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Efficacy of Microbial Biopesticides that may be used in Organic Farming

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This article summarizes publicly available data on efficacy of commercially-available, EPA-registered microbial biopesticides for plant disease control. At the time of writing, these materials were allowed for use on organic farms. However, products and their status for use on organic farms changes, so before using any of these products, be sure to 1) read the label to be sure that the product is labeled for the crop you intend to apply it to and the disease you intend to control, 2) read and understand the safety precautions and application restrictions, and 3) make sure that the brand name product is listed in your [Organic System Plan](#) and approved by your certifier. For more information on how to determine whether a disease management product can be used on your farm, see the eOrganic article [Can I Use this Product For Disease Management On My Organic Farm?](#)

Because product lines change periodically, some relevant products may not be listed. Additional data on efficacy may be obtained from the companies producing biopesticides and their University cooperators. For a more detailed introduction see the related eOrganic article [Biopesticides for Plant Disease Management in Organic Farming](#).

The efficacy ratings presented here are based on the results of one-year field studies published between 2000 and 2009 in the Plant Disease Management Reports (<http://www.plantmanagementnetwork.org/pub/trial/pdmr/>). These ratings are based on a comparison between untreated controls and the application of each product independently. These studies were not, in general, conducted on organic farms or on organically-managed land.

Efficacy ratings are scaled as follows:

- (+) – evidence for disease control and/or yield increase
- (±) – evidence for disease control is mixed with some reports showing positive results and others not
- (0) – no obvious response to treatment in one or more published reports
- (n.d.) – no data available in the selected PDMR publications

Table 1. Microbial biopesticide products labeled for plant disease control.

Biocontrol	Trade	Target Disease	Crops	Efficacy ^{1,2}
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Organism	Name			
Bacteriophages of <i>Xanthomonas</i> spp. and <i>Pseudomonas syringae</i> pv. tomato	Agriphage™	Bacterial spot in pepper and tomatoes and bacterial speck in tomatoes	Tomatoes and pepper	Bell Pepper/bacterial spot: (+)
<i>Pseudomonas syringae</i> strain ESC 10	Bio-Save® 10LP3	Ice inducing bacteria and biological decay	Apples, pears, lemons, oranges, or grapefruit after the fruit is harvested	Sweetpotato/Rhizopus soft rot: (+)
<i>Pantoea agglomerans</i> strain E325	Bloomtime Biological™ 3	Fireblight (<i>Erwinia amylovora</i>)	Apples and pears	Apple/Fire blight: (±)
	Bloomtime Biological™ FD3	Fireblight (<i>Erwinia amylovora</i>)	Apples and pears	Apple/Fire blight: (±)
<i>Streptomyces lydicus</i> WYEC 108	Actinovate® SP	Soilborne pathogens: <i>Pythium</i> spp., <i>Rhizoctonia</i> spp., <i>Phytophthora</i> spp., <i>Fusarium</i> spp., <i>Verticillium</i> spp., <i>Phymatotrichum omnivorum</i> and other root decay fungi. Foliar pathogens: <i>Podosphaera</i> spp., <i>Botrytis</i> spp., <i>Sclerotinia</i> spp., <i>Monilinia</i> spp., <i>Alternaria</i> spp., <i>Peronospora</i> spp. and other foliar fungi	Greenhouse, nursery and turf	Pumpkin/Powdery mildew: (+) Pumpkin/Phytophthora leaf blight: (0) Pepper/Phytophthora foliar blight: (+)
<i>Bacillus pumilus</i> QST 2808	Ballad® Plus Biofungicide	Rust, powdery mildew, <i>cercospora</i> , and brown spot	Soybeans, cereal crops, and potatoes	Soybean/Asian Soybean Rust: (±) Soybean/Target Spot: (±) Snap Bean/Ashy Stem Blight: (±) Snap Bean/Rust: (+)
<i>Coniothyrium minitans</i> strain CON/M/91-08	Contans® WG	<i>Sclerotinia minor</i> , <i>Sclerotinia sclerotiorum</i>	Agricultural soils	Snap beans/White mold: (±) Snap beans/Gray mold: (0) Lettuce/White mold: (±) Lettuce/Lettuce drop: (+)
<i>Bacillus subtilis</i> GB03	Kodiak® Concentrate Biological Fungicide	<i>Rhizoctonia</i> , <i>Fusarium</i> , <i>Alternaria</i> , <i>Aspergillus</i> , and others that attack the root systems of plants	Cotton, peanuts, soybeans, wheat, barley, peas, and beans	Snap beans/ <i>Fusarium</i> Root rot: (±) Snap bean/ <i>Rhizoctonia</i> root rot: (0) Pea/ <i>Fusarium</i> , <i>Phoma</i> / <i>Pythium</i> : (±) Wheat/ <i>Fusarium</i> crown rot: (0) Cucumber/Damping off: (0)

