

Products for Managing Diseases in Organic Vegetables

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Regulations: note that in the US products for which the manufacturer claims disease control must be registered as fungicides with EPA unless the ingredients are ‘generally recognized as safe’ (GRAS) by EPA. Exemption from registration is in section 25(b) of FIFRA. Products also must be registered in the state where used. Crop must be listed on pesticide label. In NY the target pathogen or disease must be specified clearly (e.g. root rot is not sufficient). Applying a product for a non-labeled pest is a variation to use directions that is authorized under FIFRA Section 2(ee). In NY, this type of variation must be approved in writing by NYS DEC. A product cannot be recommended for use for a pest not on the label without obtaining this approval in any state.

Table 1. Biofungicides - Biological control products for managing plant diseases.

Product name	Biocontrol organism	Disease	Company
Ballad	<i>Bacillus pumilus</i>	Several (foliar)	AgraQuest
Bio-Save	<i>Pseudomonas syringie</i>	Post-harvest	Jet Harvest Solutions
Contans	<i>Coniothyrium minitans</i>	White mold	Sylvan Bioproducts
Kodiak	<i>Bacillus subtilis</i>	Several (soil-borne)	Gustafson, LLC
Mycostop	<i>Streptomyces griseoviridis</i>	Several (soil-borne)	Ag-Bio, Inc.
Plant-Shield	<i>Trichoderma</i> spp.	Root diseases	BioWorks, Inc.
Rootshield	<i>Trichoderma</i> spp.	Pythium, Rhizoctonia, Phytophthora	BioWorks, Inc.
Serenade	<i>Bacillus subtilis</i>	Several (foliar)	AgraQuest
SoilGard	<i>Gliocladium virens</i>	Damping off	Certis USA, LLC
Sonata	<i>Bacillus pumilus</i>	Several (foliar)	AgraQuest
T22-HC	<i>Trichoderma harzianum</i>	Pythium, Rhizoctonia, Fusarium	BioWorks, Inc.
T22-Planter Box	<i>Trichoderma harzianum</i>	Pythium, Rhizoctonia, Fusarium	BioWorks, Inc.
Yield Shield	<i>Bacillus pumillus</i>	Several (soil-borne)	Gustafson, LLC

Ballad *Bacillus pumilus* (strain QST 2808) AgraQuest www.agraquest.com
 New product in 2005. Labeled for use on potatoes, soybean, cereal crops.

From company web site: Broad spectrum. Registered for control of rust (including Asian soybean rust), powdery mildew, downy mildew and blight. Exempt from the requirements of a residue tolerance. OMRI listed. 4-hr REI. 0-d PHI.

Bacillus pumilus produces an antifungal amino sugar compound which prevents the formation of new cell walls and disrupt cell metabolism, leading to the destruction of the cell and death of the plant pathogen. Ballad also creates a bacterial barrier on leaf surfaces, preventing pathogens such as fungi causing rust and mildew from establishing on the plant. The novel mode of action is unlikely to be overcome through development of pathogen resistance.

Bio-Save *Pseudomonas syringie* Jet Harvest Solutions www.bio-save.com

From company web site: Bio-Save helps to control and prevent post harvest diseases such as: *Penicillium expansum* (blue mold), *Mucor piriformis* (mucor rot), *Botrytis cinerea* (gray mold), *Penicillium digitatum* (green mold), *Geotrichum candidum* (sour rot), Fusarium dry rot, and silver scurf.

Contans *Coniothyrium minitans* (strain CON/M/91-08) Sylvan Bioproducts www.sylvanbio.com

From label: Contans WG is applied directly on the soil surface and incorporated into the upper soil level. It is intended for use on agricultural and greenhouse soils used for the

production of plants that are susceptible to infection by *Sclerotinia sclerotiorum* and *Sclerotinia minor*. Plants susceptible are leafy vegetables, brassica vegetables, fruiting vegetables, bulb vegetables, cereal grains, legume vegetables, oil seeds, herbs and spices and ornamental plants. Contans may be applied directly to the soil prior to planting, at planting or during transplanting.

Contans is intended for use as part of an Integrated Pest Management system. When used in conjunction with good cultural management practices and as part of a complete disease control program, Contans reduces/controls soil infestations of *Sclerotinia sclerotiorum* and *Sclerotinia minor*.

