

Biopesticides for Managing Diseases of Pepper Organically

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More information at: <http://livegpath.cals.cornell.edu/organic/organic-management-of-vegetable-diseases/>

Following is a list of some biopesticides labeled for disease control in pepper. The active ingredient follows product name. Most products are labeled for managing multiple diseases on many crops. The diseases of bell and chili pepper that are specified on these labels and occur in the northeastern U.S. are included below. This information provides some indication about the breadth of activity of the product. Some products are labeled broadly (general label) with separate lists for crops and target diseases and pathogens. 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. This list does not include the few conventional biopesticides (e.g. phosphorous acid fungicides) that are not permitted in organic production.

Actinovate AG. 0.0371% *Streptomyces lydicus* strain WYEC 108. Labeled for application to soil for Fusarium crown and root rot, Pythium damping-off, and Phytophthora blight, and to foliage for anthracnose, bacterial spot, and gray mold. For best results with applications to foliage, label indicates to use a spreader-sticker. OMRI-listed. EPA Reg. No. 73314-20. Novozymes.

AgriPhage. < 1% Bacteriophage active against *Xanthomonas campestris* pv. *vesicatoria*. Labeled for bacterial spot. NOP compliant, not reviewed. EPA Reg. No. 67986-1-70051. OmniLytics; distributed by Certis USA.

Aviv. 0.08% *Bacillus subtilis* strain IAB/BS03. Labeled for bacterial spot and also as soil treatment for root pathogens (*Fusarium*, *Phytophthora*, *Rhizoctonia*, and *Verticillium*). Replaces Prevont. OMRI-listed. EPA Reg. No. 91473-1-86182. Seipasa S.A.

BioST Nematicide 100. 95% heat-killed *Burkholderia* spp. strain A396 cells and spent fermentation media. Labeled for several nematodes including root-knot. OMRI-listed. EPA Reg. No. 84059-14-42750. Albaugh, LLC.

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. Labeled for application to soil for pathogens that attack roots and crown tissue: *Fusarium*, *Phytophthora*, *Rhizoctonia*, *Pythium*, *Sclerotinia*, and *Verticillium*. General label. OMRI-listed. EPA Reg. No. 80289-9-67690. Manufactured by Isagro USA; distributed by SePRO Corporation.

Brandt Organics Aleo. 78% garlic oil. Labeled generally for bacterial and fungal diseases including gray mold, Pythium damping off and white mold. OMRI-listed. Exempt from EPA registration. Brandt Consolidated, Inc.

Carb-O-Nator. 85% potassium bicarbonate. Labeled for anthracnose and gray mold. OMRI-listed. EPA Reg. No. 70051-117. Certis USA, LLC.

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

Cinnerate. 60% cinnamon oil. Labeled for pathogens such as *Botrytis cinerea* which causes gray mold (label has separate lists of crops and diseases). OMRI-listed. Exempt from EPA registration. Seipasa S.A.

Companion. 0.03% *Bacillus subtilis* strain GB03. Labeled for bacterial leaf spot, blight caused by *Sclerotinia* (white mold), and root rots caused by *Pythium* and *Rhizoctonia*. EPA Reg. No. 71065-3. Growth Products, Ltd.

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

DiTera DF Biological Nematicide. 90% *Myrothecium verrucaria* strain AARC-0255 fermentation solids and solubles. Labeled for several nematodes including root-knot. OMRI-listed. EPA Reg. No. 73049-67. Valent BioSciences LLC.

Double Nickel 55 LC and WDG. *Bacillus amyloliquefacinens* strain D747, 98.8% and 25%, respectively. Labeled for bacterial spot and damping off and root rot caused by *Fusarium*, *Pythium*, *Phytophthora*, *Rhizoctonia*, and *Verticillium*. OMRI-listed. EPA Reg No. 70051-107 and 108, respectively. Certis USA, LLC.

EcoSwing Botanical Fungicide. 82% Extract of *Swinglea glutinosa*. Labeled for use on pepper; no diseases or pathogens of pepper included in the general list of targeted pests. OMRI-listed. EPA Reg. No. 10163-357. Gowan Co.

ECOWORKS EC. 70% cold pressed neem oil. Labeled generally for fungal diseases including powdery mildew and anthracnose, and also several insects and mites. OMRI-listed. EPA Reg. No. 89152-4. ECOSTADT Technologies LLC.

