Biopesticides for Managing Diseases of Tomatoes Organically

Margaret Tuttle McGrath
Plant Pathology & Plant-Microbe Biology, Cornell University
Long Island Horticultural Research & Extension Center
3059 Sound Avenue, Riverhead, NY 11901; mtm3@cornell.edu
Additional information posted at: http://www.longislandhort.cornell.edu/vegpath/organic.html

Following is a list of some biopesticides labeled for disease control in vegetable crops. The active ingredient follows product name. Most products are labeled for managing multiple diseases on many crops. The diseases of tomato that are specified on these labels are included. This information provides some indication about the breadth of activity. Products listed with OMRI (Organic Materials Review Institute) are NOP compliant. Check state registration: each product may not be registered in all states. Also, always check with your certifier before purchasing any product. 'No Ag Label' indicates an agricultural label was not found for product.

Actinovate AG. 0.0371% *Streptomyces lydicus* strain WYEC 108. Labeled for suppressing several foliar and soil-borne diseases on many crops; diseases and crops listed separately. The biocontrol agent colonizes roots, protecting them from pathogens and making minerals and micronutrients more available to plants, which thus are more vigorous and larger. For best results with applications to foliage, label indicates to use a non-ionic spreader-sticker. OMRI-listed. EPA Reg. No. 73314-1. Monsanto BioAg (formerly Natural Industries, Inc.).

BacStop. 2.0% thyme, 2.0% clove & clove oil, 1.5% cinnamon, 1.0% peppermint & peppermint oil, and 1.0% garlic oil. Broadly labeled primarily for bacterial diseases including bacterial leaf spot, bacterial speck, bacterial canker, and bacterial wilt in tomato. Recommended used with EF400 for these and some other diseases. Exempt from EPA registration. USAgriTech, Inc.

Bio-Tam. 2% *Trichoderma asperellum* strain ICC 012 and 2% *Trichoderma gamsii* strain ICC 080. These beneficial fungi have different modes of action and are active over different temperature ranges (starting at 45°F) and environmental conditions. They are effective for diseases caused by *Phytophthora capsici*, *Rhizoctonia*, *Pythium* and *Verticillium*. General label. OMRI-listed. EPA Reg. No. 80289-9-69592. Isagro USA; distributed by Bayer CropScience (formerly AgraQuest).

Cease. 1.34% *Bacillus subtilis* strain QST 713. Broadly labeled for use on greenhouse vegetables. Labeled for bacterial spot, bacterial speck, early blight, gray mold, late blight, and powdery mildew in tomato. OMRI-listed. EPA Reg. No. 69592-19-68539. BioWorks, Inc.

Companion. 0.03% *Bacillus subtilis* strain GB03. Broadly labeled for foliar and soil-borne diseases, including bacterial spot, buckeye fruit rot, damping-off, early blight, Fusarium wilt, gray mold, late blight, white mold, and root rot and crown rot caused by *Pythium* and *Rhizoctonia* in tomato. EPA Reg. No. 71065-3. Growth Products, Ltd.

Contans WG. 5.3% *Coniothyrium minitans* strain CON/M/91-08. Soil-applied product for *Sclerotinia sclerotiorum* (white mold pathogen). OMRI-listed. EPA Reg. No. 72444-1. SipcamAdvan.

Double Nickel 55 LC and WDG. *Bacillus amyloliquefacinens* strain D747, 98.8% and 25%, respectively. Broadly labeled for foliar and soil-borne diseases, including bacterial spot, bacterial speck, damping off, early blight, gray mold, late blight, powdery mildew, and root rot and crown rot caused by *Pythium, Fusarium, Phytophthora, Verticillium,* and *Rhizoctonia* in tomato. OMRI-listed. EPA Reg No. 70051-107 and 108, respectively. Certis USA, LLC.

EF400. 8.2% clove, 8.1% rosemary, and 6.7% peppermint. Labeled for anthracnose and late blight in tomato. Exempt from EPA registration. USAgriTech, Inc.

Kaligreen. 82% potassium bicarbonate. Labeled only for powdery mildew. OMRI-listed. EPA Reg. No. 11581-2. Arysta LifeScience North America LLC.

