

# Biopesticides for Managing Diseases of Brassicas 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 brassica (aka cole, crucifer) crops (broccoli, Brussels sprouts, cabbage, cauliflower, kale, kohlrabi, etc.). The active ingredient follows product name. Most products are labeled for managing multiple diseases on many crops. The diseases of brassica crops 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 damping-off, Phytophthora root rot, and Sclerotinia stem rot, and to foliage for gray mold and powdery 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, black rot (aka Xanthomonas leaf spot), downy mildew, and powdery mildew. 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 black rot, Pythium damping off and gray mold. OMRI-listed. Exempt from EPA registration. Brandt Consolidated, Inc.

**Carb-O-Nator.** 85% potassium bicarbonate. Labeled for Alternaria leaf spot, Phoma black leg, gray mold, downy mildew, and powdery mildew. OMRI-listed. EPA Reg. No. 70051-117. Certis USA, LLC.

**Cease.** 1.34% *Bacillus subtilis* strain QST 713. Labeled for use on greenhouse vegetables. Labeled for Alternaria leaf spot and black rot. OMRI-listed. EPA Reg. No. 69592-19-68539. BioWorks, Inc.

**Cinnerate.** 60% cinnamon oil. Labeled for diseases such as powdery mildew and 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 *Alternaria*, clubroot, blight caused by *Sclerotinia* (white mold), *Pythium* root rot, and *Fusarium* wilt. 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 *Alternaria* leaf spot, black rot, downy mildew, powdery mildew, 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 *Alternaria* leaf spot and powdery mildew. OMRI-listed. EPA Reg. No. 10163-357. Gowan Co.

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

**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 brassicas include downy mildew and white mold. Exempt from EPA registration. Mar Vista Resources.

**Howler.** 50% *Pseudomonas chlororaphis* strain AFS009. Labeled for foliar spray 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. 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 *Alternaria* (some species cause *Alternaria* leaf spot\*), *Botrytis* (gray mold\*), and also powdery mildew. \*This disease not specified on label. 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 downy mildew. OMRI-listed. EPA Reg No. 70051-119. Certis USA, LLC.

**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. Labeled diseases of agricultural crops that occur in brassicas include *Alternaria* leaf spot, downy mildew, and powdery mildew. OMRI-listed. EPA Reg. No. 70870-1-68539. BioWorks, Inc.

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

**Mycostop.** 35% *Streptomyces griseoviridis* strain K61. 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 *Alternaria* leaf spot. OMRI-listed. EPA Reg No. 68173-4-70051. Certis USA, LLC.

**OxiDate 2.** 27% hydrogen dioxide and 2% peroxyacetic acid. Labeled for *Alternaria* leaf spot, downy mildew, and powdery mildew. OMRI-listed. EPA Reg. No. 70299-12. BioSafe Systems, LLC.

**PerCarb.** 85% sodium carbonate peroxyhydrate. Labeled for black rot, downy mildew, and powdery mildew. 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 *Alternaria*, *Botrytis*, 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.

**Procidic.** 3.5% citric acid. Labeled for soft rot and black rot. 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.

**PRango.** 70% cold pressed neem oil. Generally labeled for 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. Labeled for *Alternaria* leaf spot, *Xanthomonas* leaf spot caused by *Xanthomonas campestris* (aka black rot), downy mildew, and purple blotch, and pin rot complex (*Alternaria/Xanthomonas*). 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 and powdery mildew. 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 roots, soil, 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. Labeled for foliar application for Alternaria leaf spot, bacterial leaf spot, bacterial rot cause by Erwinia, black rot, downy mildew, and powdery mildew, and applied to soil for soil-borne pathogens: *Plasmiodiophora brassicae* which causes clubroot and *Fusarium*, *Phytophthora*, *Pythium*, *Rhizoctonia*, and *Verticillium*. OMRI-listed. EPA Reg. No. 264-1152. Bayer CropScience.

**Serenade Opti.** 26.2% *Bacillus subtilis* strain QST 713. Labeled for Alternaria leaf spot. 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 powdery mildew. Replaces Subtilex NG. OMRI-listed. EPA Reg No. 71840-8. BASF Corporation.

**Serifel.** 9.9% *Bacillus amyloliquefacinens* strain MBI 600. Labeled for Fusarium wilt, Pythium damping off, and root rots caused by *Phytophthora* and *Rhizoctonia*. OMRI-listed. EPA Reg No. 71840-18. 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 rots 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 downy mildew and powdery mildew. OMRI-listed. EPA Reg. No. 264-1153. Bayer CropScience.

**Sporan EC<sup>2</sup>.** 16% rosemary oil, 10% clove oil, 10% thyme oil, 2% peppermint oil. Labeled for Alternaria leaf spot, downy mildew, gray mold, and powdery mildew. OMRI-listed. Exempt from EPA registration. KeyPlex.

**Stargus.** *Bacillus amyloliquefacinens* strain F727. Labeled for downy mildew. OMRI-listed. EPA Reg. No. 084059-28. ProFarm Group (Formerly Marrone Bio Innovations, Inc).

**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. Generally labeled 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 foliar diseases caused by fungal pathogens such as *Alternaria* and *Botrytis* (label does not have crop specific diseases), 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 Alternaria leaf spot, bacterial leaf spot, bacterial blight, black rot, downy mildew, pin rot, 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.

**Triathlon BA.** 98.85% *Bacillus amyloliquefaciens* strain D747. Labeled for control of downy and powdery mildews and leaf spots caused by *Alternaria* and *Xanthomonas*, and for suppressing pin rot complex (*Alternaria/Xanthomonas*) 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*, 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 biofungicide.** 8.5% rhamnolipid biosurfactant. Kills zoospores, which is one spore type produced by Oomycete pathogens which cause diseases such as downy mildew. 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 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 vectored by aphids, and Alternaria leaf spot and powdery mildew. 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.*

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