

Biopesticides for Managing Diseases of Cucurbits 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 cucurbits. The active ingredient follows product name. Most products are labeled for managing multiple diseases on many crops. The diseases of cucurbits that are specified on these labels and occur in the northeastern U.S. are included. 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 the 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 damping-off and Phytophthora blight, and to foliage for bacterial leaf spot and downy mildew. For best results with applications to foliage, label indicates to use a spreader-sticker. OMRI listed. EPA Reg. No. 73314-20. Novozymes.

Aviv. 0.08% *Bacillus subtilis* strain IAB/BS03. Labeled for Alternaria leaf spot, anthracnose, downy mildew, gummy stem blight, powdery mildew, Phytophthora blight and also as soil treatment for root pathogens (*Fusarium*, *Phytophthora*, *Pythium*, and *Rhizoctonia*) in cucurbits. 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* 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 *Pythium* damping off and scab. OMRI listed. Exempt from EPA registration. Brandt Consolidated, Inc.

Carb-O-Nator. 85% potassium bicarbonate. Labeled for Alternaria leaf blight, anthracnose, downy mildew, and powdery mildew. OMRI listed. EPA Reg. No. 70051-117. Certis USA.

Cease. 1.34% *Bacillus subtilis* strain QST 713. Broadly labeled for use on greenhouse vegetables. Labeled for angular leaf spot, anthracnose, bacterial fruit blotch, downy mildew, gummy stem blight, and powdery mildew in cucurbits. OMRI listed. EPA Reg. No. 69592-19-68539. BioWorks, Inc.

Cinnerate. 60% cinnamon oil. Labeled for diseases such as powdery mildew and gray mold. OMRI listed. Exempt from EPA registration. Seipasa S.A.

Companion. 0.03% *Bacillus subtilis* strain GB03. Broadly labeled for foliar and soil-borne diseases, including bacterial wilt, gummy stem blight, powdery mildew, damping-off, crown and root rot, *Phytophthora* blight, and *Fusarium* wilt in cucurbits. 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. Broadly labeled for foliar and soil-borne diseases, including downy mildew, gummy stem blight, powdery mildew, damping-off, crown and root rot, *Monosporascus* vine decline, and charcoal rot in cucurbits. OMRI listed. EPA Reg No. 70051-107 and 108, respectively. Certis USA, LLC.

EcoSwing Botanical Fungicide. 82% extract of *Swinglea glutinosa*. Labeled for powdery mildew. OMRI listed. EPA Reg. No. 10163-357. Gowan Co.

ECOWORKS EC. 70% cold pressed neem oil. Labeled generally for powdery mildew, downy mildew, leaf spot, botrytis, anthracnose, blight, etc. and also several insects and mites. OMRI listed. EPA Reg. No. 89152-4. ECOSTADT Technologies LLC.

FungOUT. 1.07% citric acid. Labeled for powdery mildew in field and greenhouse crops. OMRI listed. Exempt from EPA registration. AEF Global Inc.

GreenFurrow 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 wilt, bacterial fruit blotch, downy mildew, and powdery mildew in cucurbits. Recommended used with EF400 for these and some other diseases. Exempt from EPA registration. Mar Vista Resources.

GreenFurrow EF400. 8.2% clove oil, 8.1% rosemary oil, and 6.7% peppermint oil. Broadly labeled including downy mildew and powdery mildew in cucurbits. Exempt from EPA registration. Mar Vista Resources.

Howler. 50% *Pseudomonas chlororaphis* strain AFS009. Labeled for foliar spray for diseases caused by *Alternaria*, *Botrytis* (gray mold) and *Phytophthora* (blight) and for downy mildew, gummy stem blight, and powdery mildew [some uses on 2(ee) label], 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 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. EPA Reg. No. 73512-4. KeyPlex.