Kodiak *Bacillus subtilis* Gustafson, LLC www.gustafson.com

From company web site: America's first biological fungicide seed treatment, contains a selected strain of the naturally occurring bacterium, *Bacillus subtilis*. On vegetables, Kodiak provides extended protection against *Fusarium*, *Rhizoctonia* and other diseases. Kodiak delivers extended protection against disease pathogens through three distinct modes of action:

1. Colonies of *Bacillus subtilis* take up space on the roots, leaving less area or source for occupation by disease pathogens.
2. Kodiak feeds off plant exudates, which also serve as a food source for disease pathogens. Because it consumes exudates, Kodiak deprives disease pathogens of a major food source, thereby inhibiting their ability to thrive and reproduce.
3. Kodiak combats pathogenic fungi through the production of a chemical that inhibits the pathogen's growth.

NOTE: 2 Kodiak products. Concentrate is OMRI listed, Flowable is not (not on label or in OMRI list).

Mycostop *Streptomyces griseoviridis* AgBio, Inc. www.agbio-inc.com

Primarily used by greenhouse growers. Reportedly 'quite well established in greenhouse vegetables'. Not expected to slow down *Pythium* in field vegetables. Possibly would help if applied to transplants going to field. Works best under cool temp. Not recommended for high pressure Botrytis.

From company web site: 30% *Streptomyces griseoviridis* Strain K61 (Dried spores and mycelium). EPA registered since 1994. OMRI listed.

From label: Applicators and other handlers must wear: Long-sleeved shirt and long pants. Waterproof gloves. Shoes plus socks. Dust/mist filtering respirator. 4 hr REI.

Mycostop is used for the control of seed rot, root and stem rot and wilt caused by *Fusarium*, *Alternaria* and *Phomopsis* of container grown ornamentals, vegetables and tree and forest seedlings. Mycostop has also shown suppression of *Botrytis* Gray Mold and root rots of *Pythium*, *Phytophthora* and *Rhizoctonia* in the greenhouse. Mycostop can be used as a seed treatment for seed or soil-borne damping off and early root rot of vegetables (not melon), herbs and ornamentals planted in the field or greenhouse. Application methods: Seed soak (check effect on germination first). Transplant dip. Soil spray. Drip irrigation. Foliar spray for Botrytis. Store in cool, dry place (below 46 F). Small packets store for 1 yr. when refrigerated.

2005 suggested list price is \$6.75 per 1 gram pkg and \$144 per 25 gram pkg.

Serenade *Bacillus subtilis* (QST 713 Strain) AgraQuest www.agraquest.com

Contains a specific strain of *Bacillus subtilis* that blocks germination and attachment of many fungal and bacterial pathogens. Additionally, lipopeptides, which are produced in the fermentation process, perforate membranes in germ tubes and mycelia leading to their destruction.

From company web site: provides over 30 different lipopeptides that work synergistically to destroy disease pathogens and provide superior antimicrobial activity. It protects vegetables,

fruit, nut and vine crops against diseases such as fire blight, Botrytis, sour rot, rust, Sclerotinia, powdery mildew, bacterial spot and white mold.

SoilGard *Gliocladium virens* GL-21 Certis USA, LLC www.certisusa.com

Targeted for damping-off and root rot pathogens especially *Rhizoctonia solani* and *Pythium* spp. Labeled for use on ornamental and food crop plants grown in greenhouses, nurseries, homes, and interiorscapes. Formulated as granules to be incorporated in soil or soilless growing media prior to seeding

Sonata *Bacillus pumilus* AgraQuest www.agraquest.com

From company web site: Applied as a foliar spray, Sonata employs a novel mode of action that inhibits fungal pathogen development on the leaf surface and also activates the plant's immune system. Initial research has shown that Sonata may have curative activity as well as preventive properties thereby arresting the development of powdery and downy mildews, rusts and other pathogens. Sonata's active ingredient naturally occurs in the environment, is non-toxic and will complement growers' integrated pest management programs.

T22-HC and T22-Planter Box *Trichoderma harzianum* BioWorks
www.bioworksinc.com

T-22 HC is formulated for broadcast and in-furrow applications. T-22 Planter Box is for seed coating, seed pieces, in-furrow spray, and as transplant starter.

From company web site: The active ingredient in T-22 is the highly-effective, beneficial fungus *Trichoderma harzianum* strain T-22, a special hybrid strain developed in a university microbial breeding program. Provides natural, season-long control of diseases because it grows on the root system in a way that benefits the plant (root colonization). Protects roots from diseases caused by *Pythium*, *Rhizoctonia* and *Fusarium* and permits stronger, healthier root systems. Allows greater soil exploration by the roots and therefore enhances nutrient and moisture uptake and improves tolerance to stressful growing conditions. T-22 improves yield in stress conditions. It extends root protection beyond seed treatment chemicals. It is not a replacement for seed-protectant treatments. T-22 can be applied to seeds that have a chemical fungicide seed-protectant coating. Exempt from tolerance. OMRI listed. Used by organic growers throughout the U.S.

