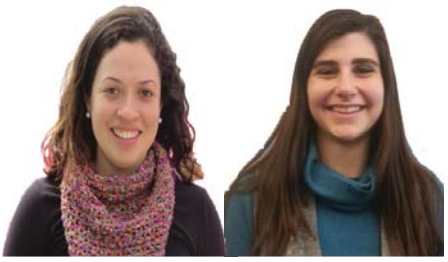
e-GRO Edible Alert
Volume 2, Number 7 April 2017



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Biofungicides for Control of Root Diseases on Greenhouse-Grown Vegetables

Biocontrol is not only for insects!

In this issue, we will present a summary of the microbial biofungicides labeled for control of root diseases of greenhouse-grown vegetables.

Water- and soil-borne pathogens can cause seedling damping-off and root rot in seedlings and mature plants. *Pythium, Rhizoctonia*, and *Fusarium* species are the most common pathogens causing root diseases in greenhouses. In research settings, we observed over 25% reduction on lettuce fresh weight in plants infected with *Pythium aphanidermatum*. In commercial farms, we have observed complete loss caused by root diseases in lettuce grown in hydroponic systems during the summer months (Fig 1). There is a critical need to proactively protect plants from plant pathogens to prevent crop loss caused by root diseases.

In plant pathology, **biological control** or **biocontrol** refers to the use of microbial antagonists to prevent disease development. Most biocontrol agents present multiple control mechanisms (predation, antibiosis, enzymatic lysis, competition, induced host resistance and physical interference) to antagonize pathogens. Therefore, plant pathogens are less likely to develop resistance to biocontrol options compared with synthetic products.

Biofungicides are a class of fungicides in which the active ingredient is a microorganism or a microorganism's byproduct.

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Figure 1. Lettuce plants grown in a commercial hydroponic farm in summer 2015. Both plants are the same cultivar and growth stage. The plant on the right was infected with Pythium. The infected plants were severly wilted and did not recover.

Biofungicides are a preventive strategy to control plant pathogens and they should be applied before problems arise. The beneficial microbes, which are the active ingredient, need to establish and multiply to be able to protect the plants from plant pathogens. Most biofungicides require multiple applications over time to ensure a steady population of beneficial microorganisms in the growing media or nutrient solution.

When we think of biocontrol, we should think of microbes against microbes (in the same way we think of natural enemies for pests, insects against insects). Therefore, when we decide to use biofungicides, we should avoid product rotation with fungicides or bactericides that can affect the beneficial microbe populations.

Some of the biofungicides can be applied directly in the nutrient solution via chemigation or in the hydroponic nutrient solutions. For example, Companion®, Actinovate®SP, and Rootshield® can be used in hydroponic solutions.

Unlike natural enemies used for biocontrol of insect pests, US EPA regulates microbial biofungicides. Therefore, biofungicides are limited to the crops and growing conditions provided in the label. As always, follow the instructions in specimen labels and develop an integrated crop management approach with high sanitation standards and control of environmental conditions to prevent disease development.

Table 1. Microbial-based biological fungicides registered for greenhouse use to control plant pathogens causing root rots and seedling damping-off on fruiting and leafy vegetables, herbs and spices. Summary based on specimen labels registered in the US (Updated on April 2017).

Active Ingredient	Trade Names (Manufacturer)	Application	REI
Bacillus amyloliquefaciens D747	**Double Nickel 55** (Certis USA) **Double Nickel LC** (Certis USA) **Triathlon BA** (OHP, Inc.)	Drench	4 hr
Bacillus subtilis GB03	**Companion®** (Growth Products)	Drench, soak plugs, hydroponic nutrient solution	4 hr
Bacillus subtilis QST 713	**Cease®** (BioWorks)	Drench	4 hr
Gliocladium catenulatum J1446	**Prestop®** (Verdera)*	Drench	0 hr
Streptomyces K61	**Mycostop®** (Verdera)	Seed treatment, growing media incorporation, transplant dip, soil spray or drench, chemigation	4 hr
Streptomyces lydicus WYEC 108	**Actinovate®** (Novozymes BioAg) **Actino-Iron®** (Novozymes BioAg)	Soil drench, chemigation (including hydroponics), transplants dip	1 hr (Actinovate) 4h (Actino-Iron)
Trichoderma asperellum ICC012 and *T. gamsii* ICC080	**Tenet®** (Isagro USA) **Bio-Tam®2.0** (Isagro USA)	Drench	4 hr
Trichoderma harzianum Rifai KRL-AG2	**RootShield®WP**- (BioWorks)	Drench or chemigation	O hr
Trichoderma harzianum Rifai T22	**PlantShield HC** (BioWorks)	Drench or chemigation	4 hr
Trichoderma harzianum Rifai T22 *and T. virens* G-41	**RootShield Plus+** (BioWorks)	Drench or chemigation	4 hr

* Labeled only for leafy greens, herbs and spices.

Additional References

Pundt L (2017) Biological Fungicides. UConn Extension Integrated Pest Management Factsheet. http://ipm.uconn.edu/pa_greenhouse/

Raudales RE, BB McSpadden Gardener (2008) Microbial Biopesticides for the Control of Plant Diseases in Organic Farming. The Ohio State University Extension Factsheet HYG-3310-08.

Stack LB, J Dill, L Pundt, R Raudales, C Smith, T Smith. 2016. New England Greenhouse Floriculture Guide. New England Floriculture, Inc.

United States Environmental Protection Agency. 2017. What are Biopesticides? Retrieved on 11 April 2017 from https://www.epa.gov/pesticides/biopesticides

Acknowledgements

This project is supported, in part, by the USDA via the Connecticut Department of Agriculture – Specialty Crop Block Grant # AG151260 and USDA National Institute of Food and Agriculture, Hatch Multistate Accession Number 1004968, project number #CONS00944.

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