KeyPlex 350 OR. 0.063% yeast extract hydrolysate from *Saccharomyces cerevisiae*. Combination of defensive proteins (alpha-keto acids) and secondary and micronutrients. Elicits systemic acquired resistance in plants against fungal and bacterial pathogens. Labeled for general disease control in vegetables with specific mention of bacterial leaf spot in tomato. EPA approval for organic production. EPA Reg. No. 73512-4. KeyPlex.

MeloCon WG. 6% *Paecilomyces lilacinus* strain PL251. This soil fungus parasitizes many types of plant parasitic nematodes, including root knot and root lesion, without adverse impact on beneficial nematodes. OMRI-listed. EPA Reg No. 72444-2. Certis USA, LLC.

Mildew Cure (formerly GC-3 Organic fungicide**)**. 30% cottonseed oil, 30% corn oil, 23% garlic extract. Labeled only for powdery mildew. OMRI-listed. Exempt from EPA registration. JH Biotech, Inc.

MilStop. 85% potassium bicarbonate. Broadly labeled including anthracnose, early (Alternaria) blight, gray mold, powdery mildew, and Septoria leaf spot in tomato. OMRI-listed. EPA Reg. No. 70870-1-68539. BioWorks, Inc.

M-Pede. 49% Potassium salts of fatty acids. Labeled for powdery mildew and several insects and mites. OMRI-listed. EPA Reg. No. 10163-324. Gowan Co.

Mycostop. 30% *Streptomyces griseoviridis* strain K61. Mycostop can be incorporated in potting mix, applied as a seed treatment, used as a transplant dip, and applied to soil as a spray, drench, or through drip irrigation. It is labeled for control of seed rot, root and stem rot, and wilt caused by *Fusarium, Alternaria, and Phomopsis* of container-grown vegetables and damping-off and early root rot of vegetables in the field. OMRI listed. EPA Reg No. 64137-5. Verdera Oy.

Organocide. 5% sesame oil. Labeled broadly for several fungal diseases and insects. OMRI-listed. Exempt from EPA registration. No Ag Label. Organic Laboratories, Inc.

OxiDate. 27% hydrogen dioxide. Broadly labeled including anthracnose, bacterial speck, bacterial spot, early blight, Botrytis (gray mold), late blight, Cladosporium (leaf) mold, powdery mildew, Rhizoctonia fruit rot, and root rots caused by *Pythium* and *Phytophthora* in tomato. OMRI-listed. EPA Reg. No. 70299-2. BioSafe Systems, LLC.

Prestop. 32% *Gliocladium catenulatum* strain J1446. Broadly labeled primarily for application to soil for several seed and soil pathogens, and also to foliage for select crops and before fruiting. New formulation expected in 2016 will permit use on edible plant parts thus also enabling label expansion. OMRI-listed. EPA Reg. No. 64137-11. Verdera Oy. U.S. Distributor: AgBio Inc.

Procidic. 3.5% Citric acid. Labeled for damping-off, foliar diseases caused by fungal and bacterial pathogens, and post-harvest diseases. Previously marketed as Citrex. Procidic was reviewed and determined to be NOP compliant by Washington State Dept of Ag. Exempt from EPA registration. Greenspire Global, Inc.

Promax. 3.5% Thyme oil. Protective and curative soil fungicide and nematicide for control of soil-borne diseases and plant parasitic nematodes on a broad range of crops. OMRI-listed. Exempt from EPA registration. Bio Huma Netics, Inc.

Regalia. 5% Extract of *Reynoutria sachalinensis.* Boosts the plant's natural defense mechanisms against certain fungal and bacterial diseases. Broadly labeled including bacterial spot, bacterial speck, early blight, gray mold, late blight, Phytophthora blight, and powdery mildew in tomato. OMRI-listed. EPA Reg. No. 84059-2. Marrone Bio Innovations, Inc.

RootShield WP and Granules (formerly T-22 HC and PlantShield HC). 1.15% *Trichoderma harzianum* Rifai strain KRL-AG2. Protects plant roots against fungal pathogens such as *Rhizoctonia, Pythium*, and *Fusarium*. The biocontrol fungus accomplishes this by growing on roots and releasing enzymes that dissolve the cell wall of many fungal pathogens, which it consumes. OMRI-listed. EPA Reg. No. 68539-3 and -7 for Granules and WP formulations, respectively. BioWorks, Inc.