GreenFurrow BacStop. 7.5% clove, 3.5% rosemary, 3.2% peppermint oil, 3.2% cottonseed oil, 3.0% thyme, 3.0% garlic, 2.0% cinnamon. Labeled for bacterial leaf spot. Exempt from EPA registration. Mar Vista Resources.

GreenFurrow EF 400. 5.6% clove, 7.1% rosemary, 11.3% peppermint oil, 10.5% cottonseed oil. Labeled diseases of vegetable crops that occur in pepper include anthracnose and white mold. Exempt from EPA registration. Mar Vista Resources.

Howler. 50% *Pseudomonas chlororaphis* strain AFS009. Labeled for foliar spray for diseases caused by *Botrytis* (gray mold) and *Colletotrichum* (anthracnose) and soil treatment for *Fusarium*, *Phytophthora*, *Pythium*, *Rhizoctonia*, and *Sclerotinia*. OMRI-listed. EPA Reg. No. 91197-3-92488. AgBiome Innovations Inc.

Kaligreen. 82% potassium bicarbonate. Labeled only for powdery mildew which does not affect pepper in the northeast. OMRI-listed. EPA Reg. No. 11581-2. Arysta LifeScience North America LLC.

KeyPlex 350 OR. 0.063% yeast extract hydrolysate from *Saccharomyces cerevisiae*. Contains 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. EPA approval for organic production. EPA Reg. No. 73512-4. KeyPlex.

LALSTOP G46 WG. 93% *Gliocladium catenulatum* Strain J1446. Labeled generally for seed-borne and soil-borne diseases caused by several pathogens including *Fusarium*, *Phytophthora*, *Pythium*, *Rhizoctonia*, *Sclerotinia*, and *Verticillium*, and foliar diseases caused by several pathogens including *Botrytis* (gray mold*), and also anthracnose. *This disease not specified on label. OMRI-listed. EPA Reg. No. 64137-13. Lallemand Specialties Inc.

LifeGard WG. 40% *Bacillus mycoides* isolate J. Biological Plant Activator. Labeled for bacterial leaf spot and gray mold. OMRI-listed. EPA Reg No. 70051-119. Certis USA, LLC.

Majestene. 94.5% heat-killed *Burkholderia* spp. strain A396 cells and spent fermentation media. Bionematicide for root-knot, lesion, and other parasitic nematodes. Controls by contact and ingestion. OMRI-listed. EPA Reg. No. 84059-14. ProFarm Group (Formerly Marrone Bio Innovations, Inc).

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.

MilStop. 85% potassium bicarbonate. Labeled diseases of agricultural crops that occur in pepper include anthracnose. OMRI-listed. EPA Reg. No. 70870-1-68539. BioWorks, Inc.

Minuet. 9.89% *Bacillus subtilis* strain QST 713. Labeled for application to soil for *Fusarium*, *Phytophthora*, *Pythium*, *Rhizoctonia*, and *Verticillium*. OMRI listed. EPA Reg No. 264-1202. Bayer CropScience.

Mycostop. 35% *Streptomyces griseoviridis* strain K61. Labeled for foliar spray to suppress *Botrytis*. Labeled for seed and root rots caused by *Pythium*, *Phytophthora* and *Rhizoctonia*. 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. OMRI listed. EPA Reg No. 64137-5. Lallemand Plant Care.

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

OSO. 5% polyoxin D zinc salt. Labeled diseases include anthracnose and gray mold. OMRI-listed. EPA Reg No. 68173-4-70051. Certis USA, LLC.

OxiDate 2. 27% hydrogen dioxide and 2% peroxyacetic acid. Labeled for anthracnose, bacterial leaf spot and gray mold, and root rots caused by *Fusarium*, *Pythium*, and *Rhizoctonia*. OMRI-listed. EPA Reg. No. 70299-12. BioSafe Systems, LLC.

PerCarb. 85% sodium carbonate peroxyhydrate. Labeled for anthracnose and bacterial spot. OMRI-listed. EPA Reg. No. 70299-15. BioSafe Systems, LLC.