<p><i>Trichoderma harzianum</i> <i>Rifai</i> strain KRL-AG2</p>	<p>Plant Shield® HC Biological Foliar and Root Fungicide</p>	<p><i>Fusarium</i>, <i>Pythium</i>, and <i>Rhizoctonia</i></p>	<p>Cucurbit vegetables, flowers, bedding plants, ornamentals, fruiting and leafy vegetables, Cole crops, hydroponic crops, pome fruits, shade house, outdoor nursery, stone fruit, and tree nuts</p>	<p>Dry beans/<i>Fusarium</i> Root Rot: (±)</p> <p>Snap beans/<i>Rhizoctonia</i> Root Rot: (0)</p> <p>Tomato/Grey mold: (0)</p> <p>Potato/Silver Scurf: (+)</p> <p>Potato/Black Scurf: (0)</p> <p>Geranium/Black Leg Disease: (0)</p> <p>Gladiolus/<i>Fusarium</i> root rot: (0)</p> <p>African Daisy/Powdery mildew: (±)</p>
	<p>RootShield® Granules</p>	<p><i>Fusarium</i>, <i>Pythium</i>, and <i>Rhizoctonia</i></p>	<p>Flowers, bedding plants, ornamentals, fruiting vegetables, herbs and spices, hydroponic crops, leafy vegetables, cole crops, pome fruits, stone fruits, and tree nuts</p>	<p>Myrtle/Leaf rot: (+)</p> <p>Potato/<i>Rhizoctonia</i> canker and Black scurf: (0)</p> <p>Gladiolus/<i>Fusarium</i> corm rot: (0)</p> <p>Tomato/Bacterial speck: (±)</p>
<p><i>Bacillus subtilis</i> strain QST 713</p>	<p>Serenade® Garden Disease Control Concentrate</p>	<p>Bacterial spot, powdery mildew, rust, gray mold, leaf blight, scab, and more</p>	<p>Fruits, vegetables, and flowers</p>	<p>(n.d.)</p>
	<p>Serenade® Garden Disease Control Ready to Use</p>	<p>Bacterial spot, powdery mildew, rust, gray mold, leaf blight, scab, and more</p>	<p>Vegetable, fruit, nuts, ornamentals plants, annual and perennial flowering plants, tropical foliage, trees, and shrubs</p>	<p>(n.d.)</p>
	<p>Serenade® MAX™</p>	<p>Fire Blight, <i>Botrytis</i>, Sour Rot, Rust, <i>Sclerotinia</i>, Powdery Mildew, Bacterial Spot and White Mold</p>	<p>Vegetables, fruit, nut, and vine crops</p>	<p>Blueberry/Anthracnose fruit rot: (+)</p> <p>Blueberry/Mummy berry: (±)</p> <p>Cranberry/Fruit rot: (0)</p> <p>Apple/Fireblight: (0)</p> <p>Apple/Flyspeck: (0)</p> <p>Apple/Sooty blotch: (0)</p> <p>Apple Black pox: (0)</p> <p>Apple/Brooks fruit spot: (0)</p>
				<p>Apple/Fire blight: (0)</p> <p>Red Raspberry: Fruit rot: (0)</p> <p>Grape/Bunch rot and Powdery mildew: (+)</p> <p>Turnip greens/bacterial leaf spot: (0)</p>

