA, LLC	<i>Gliocladium virens</i> strain GL-21	Granules (1–4 weeks as needed)

STRENGTHS AND WEAKNESSES (VARY BY PRODUCT)

- Frequency of application
- Sensitivity to other inputs (Cu, H₂O₂, etc.)
- Mixing and prep complexity
- Disease spectrum
- Solubility or practicality of rate
- Shelf life, storage conditions

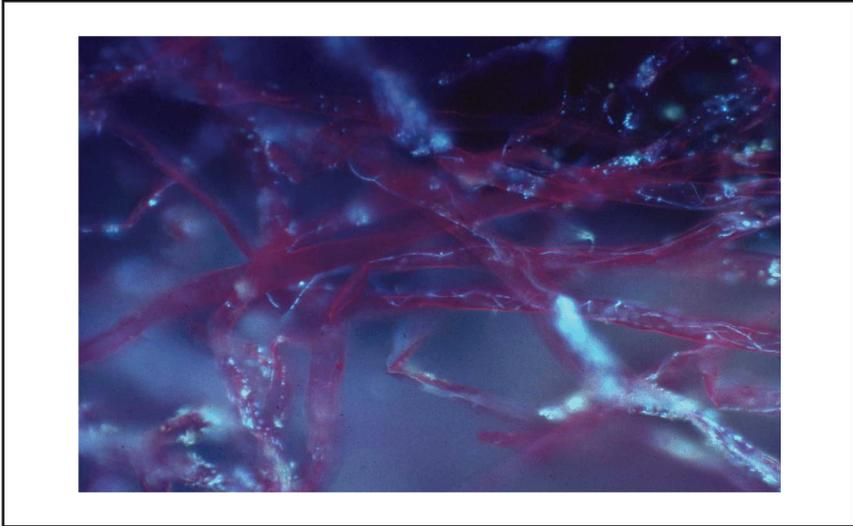


Figure 1. *Trichoderma harzianum* strain T-22 colonizing roots. An example of competitive exclusion.

HOW DO THEY WORK?

The main principle of activity for biological fungicides is numbers. Introduce a high enough population of good organisms to overwhelm the bad or ineffective organisms. Various modes of action are claimed for both types of biological fungicides which include:

- Competitive exclusion (competition for nutrients and space, Fig. 1)
- Mycoparasitism (one organism eating the other, Figs. 2 and 3)
- Antagonistic to plant pathogens
- Disruption of pathogen cell membranes with metabolites, including lipopeptides (Fig. 4)
- Production of antibiotic agents, anti-fungal enzymes

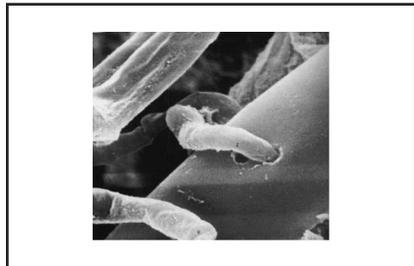


Figure 2. *Trichoderma harzianum* strain T-22 parasitizing a *Rhizoctonia* hyphal strand.

WHY CONSIDER BIOLOGICAL FUNGICIDES IN YOUR ROOT DISEASE CONTROL STRATEGY?

- Can be an effective part of your overall root disease prevention program along with sanitation, cultural practices, and pesticides
- Eliminate or reduce use of chemical fungicides
- Integrates well into sustainability efforts
- Can be softer on tender plant material
- Break disease-resistance potential