LALSTOP G46 WG. 93.0% *Gliocladium catenulatum* strain J1446. Labeled generally for seed-borne and soil-borne plant diseases such as damping-off and root rot caused by several pathogens including *Fusarium*, *Phytophthora*, *Pythium*, *Rhizoctonia*, *Sclerotinia* and

Verticillium, and foliar diseases caused by several pathogens including powdery mildew. OMRI listed. EPA Reg. No.: 64137-13. Lallemand Specialties Inc./Lallemand Plant Care.

LifeGard WG. 40% *Bacillus mycoides* isolate J. Biological plant activator. Labeled for anthracnose, downy mildew, gummy stem blight, and powdery mildew. 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.

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

MilStop. 85% potassium bicarbonate. Broadly labeled including *Alternaria* leaf spot, anthracnose, downy mildew, powdery mildew, scab, and *Septoria* leaf spot in cucurbits. OMRI listed. EPA Reg. No. 70870-1-68539. BioWorks, Inc.

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

Mycostop. 35% *Streptomyces griseoviridis* strain K61. 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. Labeled for seed and root rots caused by *Fusarium*, *Pythium*, *Phytophthora* and *Rhizoctonia*. 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 for *Alternaria*, anthracnose, downy mildew, gray mold, gummy stem blight, powdery mildew, and scab in cucurbits. OMRI listed. EPA Reg No. 68173-4-70051. Certis USA, LLC.

OxiDate 2. 27% hydrogen dioxide and 2% peroxyacetic acid. Labeled for *Alternaria*, anthracnose, belly rot, downy mildew, *Fusarium* wilt, gummy stem blight, leaf spot, *Phytophthora*, powdery mildew, and root rots in cucurbits. OMRI listed. EPA Reg. No. 70299-12. BioSafe Systems, LLC.

PerCarb. 85% sodium carbonate peroxyhydrate. Labeled for *Alternaria* leaf spot, anthracnose, downy mildew, gummy stem blight, leaf spot, powdery mildew in cucurbits. 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 (*Alternaria*, *Colletotrichum*, *Botrytis*, *Didymella*, and *Fusarium* plus powdery mildew). Can be incorporated in potting mix, applied to soil and to foliage. OMRI listed. EPA Reg. No. 64137-13. Lallemand Plant Care.

Prevont. Renamed AVIV.

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

Procidic. 3.5% citric acid. Labeled for bacterial wilt of cucumber, post-harvest rotting in cucumber and melon, and damping-off, downy mildew, and powdery mildew in melon, pumpkin, and squash. 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, downy mildew, powdery mildew, scab, and foliar diseases caused by fungal pathogens such as *Alternaria* and *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. Broadly labeled including *Alternaria* blight, anthracnose, *Cercospora* leaf spot, downy mildew, gummy stem blight, *Phytophthora* blight, and powdery mildew. 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 downy mildew, *Botrytis* gray mold, and powdery mildew. OMRI listed. EPA Reg. No. 91810-2. Lesaffre Yeast Corporation

RootShield WP and Granules (formerly T-22 HC and PlantShield HC). 1.15% *Trichoderma harzianum* Rifai strain KRL-AG2. Protects plant roots against the fungal pathogens *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 ASO. 1.34% *Bacillus subtilis* strain QST 713. This bacterium colonizes roots when applied to soil and produces compounds that affect pathogens directly and triggers metabolic pathways to activate the plant's natural defenses and modulate growth. Labeled for angular leaf spot, anthracnose, downy mildew, gummy stem blight, and powdery mildew and for soil diseases caused by *Rhizoctonia*, *Pythium*, *Fusarium*, *Verticillium* and *Phytophthora*. Serenade ASO has replaced Serenade Soil. OMRI listed. EPA Reg. No. 264-1152. Bayer CropScience.

Serenade Opti. 26.2% *Bacillus subtilis* strain QST 713. New formulation. Broadly labeled including downy mildew, gummy stem blight, and powdery mildew in cucurbits. OMRI listed. EPA Reg. No. 264-1160. Previous product names and formulations: Serenade, Serenade Max, Serenade Optimum. Bayer CropScience.