Prestop. 93% *Gliocladium catenulatum* strain J1446. Broadly labeled for seed-borne and soil-borne diseases (such as those caused by *Phytophthora*, *Pythium*, *Rhizoctonia*, *Sclerotinia*, and *Verticillium*) and foliar diseases (including those caused by *Colletotrichum* and *Botrytis*). Can be incorporated in potting mix, applied to soil and to foliage. OMRI-listed. EPA Reg. No. 64137-13. Lallemand Plant Care.

Problad Verde. 20% Banda de Lupinus albus doce (BLAD). Labeled for gray mold. OMRI-listed. EPA Reg. No. 84876-2. CEV, S.A.

Procidic. 3.5% citric acid. Labeled for gray mold 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.

Rango. 70% cold pressed neem oil. Generally labeled for anthracnose and foliar diseases caused by fungal pathogens such as *Botrytis*, and for soil applications for nematodes and soil-borne fungal pathogens including *Fusarium*, *Pythium*, and *Rhizoctonia solani* (label has separate lists of crops and diseases). OMRI-listed. EPA Reg. No. 88760-10. Terramera, Inc.

Regalia. 5% extract of *Reynoutria sachalinensis*. Boosts the plant's natural defense mechanisms against certain fungal and bacterial diseases. Labeled for bacterial spot, gray mold, and

Phytophthora blight, and damping-off and root rot caused by *Fusarium*, *Pythium*, and *Rhizoctonia*. OMRI-listed. EPA Reg. No. 84059-2. ProFarm Group (Formerly Marrone Bio Innovations, Inc).

Romeo. 94.1% cerevisane (cell walls of *Saccharomyces cerevisiae* strain LAS117). Labeled for Botrytis gray mold. OMRI-listed. EPA Reg. No. 91810-2. Lesaffre Yeast Corporation

RootShield Granules, AG, and WP. 1.15% *Trichoderma harzianum* Rifai strain KRL-AG2. Apply to transplant roots, soil (greenhouse or field), or seed (RootShield AG). The biocontrol fungus grows on roots protecting them against fungal pathogens such as *Rhizoctonia*, *Pythium*, and *Fusarium*. OMRI-listed. EPA Reg. No. 68539-3, -4 and -7 for Granules, AG, 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 ASO. 1.34% *Bacillus subtilis* strain QST 713. Replaced Serenade Soil. This bacterium colonizes roots and produces compounds that affect pathogens directly and triggers metabolic pathways to activate the plant's natural defenses and modulate growth. Labeled for foliar application targeting anthracnose and gray mold, and applied to soil for *Fusarium*, *Phytophthora*, *Pythium*, *Rhizoctonia*, Southern blight, and *Verticillium*. OMRI-listed. EPA Reg. No. 264-1152. Bayer CropScience.

Serenade Opti. 26.2% *Bacillus subtilis* strain QST 713. Labeled for anthracnose, bacterial spot, and gray mold. OMRI-listed. EPA Reg. No. 264-1160. New formulation. Previous product names and formulations: Serenade, Serenade Max, Serenade Optimum. Bayer CropScience.

Serifel NG. 11% *Bacillus amyloliquefacinens* strain MBI 600. Labeled for use on greenhouse crops applied to soil or growing media for root rot pathogens (*Fusarium*, *Pythium*, and *Rhizoctonia*) and as foliar spray for gray mold. Replaces Subtilex NG. OMRI-listed. EPA Reg No. 71840-8. BASF Corporation.

Serifel. 9.9% *Bacillus amyloliquefacinens* strain MBI 600. Labeled for anthracnose, bacterial leaf spot, and Botrytis gray mold. OMRI-listed. EPA Reg No. 71840-18. BASF Corporation.

SoilGard. 12% *Gliocladium virens* strain GL-21. Labeled for soil application in greenhouse and field for damping-off and root rot caused by *Fusarium*, *Pythium*, *Rhizoctonia*, *Sclerotinia*, and *Phytophthora*. OMRI-listed. EPA Reg. No. 70051-3. Certis USA, LLC.

Sonata. 1.38% *Bacillus pumilus* strain QST 2808. Labeled for use on pepper but none of the labeled diseases occur on pepper in the northeast. OMRI-listed. EPA Reg. No. 264-1153. Bayer CropScience.

Sporan EC². 16% rosemary oil, 10% clove oil, 10% thyme oil, 2% peppermint oil. Labeled for bacterial spot and gray mold. OMRI-listed. Exempt from EPA registration. KeyPlex.