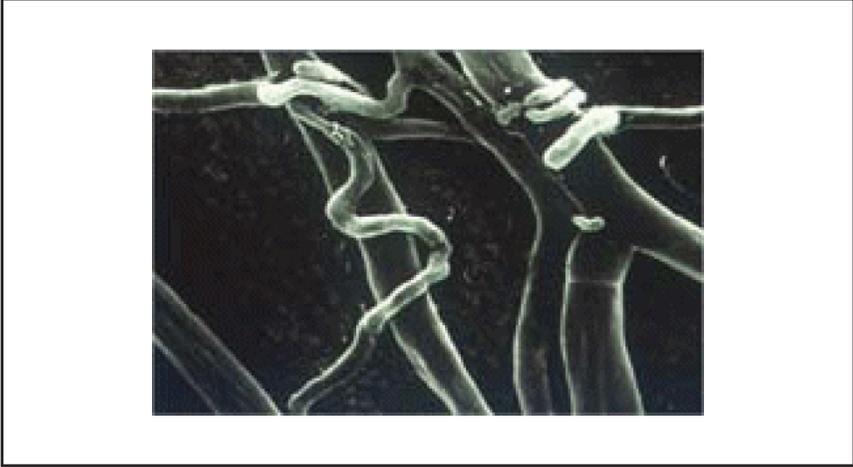


Figure 3. *Trichoderma harzianum* strain T-22 showing how it coils around both pathogens and roots.

- Many labeled for edible crops (vegetables, herbs)
- Short or no Restricted Entry Interval (REI)
- Compatible with biocontrols agents (BCAs) (predatory mites, insects)
- Fit well into the “Clean Plants” concept of history or pedigree of the crop (start to finish)

FACTORS FOR SUCCESSFUL USE

- Preventative only — apply early!
- Use throughout the propagation cycle starting with stock plants
- Be sure you use a living biological fungicide product
- Observe expiration dates
- Apply appropriate rates (get enough on)
- Be aware of chemical compatibilities — what can be applied without impacting the biological fungicide
- Compare to standard practice at first (with no, or reduced chemical fungicide applications)

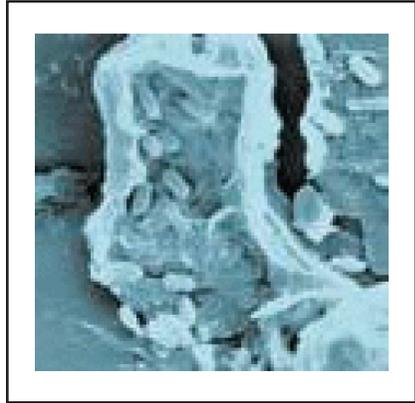


Figure 4. *Bacillus subtilis* strain QST 713 damaging a fungal spore.

- Match the product's labeled diseases to the potential crop diseases
- Observe reapplication intervals (careful of "season long" claims)
- Maintain proper storage conditions for the biological fungicide
- Remember that like chemical fungicides, biological fungicides are not a "silver bullet," nor "bullet-proof"

WHY DON'T RESEARCHERS ALWAYS GET GREAT RESULTS?

- Many researchers have applied a chemical eradicator protocol to a preventative product
- Artificially high pathogen inoculant load (very high to show kill in control plants)
- Not enough time given to allow the biological fungicide to adequately colonize the root system
- Worst case testing which favors the pathogen, often overwhelming the biological fungicide

APPLICATION METHODS

- Media incorporation
- Media drench
- Wet dip (usually trays, flats, cuttings)
- Dry dip into powder (usually cuttings before sticking)

COST EFFECTIVENESS

- Depends on product
- Application frequency (significant - material + labor)
- Cost per production unit
- Cost of present program
- Cost of ineffectiveness
- Other issues: Labor costs, sustainability, worker safety, plant establishment

CASE STUDY

- Large Midwestern greenhouse with 35 acres of seeded plug production
- Was subirrigating each tray with Cleary's 3336 at 1/2 rate
- Problems with phytotoxicity in some crops, short residual control, concern over worker safety
- For several years now uses PlantShield HC/RootShield WP subirrigated on every tray
- Result: No phytotoxicity, 0-hour REI, no worker concerns, long-term disease control, cost-effective, clean, well-rooted product

SUMMARY

With careful selection of a biological fungicide, being aware of the product's characteristics and proven track record, and understanding the factors for effective use, excellent root disease control can be maintained in all types of propagation where roots need protection from diseases.