Serifel. 9.9% *Bacillus amyloliquefacinens* strain MBI 600. Broadly labeled for foliar diseases, including anthracnose, *Alternaria* leaf spot, downy mildew, gummy stem blight, and powdery mildew in cucurbits. OMRI listed. EPA Reg No. 71840-18. BASF Corporation.

Serifel NG. 11% *Bacillus amyloliquefacinens* strain MBI 600. Labeled for use on greenhouse crops applied to soil for root rot pathogens and as foliar spray for powdery mildew. Replaces Subtilex NG. OMRI listed. EPA Reg No. 71840-8. BASF Corporation.

Sil-MATRIX LC. 29% potassium silicate. Broad spectrum fungicide for fungal diseases labeled specifically for powdery mildew. OMRI listed. EPA Reg. No. 82100-1. PQ Corp.

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 capsici* plus *Fusarium* crown rot. OMRI listed. EPA Reg. No. 70051-3. Certis USA, LLC.

Sonata. 1.38% *Bacillus pumilus* strain QST 2808. Labeled for downy mildew and powdery mildew. OMRI listed. EPA Reg. No. 264-1153. Bayer CropScience (formerly AgraQuest).

Sporan EC². 16% rosemary oil, 10% clove oil, 10% thyme oil, 2% peppermint oil. Labeled for *Alternaria* leaf spot, downy mildew, and powdery mildew. OMRI listed. Exempt from EPA registration. KeyPlex.

Stargus. *Bacillus amyloliquefacinens* strain F727. Labeled for downy mildew, *Phytophthora* blight, and root rot pathogens (*Fusarium*, *Phytophthora*, *Pythium*, and *Rhizoctonia*). 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 powdery mildew and seedling diseases caused by *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. Gowan Co, LLC.

TerraClean 5. 27% hydrogen dioxide and 5% peroxyacetic acid. Generally labeled for control of soil-borne plant diseases such as those caused by *Fusarium* (root rot), *Phytophthora* (blights, rots), *Pythium*, and *Rhizoctonia* on any crop; 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, downy mildew, powdery mildew, and foliar diseases caused by fungal pathogens such as *Alternaria* and *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. 88760-5. 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 angular leaf spot, anthracnose, downy mildew, gummy stem blight, and powdery mildew. 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 powdery mildew and 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 downy mildew, gummy stem blight, powdery mildew, and applied to soil for damping-off, and crown and root disease 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 downy mildew, gummy stem blight, powdery mildew, 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 *Alternaria*, anthracnose, downy mildew, leaf spot, and powdery mildew (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 downy mildew and *Phytophthora* blight. OMRI listed. EPA Reg. No. 72431-1. PropTera, LLC.

Below are some organic fungicides with active ingredients that are considered to be biocompatible, but the ingredients have not been reviewed by EPA or are not naturally occurring substance and thus are not in the US EPA biopesticide active ingredient list at <https://www.epa.gov/ingredients-used-pesticide-products/biopesticide-active-ingredients>:

KOPA insecticidal soap. 47% potassium salts of fatty acids. Labeled for powdery mildew and several insects and mites. OMRI listed. EPA Reg. No. 67702-11-59807. OHP, Inc.

DES-X insecticidal soap. 47% potassium salts of fatty acids. Labeled for powdery mildew and several insects and mites. OMRI listed. EPA Reg. No. 67702-22-70051. Certis USA.

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

Organic JMS Stylet-oil. 97.1% paraffinic oil. Labeled for several insect pests, viruses transmitted by aphids, and *Alternaria* leaf spot, gummy stem blight, and powdery mildew. OMRI listed. EPA Reg. No. 65564-1. JMS Flower Farms, Inc.

Surround WP. 95% kaolin. Labeled for powdery mildew, insects, and sunburn plus heat stress. OMRI listed. EPA Reg. No. 61842-18. Tessenderlo Kerley, Inc.

TriTek. 80% mineral oil. Labeled for several insect pests and powdery mildew. 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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