	<p>Serenade® Wettable Powder Biofungicide</p>	<p>Fire Blight, Botrytis, Sour Rot, Rust, <i>Sclerotinia</i>, Powdery Mildew, Bacterial Spot, and White Mold</p>	<p>Vegetables, fruit, nut, and vine crops</p>	<p>Hydrangea/Powdery mildew: (+) Pansy/<i>Cercospora</i> leaf spot: (+) Pumpkin, Cantaloupe, Honeydew/Powdery mildew: (+) Lettuce/Lettuce drop: (±) Lettuce/Powdery mildew: (+) Broccoli/Downey mildew: (+)</p>
	<p>Serenade® ASO</p>	<p>Fungi and bacteria that cause scab, powdery mildew, sour rot, downy mildew, and early leaf spot, early blight, late blight, bacterial spot, and walnut blight diseases</p>	<p>Food crops including cherries, cucurbits, grapes, leafy vegetables, peppers, potatoes, tomatoes, and walnuts</p>	<p>Cranberry/Cotton ball: (±) Spinach/<i>Stemphylium</i> leaf spot: (0) Snap bean/<i>Rhizoctonia</i> root rot: (0) Radish/<i>Hypocotyl</i> root rot and Clubroot: (±)</p>
<p><i>Trichoderma virens</i> (formerly <i>Gliocladium virens</i>)</p>	<p>SoilGard 12G3</p>	<p><i>Pythium</i>, <i>Rhizoctonia</i>, and Root rots</p>	<p>Ornamental and food crop plants grown in greenhouses, nurseries, interiorscapes, and outdoors</p>	<p>Geranium/Root rot: (0) Gladiolus/<i>Fusarium</i> Corm Rot: (0) Poinsettia/<i>Pythium</i> root rot: (+) Azalea/<i>Phytophthora</i> root rot: (0) Potato/Black scurf: (+) Potato/<i>Rhizoctonia</i> and <i>Streptomyces</i>: (0) Snap Beans/gray mold: (±) Snap Beans/white mold: (0) Cucumber/Damping off: (0)</p>
<p><i>Bacillus pumilus</i> QST 2808</p>	<p>Sonata®</p>	<p>Fungal pests such as molds, mildews, blights, and rusts</p>	<p>Many food and non-food crops, including trees susceptible to sudden oak death syndrome. For use outdoors, including nurseries, landscapes, and rights-of-way, and for use in greenhouses</p>	<p>Lima Beans/White mold: (0) Lettuce/Powdery mildew: (+) Lettuce/Lettuce drop: (±) Broccoli/Downey mildew: (+) Pumpkin/Powdery mildew: (0) Radish/Downey mildew: (+) Radish/Clubroot and <i>Rhizoctonia</i> hypocotyl root rot: (0)</p>
			<p>Agronomic field</p>	

<i>Trichoderma harzianum</i> Rifai strain KRL-AG2	T-22™ HC	<i>Fusarium</i> , <i>Pythium</i> , and <i>Rhizoctonia</i>	and row crops, alfalfa, hay and forage crops, bulb crops, cucurbits, fruiting vegetables, herbs, spices, leafy vegetables, cole crops, legumes, root crops, small grains and tuber crops	Soybean/Rhizoctonia solani and drought: (0)
	T-22™ Planter Box	<i>Fusarium</i> , <i>Pythium</i> , and <i>Rhizoctonia</i>	Agronomic field and row crops, alfalfa, hay and forage crops, bulb crops, cucurbits, fruiting vegetables, herbs, spices, leafy vegetables, cole crops, legumes, root crops, small grains and tuber crops	Pea/Root rot: (±) Bean (Baby Lima)/Root rot: (0) Pea/Root Rot: (0)
	RootShield® WP	<i>Pythium</i> , <i>Rhizoctonia</i> , <i>Fusarium</i> , <i>Thielaviopsis</i> and <i>Cylindrocladium</i>	berries and small fruits; bulb crops; citrus fruits; additional leafy vegetables and cole crops; tree nuts; root crops and tuber crops)	Geranium/Blackleg; <i>Pythium</i> sp.(+) Potato/Rhizoctonia canker (+) Potato/black scurf (0)
<i>Bacillus subtilis</i> QST 708	Rhapsody®	Fungal and bacterial diseases; Brown Patch, <i>Anthracnose</i> , and Dollar Spot	Turf, ornamentals, trees, shrubs, flowers, bedding plants, tropical plants, seedlings, conifers, fruity and leafy vegetables, and bulbs	Creeping bent grass/Dollar spot, abiotic stress, Brown patch and Anthracnose: (0) Annual bluegrass (60%) and Creeping Bentgrass (40%)/ Anthracnose: (+) Tall Fescue/Pythium blight and Gray leaf spot: (0) Geranium/Botrytis blight: (+) Dogwood/Powdery mildew: (+) Dogwood/ <i>Cercospora</i> leaf spot and Spot Anthracnose: (0)

References and Citations

- Plant Management Network International. Plant disease management reports [Online]. American Phytopathological Society. Available at: <http://www.plantmanagementnetwork.org/pub/trial/pdmr/> (verified 20 Aug 2010).

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