RootShield Plus WP. 1.15% *Trichoderma harzianum* Rifai strain T-22 and 0.61% *Trichoderma virens* strain G-41. See previous product. OMRI-listed. EPA Reg. No. 68539-9. BioWorks, Inc.

Serenade Max and Serenade ASO. 14.6% *Bacillus subtilis* strain QST 713. Broadly labeled including bacterial speck, bacterial spot, early blight, gray mold, late blight, and powdery mildew in tomato. OMRI-listed. EPA Reg. No.69592-11 and -12, respectively. Bayer CropScience (formerly AgraQuest).

Serenade Opti. 26.2% *Bacillus subtilis* strain QST 713. New formulation. Broadly labeled including anthracnose, bacterial speck, bacterial spot, buckeye fruit rot, early blight, gray mold, and late blight in tomato. OMRI-listed. EPA Reg. No. 264-1160. Previous product names and formulations: Serenade, Serenade Max, Serenade Optimum. Bayer CropScience (formerly AgraQuest).

Serenade ASO. 1.34% *Bacillus subtilis* strain QST 713. This product will replace Serenade Soil. EPA Reg. No. 264-1152. Bayer CropScience (formerly AgraQuest).

Serenade Soil. 1.34% *Bacillus subtilis* strain QST 713. This bacterium colonizes roots and produces compounds that affect pathogens directly and trigger metabolic pathways to activate the plant's natural defenses and modulate growth. Labeled for diseases caused by *Rhizoctonia, Pythium, Fusarium, Verticillium* and *Phytophthora*. OMRI-listed. EPA Reg. No. 264-1152. Bayer CropScience (formerly AgraQuest).

SoilGard 12G. 12% *Gliocladium virens* strain GL-21. Generally labeled for damping-off and root rot pathogens in field and greenhouse production. OMRI-listed. EPA Reg. No. 70051-3. Certis USA, LLC.

Sonata. 1.38% *Bacillus pumilus* strain QST 2808. Labeled for early blight, late blight, and powdery mildew in field and greenhouse tomato. OMRI-listed. EPA Reg. No. 264-1153. Bayer CropScience (formerly AgraQuest).

Taegro ECO. 13% *Bacillus subtilis* var. *amyloliquefaciens* strain FZB24. Labeled for diseases caused by the soil-borne pathogens *Rhizoctonia* and *Fusarium* in many crops. OMRI-listed. EPA Reg. No. 70127-5. Syngenta Crop Protection (formerly Novozymes Biologicals, Ind.)

Tenet WP. Same as Bio-Tam. OMRI-listed. EPA Reg. No. 80289-9. Isagro USA; distributed by SipcamAdvan.

Thyme . Same as Bio-Tam. OMRI-listed. EPA Reg. No. 80289-9. Isagro USA; distributed by SipcamAdvan.

Trilogy. 70% clarified hydrophobic extract of neem oil. Labeled generally for several insects and diseases. Labeled diseases that occur in tomato include anthracnose, early blight, Botrytis (gray mold), and powdery mildew. OMRI-listed. EPA Reg. No. 70051-2. Certis USA, LLC.

Zonix biofungicide. 8.5% Rhamnolipid Biosurfactant. Kills zoospores, which is one spore type produced by Oomycete pathogens which cause diseases such as late blight. OMRI-listed. EPA Reg. No. 72431-1. PropTera, LLC.

<u>Below are some organic fungicides in addition to copper and sulfur that are not biopesticides:</u>

JMS Stylet-oil. 97.1% paraffinic oil. Labeled for several insect pests, viruses vectored by aphids, and some fungal diseases in several crops including powdery mildew in tomato. OMRI-listed. EPA Reg. No. 65564-1. JMS Flower Farms, Inc.

TriTek. 80% mineral oil. Labeled for several insect pests and powdery mildew in several crops including cucumber, melon, and squash. OMRI-listed. EPA Reg. No. 48813-1. Previously named Saf-T-Side. Brandt Consolidated, Inc.

Please Note: The specific directions on fungicide labels must be adhered to -- they supersede these recommendations, if there is a conflict. If you are farming organically, before purchase make sure product is registered in your state and approved by your certifier. Any reference to commercial products, trade or brand names is for information only; no endorsement is intended.

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