Other Biofungicides:

AQ10 ¹	<i>Ampelomyces quisqualis</i>	Powdery mildew	Ecogen Inc.
Companion ²	<i>Bacillus subtilis</i> GB03		Growth Products, Ltd.
Deny	<i>Burkholderia cepacia</i>		No longer Manufactured
Prestop ³	<i>Gliocladium catenulatum</i>		AgBio, Inc.
Recharge ⁴	<i>Azospirillum brasilense</i>		Eco-Soil Systems Inc.
Yield Shield ⁵	<i>Bacillus pumilus</i>	Soil-borne diseases	Gustafson, LLC

¹ AQ10 is no longer on OMRI list and company may no longer exist; was down to 1 person a few yrs ago.

² Company is considering pursuing OMRI approval for Companion.

³ Prestop is in development. It is a new formulation of Primastop, which was never marketed because cost of manufacturing that formulation was too high. Because of formulation change it has to go thru registration process with EPA again (maybe by end of 2005) and also OMRI review.

⁴ The company that manufactures Recharge is having financial difficulties and there is no longer an active website. There are some class action suits listed on the web against the sources of funding of the company.

⁵ Labeled for use on soybean.

Table 2. Chemical control products for managing plant diseases.

Product name	Active ingredient	Disease	Company
Champion	Copper hydroxide	Various	NuFarm Americas Inc.
Eco E-RASE	Jobba Oil	Powdery mildew	IJO Products
GC-3	Cottonseed oil, corn oil, garlic extract	Powdery mildew	JH Biotech, Inc.
JMS Stylet-oil	Paraffinic oils	Powdery mildew, virus	JMS Flower Farms
Kaligreen	Potassium bicarbonate	Powdery mildew	AgBio, Inc.
Mildew-Cure	Garlic and oil extracts	Powdery mildew	Safer Gro
Milstop	Potassium bicarbonate	Powdery mildew	BioWorks
Nordox	Copper oxide	Various	AgBio, Inc.
Organocide	Sesame oil	Powdery mildew	Organic Laboratories
Oxidate *	Hydrogen peroxide	General	Biosafe
Sporan	Rosemary oil	Several	Eco-Smart Technologies
Stor-Ox	Hydrogen peroxide	General, Post-harvest	Biosafe
Surround	Kaolin	Powdery mildew	Englehard
Terraclean *	Hydrogen peroxide	General	Biosafe
Trilogy	Neem oil	Powdery mildew	Certis USA L.L.C.

* OMRI approval pending.

Kaligreen 82% potassium bicarbonate AgBio, Inc. www.agbio-inc.com
 New product for this company in 2005. OMRI listed.
 2005 Price: \$40/5 lb

MilStop 85% potassium bicarbonate BioWorks www.bioworksinc.com
 2005 suggested list price is \$35.00 per 5 lb bucket and \$160 per 25 lb bucket.

Nordox copper oxide AgBio, Inc. www.agbio-inc.com
 Nordox 75 WG (75% metallic copper micro-bead fungicide)
 It is highest copper content fungicide at 75%. It has a Caution label, whereas most coppers have Danger label. Formulation is very tenacious since it is a copper oxide. Non dusty. OMRI listed (R status), 2005 Price: \$89/12.5 lb.

Surround 95% Kaolin Engelhard corporation
 When sprayed on fruits and vegetables, it forms a barrier film, which acts as a broad-spectrum agricultural crop protectant for controlling damage from various insect and disease pests. Surround can enhance growth and reduce sunburn and heat stress.
 Labeled as suppressing powdery mildew in cucurbits.

Seed Treatment - Pellet.

Naturecoat Harris Moran Seed Company www.harrismoran.com/technology/naturecoat.htm
 From web site: An organically approved seed pellet. Most seed pellets currently contain one or more synthetically derived material and cannot be used to grow organic crops. Naturecoat contains no synthetically derived materials. OMRI approved. The pellet is a light density, melting pellet with a smooth white surface and excellent uniformity. The materials form a pellet with a high porosity for increased oxygen availability. It has been thoroughly tested and commercialized for use on carrot seed and should be approved for lettuce and onion shortly.

Being tested on tomato, pepper, broccoli and cauliflower. All of the tests thus far have shown that the quality of Naturecoat is comparable to non-organic pellets currently on the market.