Stargus. *Bacillus amyloliquefacinens* strain F727. Labeled for bacterial spot, gray mold, Phytophthora blight, and root rot pathogens (*Fusarium*, *Phytophthora*, *Pythium*, *Rhizoctonia*, and *Verticillium*). OMRI-listed. EPA Reg. No. 084059-28. ProFarm Group (Formerly Marrone Bio Innovations, Inc).

Taegro 2. 13% *Bacillus subtilis* var. *amyloliquefaciens* strain FZB24. Labeled for suppression of bacterial spot, and seedling diseases caused by the soil-borne pathogens *Fusarium*, *Phytophthora*, *Pythium*, and *Rhizoctonia*. OMRI-listed. EPA Reg. No. 70127-12. Novozymes Biologicals, Ind.

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

TerraClean 5. 27% hydrogen dioxide and 5% peroxyacetic acid. Labeled generally for control of soil-borne plant diseases such as those caused by *Fusarium* (root rot), *Phytophthora* (blights, rots), *Pythium*, and *Rhizoctonia*; crops not specified on label. It penetrates soil to kill and suppress pathogens, and it releases vast amounts of oxygen that stimulates root development, nutrient uptake, and thus plant growth. OMRI-listed. EPA Reg. No. 70299-13. BioSafe Systems, Inc.

TerraNeem EC. 84.9% cold pressed neem oil. Labeled generally for anthracnose and foliar diseases caused by fungal pathogens such as *Botrytis*, and for soil applications for nematodes and soil-borne fungal pathogens including *Fusarium*, *Pythium*, and *Rhizoctonia solani*. OMRI-listed. EPA Reg. No. 88760-5. Terramera, Inc.

Theia. 100% *Bacillus subtilis* strain AFS032321. Labeled for seed treatment and soil application (greenhouse and field) for soil-borne fungal diseases caused by *Fusarium*, *Rhizoctonia*, *Pythium*, and *Phytophthora*; and also for foliar application for anthracnose, bacterial spot, and gray mold. OMRI-listed. EPA Reg. No. 94713-2-92488. AgBiome Innovations Inc.

Thymox Control. 27% thyme oil. Proprietary nano emulsion technology. Broadly labeled for fungal diseases such as grey mold, and bacterial diseases; crops not specified. OMRI-listed. Exempt from EPA registration. Kemin Industries, Inc. Manufactured by Laboratoire M2.

Thyme Guard. 23% thyme oil extract. Broadly labeled for diseases caused by fungi, bacteria, viruses, and nematodes; crops not specified. Exempt from EPA registration. Determined to be NOP compliant by Washington State Dept of Ag. Agro Research International.

Timorex Act. 12.5% tea tree oil. Labeled for anthracnose, bacterial spot, gray mold, and applied to soil for damping-off, crown and root rot caused by *Fusarium*, *Pythium*, *Rhizoctonia*, *Sclerotinia*, *Phytophthora*, or *Verticillium*. OMRI-listed. EPA Reg. No. 86182-3-88783. Summit Agro USA, LLC.

Triathlon BA. 98.85% *Bacillus amyloliquefaciens* strain D747. Labeled for controlling gray mold and suppressing bacterial spot (label states to tank mix or rotate with copper-based fungicides to improve control) and applied to soil for suppressing damping off, seedling blights, and root or crown diseases caused by *Pythium*, *Rhizoctonia*, *Fusarium*, *Phytophthora*, or *Verticillium* spp. OMRI listed. EPA Reg. No. 70051-107-59807. OHP, Inc.

Trilogy. 70% clarified hydrophobic extract of neem oil. Labeled generally for several insects and diseases, including anthracnose and *Botrytis* (label has separate lists of crops and diseases). OMRI-listed. EPA Reg. No. 70051-2. Certis USA, LLC.

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

Below is an organic fungicide with active ingredient that is considered to be biocompatible, but the ingredient is not a naturally occurring substance and thus is not in the US EPA biopesticide active ingredient list at <https://www.epa.gov/ingredients-used-pesticide-products/biopesticide-active-ingredients>:

Organic JMS Stylet-oil. 97.1% paraffinic oil. Labeled for several insect pests and viruses vectored by aphids. OMRI-listed. EPA Reg. No. 65564-1. JMS Flower Farms, 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.

Up-dated 12-21-22.